United States Patent [19]

Brown

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[54] **ANCHORING ASSEMBLY FOR ANCHORING WELL EQUIPMENT WITHIN A TUBULAR WELL CONDUIT**

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[52] **U.S. Cl.** **166/125,** 166/121, 166/153, 166/217

[51] **Int. Cl.** **E21b 23/06,** E21b 33/126

[58] **Field of Search** ... 166/121, 138, 123, 125, 214, 166/217, 216, 153

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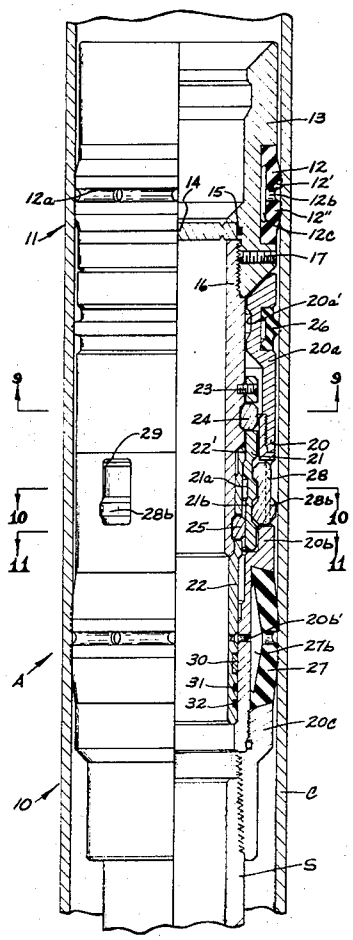
Primary Examiner—David H. Brown

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[57] **ABSTRACT**

An assembly including a pressure driven positioning member releasably connected with an anchoring member. The assembly is pumped-down a well conduit and the anchoring member is set in anchoring engagement with a collar recess in the conduit where it supports attached well equipment. A resilient annular seal on the positioning member forms a sliding pressure seal with the conduit causing the member to be moved downwardly by well-head pressure and upwardly by formation pressure. The anchoring member is set and retrieved by axial movement of the positioning member which separates from the anchoring member after it is set. The positioning member may be reconnected to release and retrieve the anchoring member and attached well equipment. The positioning member may also be retrieved by a wire-line or tubing string operated device.

22 Claims, 12 Drawing Figures



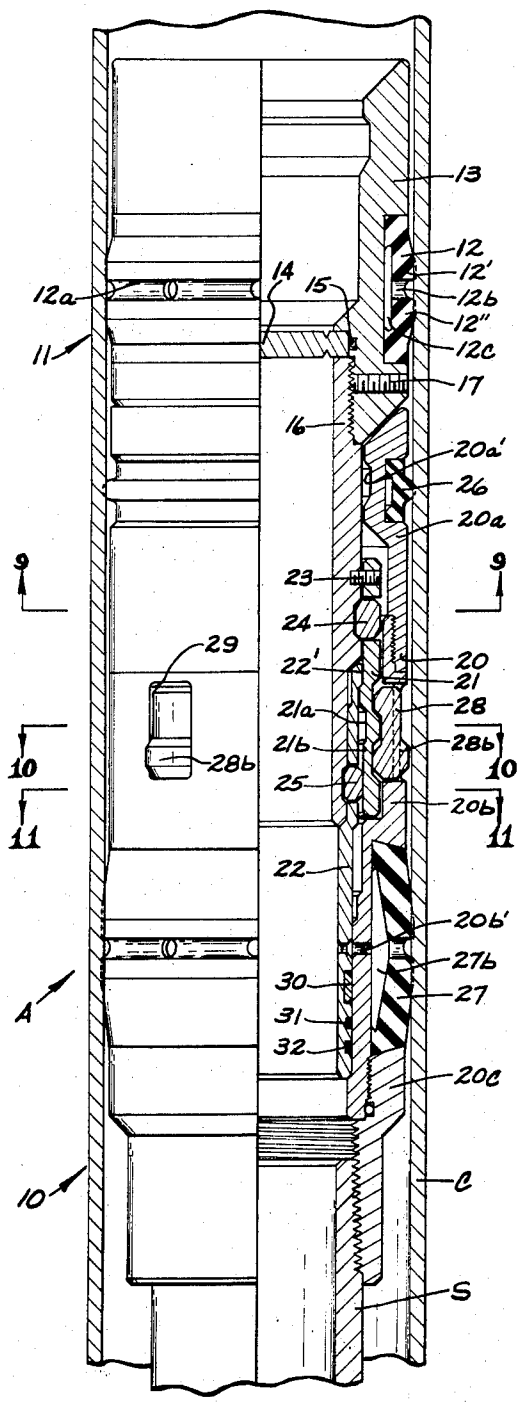


Fig. 1

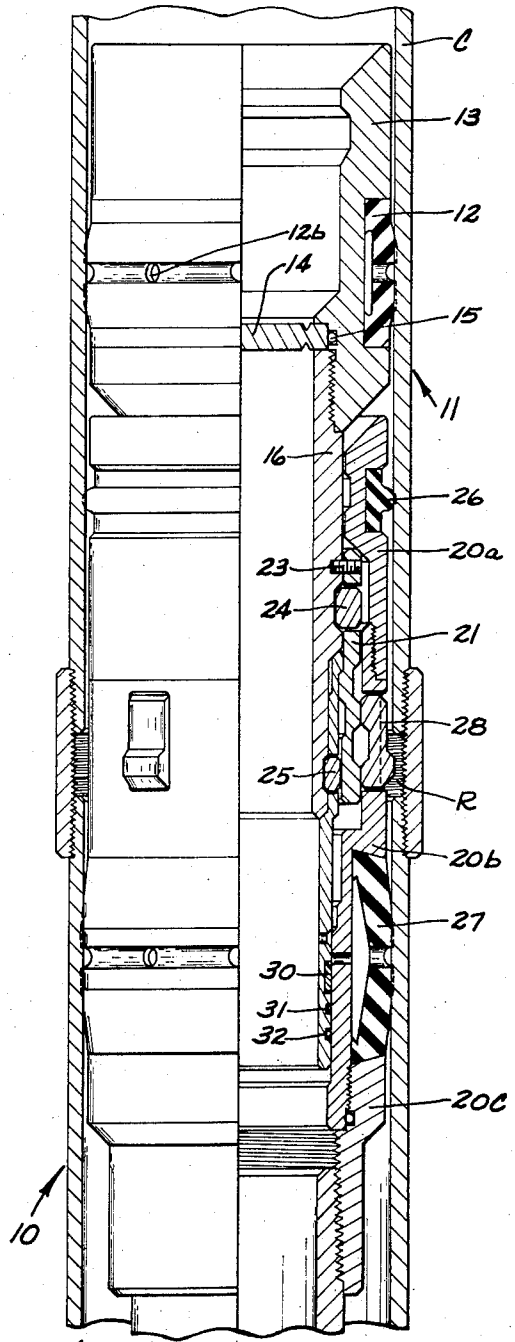


Fig. 2

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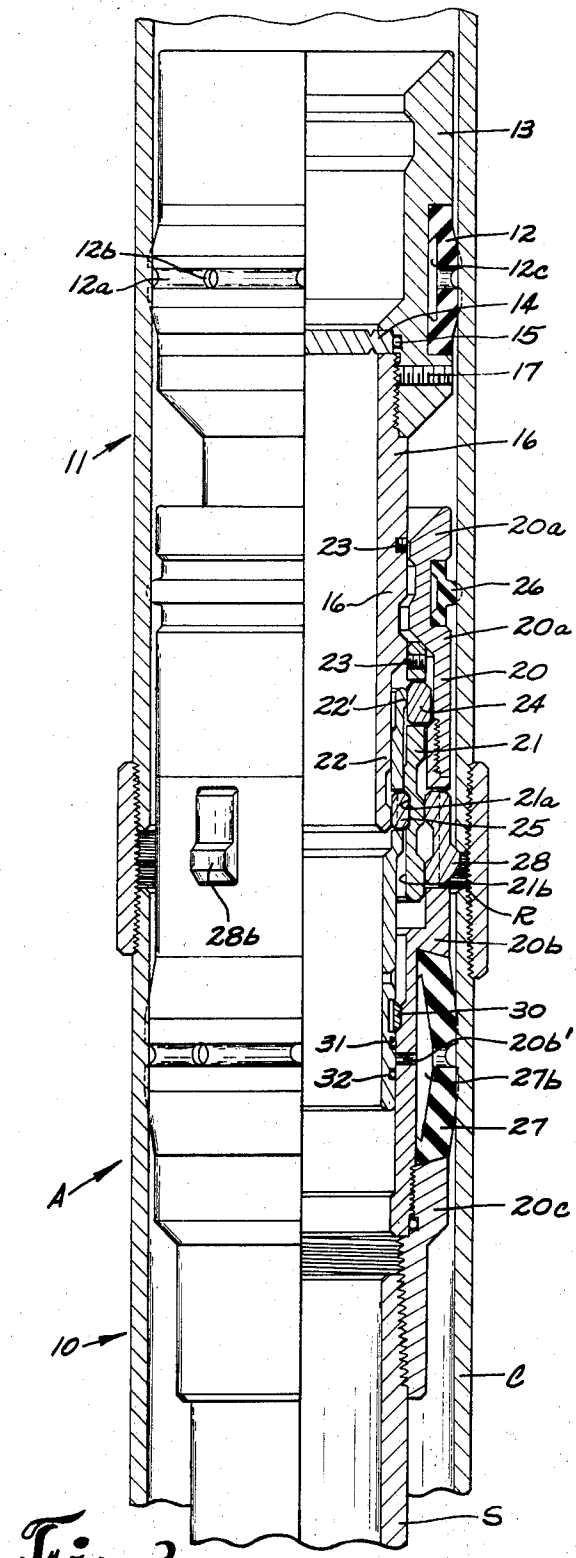


Fig. 3

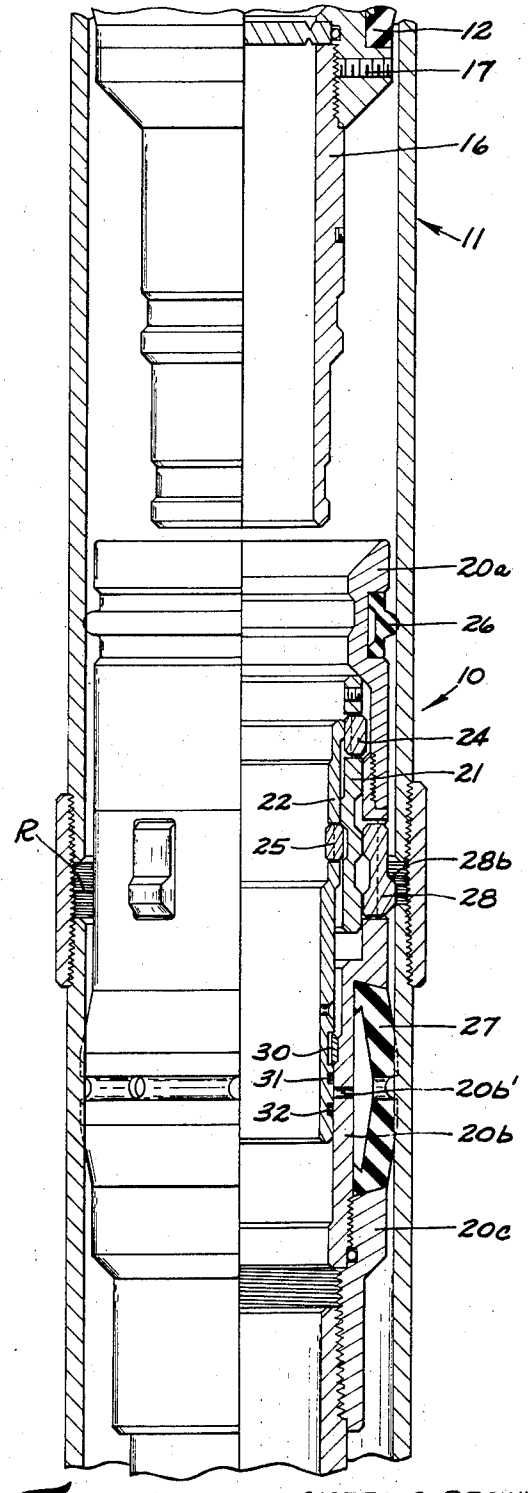


Fig. 4

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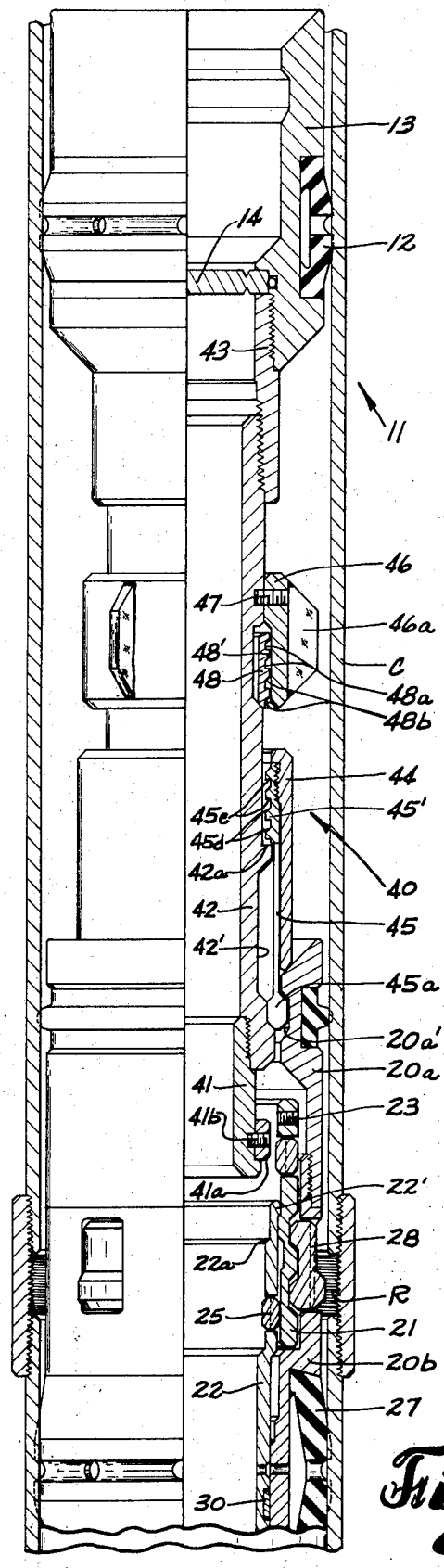


Fig. 5

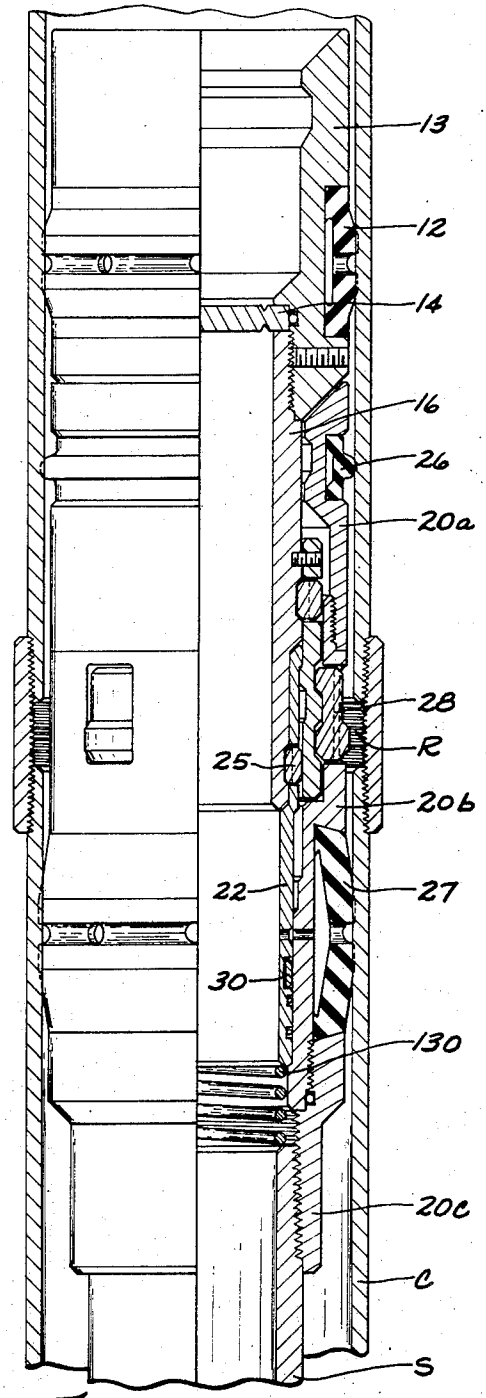


Fig. 6

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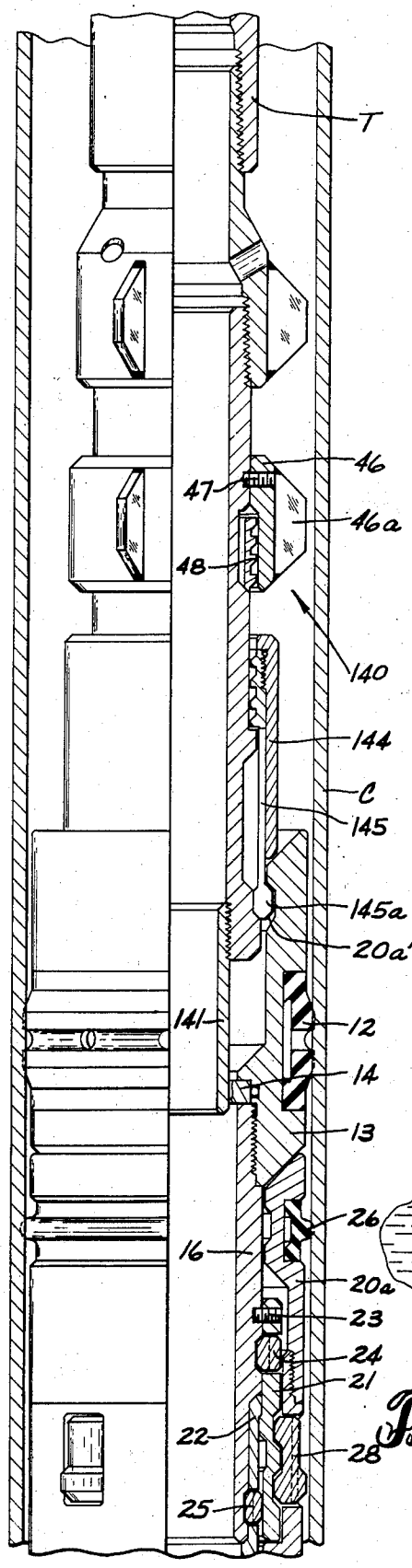


Fig. 7

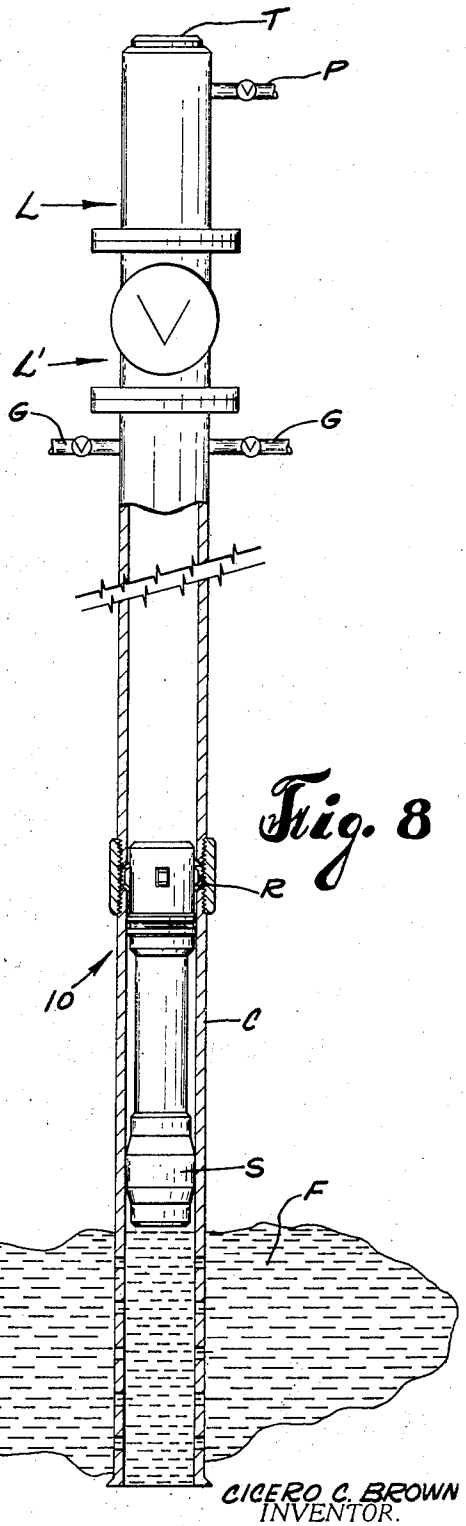


Fig. 8

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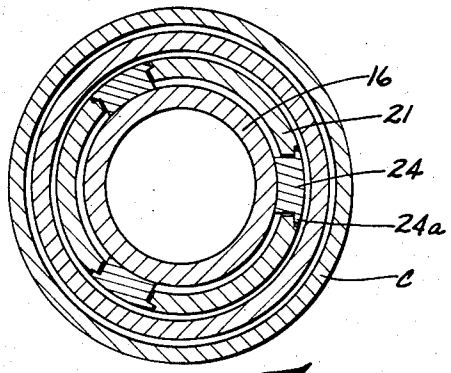


Fig. 9

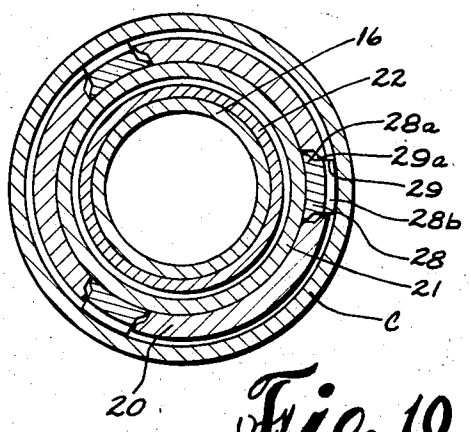


Fig. 10

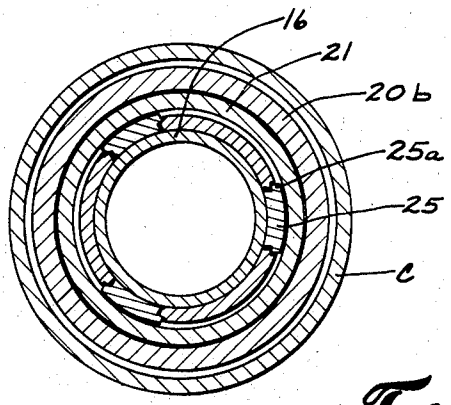


Fig. 11

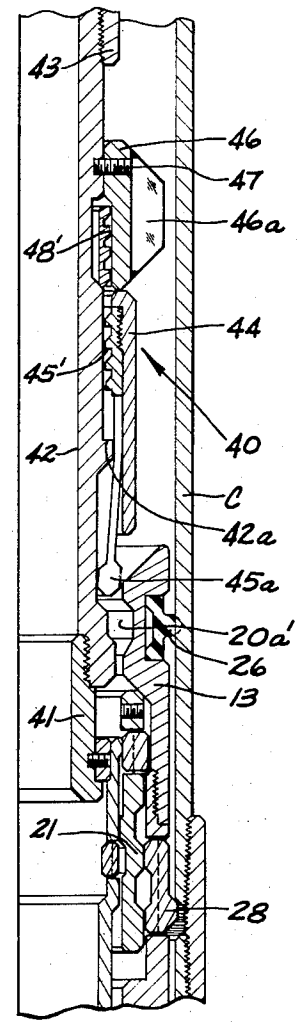


Fig. 12

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ANCHORING ASSEMBLY FOR ANCHORING WELL EQUIPMENT WITHIN A TUBULAR WELL CONDUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to means for anchoring well equipment such as storm chokes, packers, or other equipment at a sub-surface location in a well conduit. More particularly, the present invention relates to a retrievable, pump-down anchoring assembly adapted to be set in anchoring engagement within a collar recess formed between joints in a well conduit which extends into a relative high pressure formation.

2. Description of the Prior Art

Sub-surface equipment is conventionally anchored within well conduits by wire-line or tubing string operated anchoring assemblies. Often, such mechanically operated anchoring assemblies are designed to be locked within specially recessed landing nipples which are included in the well conduit. In some cases, where such nipples are not present, the mechanical anchoring assemblies are designed to be set in anchoring engagement within the collar recess formed between two mating pipe joints forming the well conduit.

When the well conduit extends into a relatively high pressure formation, setting and release of a conventional, mechanically operated anchoring assembly normally requires use of well-head equipment such as stuffing boxes and other suitable equipment which prevent loss of pressure at the well-head and simultaneously permit axial or rotative movement of the wire-line or tubing string which is used to position and set the anchoring assembly. The difficulties associated with setting and retrieving well components with the use of equipment of this type are well known in the art.

Setting and retrieval of conventional anchoring means can also become particularly difficult when, in addition to requiring the use of sealing means and the like at the well surface, it is also necessary to employ multiple, axial or rotative movements to effect the required setting or retrieving movements of the anchoring assembly. Inherent in many prior art anchoring assemblies is the danger of premature release of the assembly from the mechanical linkage before the assembly is securely anchored within the surrounding well conduit. Such dangers are increased where the components required to effect the setting and release movements are complex and may require difficult, or elaborate surface controlled manipulations. In addition, where a large number of interrelated, closely fitting components are required to provide the desired setting and retrieval operations of the anchoring assembly, the danger of malfunction and the difficulty in setting and retrieving are increased in relation to the number and complexity of such interrelated parts.

A danger which is particularly associated with "pump-down" equipment is the possibility that such equipment may lodge so firmly in a deviated or restricted part of the well conduit that the pressure differential developed across the assembly is insufficient to drive it axially into position or to return it to the surface. Unless suitable provision is employed in such pump-down devices, conventional general purpose fishing tools may be required to extract lodged assemblies which may necessitate substantial expenditures

for equipment and personnel in addition to producing significant losses of production time.

SUMMARY OF THE INVENTION

The anchoring assembly of the present invention is designed to be pumped down to a sub-surface location in a well conduit which extends into a pressurized formation. The anchoring member of the assembly includes radially movable dogs which may be moved into and locked in anchoring engagement with a collar recess formed in the conduit wall. Storm chokes, packers and other well equipment may be suspended from or secured to the anchoring assembly.

The anchoring assembly is driven downwardly through the conduit under the influence of a pressurized fluid such as a suitable gas supplied from the well-head which acts against a positioning member releasably secured to the anchoring assembly. The positioning member is equipped with an annular resilient seal which forms a substantially continuous sliding seal with the surrounding conduit walls. When the desired sub-surface location has been reached by the assembly, the well-head pressure is gradually reduced until the formation pressure can drive the positioning member and attached anchoring member back upwardly through the conduit. This upward movement causes relative axial movement between components in the anchoring assembly which tends to urge the anchoring dogs radially outwardly. When a conduit recess registers with the outwardly urged dogs, the dogs extend into the recess which thereby permits further relative axial movement between components in the anchoring assembly to a position which prevents retraction of the dogs. The extended dogs engage the upper boundary of the conduit recess to prevent upward movement of the anchoring assembly. When a sufficient pressure differential is developed across the positioning member, a connecting shear pin is severed to permit the positioning member to separate from the fixed anchoring member and move upwardly to the well-head where it can be recovered. Locking means are included in the anchoring member to maintain it in its set posiiton. Safety latch locking elements prevent the anchoring and positioning members from separating until the anchoring dogs are fully expanded and locked into position.

When the anchoring member is in set position, the relative axial positions of the anchoring assembly components are fixed by a resilient snap ring which urges the components to a position where the anchoring dogs are prevented from radially retracting. In a modified form, a coil spring may be used by itself or in combination with a snap ring to provide the desired locking force.

Retrieval of the anchoring member from its set position is effected by pumping the positioning means equipped with a retrieving head into locking engagement with the anchoring member. The retrieving head repositions the axial relationship of the movable components in the anchoring member to permit retraction of the locking dogs. Subsequent reduction in the well-head pressure permits the formation pressure to drive the positioning member and attached anchoring member upwardly to the well-head where the assembly may be recovered.

Emergency retrieving means are included with the positioning member so that a wire-line or tubing string retrieving tool may be lowered into locking engage-

ment with the positioning member to permit it to be withdrawn from the conduit by a force exerted through the wire-line or tubing string. A frangible plate included in the positioning member is ruptured by the emergency retrieving means to destroy the pressure seal existing axially across the positioning member.

From the following specification, the related drawings, and the Claims, it will be appreciated that the anchoring assembly of the present invention provides a simple, effective, mechanism for positioning an anchoring assembly at a sub-surface location in a well conduit without the need for a mechanical linkage such as a wire-line or tubing string. Recovery of the set anchoring assembly may also be accomplished by pressure drive without the need for a surface operated mechanical linkage. Moreover, the direct and simple operation and construction of the anchoring assembly ensures positive anchoring and retrieval of the anchoring member at the desired sub-surface location. These and other features and advantages of the present invention will be more fully appreciated from the following specification, the related drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical, quarter-sectional view of an anchoring assembly of the present invention in its unset running position;

FIG. 2 is a view similar to FIG. 1 illustrating the anchoring assembly moving upwardly past a first collar recess during the first stage of setting;

FIG. 3 illustrates the anchoring member components moved to the set position by the positioning member;

FIG. 4 illustrates the anchoring member in fully set condition with the positioning member moving to the surface under the influence of the formation pressure;

FIG. 5 is a vertical, quarter-sectional view illustrating the anchoring assembly in released position secured to a retrieving head carried by the positioning member;

FIG. 6 is a vertical, quarter-sectional view illustrating a modified form of the anchoring assembly employing a coil spring for preventing relative axial movement of components when the anchoring member is in set condition;

FIG. 7 illustrates the emergency retrieval of the anchoring assembly by a mechanical linkage extending from the well surface;

FIG. 8 is a partial vertical elevation in diagrammatic form illustrating the anchoring member of the present invention anchoring a storm choke in a well conduit;

FIG. 9 is a cross-sectional view taken along the line 9—9 of FIG. 1;

FIG. 10 is a cross-sectional view taken along the line 10—10 of FIG. 1;

FIG. 11 is a cross-sectional view taken along the line 11—11 of FIG. 1; and

FIG. 12 is a partial, quarter-sectional view illustrating the operation of the retrieving head employed with the positioning member of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference first to FIG. 8, the anchoring member of the present invention is indicated generally at 10 anchored within a collar recess R formed in a well conduit C which extends into a subterranean formation F. The anchoring member is employed to position equipment S within the conduit C. The equipment S may be a storm choke which is employed to prevent uncontrolled flow of fluids or gases from the formation F in a well known manner. The formation F may be a gas storage reservoir or any other relatively high pressure area which communicates through a conduit with a relatively lower pressure area.

The upper portion of the conduit C includes a conventional lubricator indicated generally at L which is employed to insert the anchoring assembly and attached equipment S into the well conduit C while the latter is under relatively high pressure. The lubricator L includes a removable top T and a valved, pressure supply line P is connected into the upper portion of the lubricator L and a large valve L′ is included at the lower portion. Conventional pipe lines G connect with the upper portion of the conduit C and are employed to convey the oil or gas produced from the formation F to remote storage, use, or transportation facilities.

Operation of the lubricator L is conventional and when equipment is to be inserted into the conduit C, the valve L′ is closed, the top T is removed and the equipment is lowered into the barrel of the lubricator L. The top T is replaced and the valve L′ is opened after the valves in the pipe lines G are moved to closed position. A suitable high pressure fluid, preferably a gas, is introduced through the high pressure supply line P and when the supply pressure is sufficiently greater than the formation pressure, the anchoring assembly and attached equipment is driven downwardly through the conduit C. Recovery of the pump-down equipment is effected by reducing the well-head pressure so that the formation pressure may move the equipment upwardly. Where the equipment can not be moved by the driving force developed by a pressure differential, it may be necessary to employ a wire-line or tubing string operated retrieving device. In the latter event, the well-head equipment is provided with suitable stuffing boxes or other means (not illustrated) which permit the wire-line or tubing string to be rotated or moved axially from the well surface without high pressure loss.

Referring now to FIG. 1, the anchoring assembly of the present invention is indicated generally at A. The anchoring member 10 which forms a part of the assembly A is illustrated within the conduit C in unset condition as it appears when being pumped downwardly through the conduit by pressure supplied from the well surface. The upper portion of the anchoring assembly A is equipped with a releasable positioning member indicated generally at 11. The positioning member 11 forms a continuous plugging seal within the conduit C. This plugging seal is provided by a resilient, annular driving seal 12 which is adapted to slide against the walls of conduit C to form a sliding seal between a latching body 13 in the positioning means 11 and the surrounding walls of the conduit C. A frangible plate 14 and an annular O-ring 15 cooperate with the seal 12 to form a complete seal in the conduit C.

The annular seal 12 includes a circumferential groove 12*a* and a plurality of radial openings 12*b* which permit pressurized fluid to act behind the seal in an annular area indicated at 12*c*. The seal 12 functions as though it were two oppositely disposed swab cups. When pressure is supplied from the well surface, the upper portion of the seal indicated at 12′ is depressed and the pressure fluid enters the bores 12*b* where it acts in the annular area 12*c* to force the lower portion of the seal indicated generally at 12″ against the walls of the

conduit C. A resultant downwardly directed force is exerted on the positioning member **11** causing the entire assembly A to be driven down through the well conduit. A sliding seal is maintained by the pressure induced outward radial force exerted in the area **12***c* against the lower seal section **12''**. When the pressure below the seal **12** on the positioning member **11** is greater than that above the seal, the seal **12** functions in the manner previously described except that the section **12''** is collapsed and the upper section **12'** functions as a sliding seal driving the entire assembly upwardly through the conduit C.

A connecting sleeve **16** is threadably engaged to the lower end of the latching body **13** and extends downwardly into the anchoring member **10.** A set screw **17** or other suitable means is employed to prevent relative rotational movement between the body **13** and sleeve **16** to prevent the two components from separating while in use.

The anchoring member **10** is constructed in substantially tubular form from a composite body which includes an outer sleeve body **20** constructed of three threadedly connected segments including an upper sleeve segment **20***a*, a middle segment **20***b*, and a lower segment **20***c*. A setting sleeve **21** is concentrically disposed within the outer sleeve **20** and is adapted to be moved axially with respect to the sleeve **60** during the setting and retrieval functions to be described. The third member in the tubular anchoring body includes an inner retaining sleeve **22** which is concentrically disposed within the outer sleeve body **20** and within a portion of the setting sleeve body **21.** As will be described, the retaining sleeve **22** is adapted to be moved axially with respect to both the outer sleeve **20** and setting sleeve **21** during the setting and retrieving operation of the anchoring assembly.

The connecting sleeve **16** is releasably secured to the tubular body of the setting member **10** by means of a severable shear pin **23** which extends from the upper end of the setting sleeve **21.** With joint reference to FIGS. **1, 9,** and **11,** radially movable upper dogs **24** and lower dogs **25** carried respectively in the setting sleeve **21** and the retaining sleeve **22** mate with receiving recesses in the connecting sleeve **16** and cooperate with the shear pin **23** to prevent relative axial movement between the connecting sleeve, retaining sleeve, and setting sleeve. The dogs **24** are equipped with circumferentially developed wings **24**a which limit inward radial movement of the dogs in the sleeve **21.** Similar wings **25**a formed on the dogs **25** limit inward radial movement of the dogs in the sleeve **22.** The anchoring member **10** also includes an upper protective packing seal **26** and a lower pack-off seal **27** which function in a manner to be described. FIGS. **1** and **10** illustrate a plurality of radially movable anchoring dogs **28** extending through windows **29** formed in the outer body sleeve segment **20***b* to provide the desired anchoring engagement with the collar recess R formed in the conduit C. Outward radial movement of the anchor dogs is limited by circumferentially extending wings **28***a* which engage retaining shoulders **29***a* formed behind the windows **29.**

The lower body segment **20***c* is connected to well equipment S which is to be anchored in the well conduit by the anchoring member **10.**

Referring jointly to FIGS. **1–4,** FIG. **1** illustrates the anchoring assembly being pumped downwardly through the conduit C, FIG. **2** illustrates the anchoring assembly A moving upwardly through the conduit with the anchoring dogs **28** in registry with the first collar recess R encountered in the upward travel, FIG. **3** illustrates the initial upward movement of the positioning member **11** away from the anchoring member **10** following initial setting of the member **10,** and FIG. **4** illustrates the anchoring member and positioning member completely separated with the anchoring member being set in the collar recess R and the positioning member traveling to the well surface to be recovered.

In the initial setting position illustrated in FIG. **2,** the upward movement of the positioning member **11** is resisted by the frictional engagement of the seal **27** with the well conduit C and by weight of the suspended equipment S. This initial resistance to movement by the anchoring member tends to hold the outer sleeve body **20** relatively stationary with respect to the upwardly moving connector sleeve **16,** setting sleeve **21,** and retaining sleeve **22.** Before the anchoring dogs **28** are in registry with the collar recess R, inclined surfaces engage each other in cooperating grooves and recesses formed between the anchoring dogs **28** and setting sleeve **21** and urge the anchoring dogs outwardly into engagement with the internal wall of the conduit C. Radial projections **28***b* extending from the outer surfaces of the anchoring dogs **28** engage the conduit wall and limit the outward radial movement of the anchoring dogs to maintain the groove and recess engagement between the anchoring dogs and the setting sleeve which in turn prevents upward movement of the setting sleeve **21** relative to the outer body sleeve **20.** When the projections **28***b* register with the collar recess R, the anchoring dogs **28** are permitted to move radially outwardly which frees the setting sleeve **21** from locking engagement with the anchoring dogs permitting the components to move into the relative positions illustrated in FIG. **2.** Continued upward movement of the outer body **20** is prevented by engagement of the projections **28***b* with the upper boundary of collar recess R and the ridge-to-ridge registery between the anchoring dogs **28** and setting sleeve **21** prevent the anchoring dogs from retracting radially. By this means, the outer body is prevented from moving axially upwardly and when a sufficient pressure differential is developed across the positioning member **11,** the shear pin **23** severs to permit the positioning member to continue to move upwardly. The upper position of the setting sleeve **21** permits the upper dogs **24** to be expanded radially outwardly and the initial upward movement of the positioning member and attached connecting sleeve **16** draws the internal retaining sleeve **22** upwardly until the lower anchoring dogs **25** drop into a receiving recess in the setting sleeve **21.** This positioning of the various components is illustrated in FIG. **3** and once the components have been so moved, the positioning member **11** is free to completely separate from the anchoring member **10.**

With the retaining sleeve **22** in the position illustrated in FIG. **3,** a resilient snap ring **30** carried by the sleeve **22** expands radially into a recess formed on the internal wall of the central outer body section **20***b*. In this latter position, the snap ring **30** resists downward axial movement of the retaining sleeve **22** which in turn prevents the setting sleeve and anchoring dogs from being moved to a position which would permit the anchoring dogs to retract radially. FIG. **6** illustrates a modified locking means which employs a coil spring **130** to resist

downward movement of the sleeve **22** with respect to the sleeve **20.** If desired, the spring **130** may be employed alone or in combination with the split ring **30.**

As best illustrated in FIGS. **3** and **4,** in the set position the setting sleeve **21** is prevented from moving upwardly by virtue of the engagement between the upper end of setting sleeve **21** with the internal shoulder formed in sleeve section **20a.** Downward movement of the setting sleeve with respect to the outer body **20** is prevented by engagement of the dogs **24** with the internal shoulder formed by the upper end of sleeve section **20***b*. The dogs **24** in turn are held in extended position by a radial lip **22'** projecting outwardly from the upper end of the retaining sleeve **22.** Dogs **25** function as a last safety mechanism or "tattle tale" preventing separation of the anchoring and positioning members until the dogs **25** has been extended into a setting sleeve recess **21***a*. The cooperation of the three sleeves in the anchoring member prevent the dogs **25** from registering with recess **21***a* until the anchoring dogs **28** have been fully extended into anchoring engagement with a conduit recess. The continued upward movement of the positioning member **11** and the attached connecting sleeve **16** from the position illustrated in FIG. **2** forces adjacent inclined surfaces on the connecting sleeve and dogs **25** together which in turn urges the dogs radially outwardly into the setting sleeve recess **21***a*. Further upward movement of the sleeve **22** with respect to the sleeve **21** is thus prevented and connecting sleeve **16** may then be moved axially upwardly into the position illustrated in FIG. **4** where it is free from the anchoring member **10.** Even in its radially innermost position, the dogs **25** extend radially away from the outer wall of the sleeve **22** and prevent the latter sleeve from moving upwardly with respect to the sleeve **21** after the dogs **25** are in recess **21***a*. As previously noted, when the components of the anchoring assembly **10** are in set position, the snap ring **30** expands radially into a receiving recess in the central sleeve section **20***b* to prevent relative downward movement between the retaining sleeve **22** and the outer body sleeve **20.** Thus, with the components in the position illustrated in FIG. **4,** the anchoring member **10** and attached equipment S are securely engaged with the recess R. In this latter position, the central bore of the anchoring member is open to permit axial flow through the assembly. The annular protective seal **26** prevents sediment and debris from dropping into the annular area between the outer body sleeve **20** and the surrounding well conduit C to protect the working components of the anchoring member and to prevent such materials from accumulating about the assembly. In the set position, a pair of axially spaced, resilient O-ring seals **31** and **32** are positioned axially above and below radial bores **20***b'* formed in the outer body sleeve section **20***b*. In the latter position, a complete seal is formed in the area **27***b* so that the seal **27** functions to provide a sealing pack off between the outer body section **20***b* and the surrounding well conduit C.

Retrieval of the anchoring member **10** will now be described with reference to FIGS. **5** and **12.** When it is desired to retrieve the anchored assembly **10** from its sub-surface position within the well conduit C, the connecting sleeve **16** on the positioning section **11** is replaced by a retrieving head indicated generally at **40.** The retrieving head **40** includes a lower shoe **41** threadedly engaged to the bottom of a latch mounting sleeve **42** which in turn is trheadedly engaged to a connecting sub **43** secured to the latching body **13.** A latching collar **44** mounted about the locking sleeve **42** for axial movement thereover includes a plurality of downwardly extending resilient fingers **45** with enlarged heads **45***a* formed at their lower ends. The upper internal portion of the collar **44** includes a plurality of circumferentially developed teeth **45'** each of which includes a lateral, downwardly facing shoulder **45***c* and a slanted, upwardly facing shoulder **45***d*. Downward axial movement of the collar **44** over the sleeve **42** is limited by engagement of the lowermost shoulder **45***c* against a radial sleeve enlargement **42***a*. Upward movement of the collar **44** on the sleeve **42** is limited by engagement of the collar with the lower end of a protective guard collar **46** which in turn is secured to the sleeve **42** by means of a severable shear pin **47.** Centralizing ribs **46***a* extend radially outwardly from the protective collar **46.** The collar **46** covers a resilient split ring **48** having circumferentially developed teeth **48'** each of which includes a plurality of lateral upwardly directed shoulders **48***a* and a plurality of slanted, downwardly directed shoulders **48***b*.

The retrieval operation of the anchoring assembly is initiated by introducing the positioning member **11** and attached retrieval head **40** into the conduit C through the lubricator L in the manner previously described. Under the influence of the well-head pressure, the positioning means is lowered to the anchoring member **10** until the lower shoe **41** enters the top of sleeve section **20***a*. The upper axial end of the section **20***a* is beveled inwardly to assist in directing the shoe into receiving position within the section. As best illustrated in FIG. **12,** the enlarged heads **45***a* of fingers **45** engage the beveled surface on section **20***a* causing the collar **44** to remain stationary as the sleeve **42** continues to move downwardly through the member **10.** When the upper end of collar **44** engages the lower end of protective collar **46,** the downward movement of the body **42** is transmitted to the fingers **45** forcing the heads **45**a against the beveled surface of section **20***a* and causing them to bend radially inwardly in the manner shown in FIG. **12.** In the latter position, the heads **45***a* are permitted to move downwardly past the initial restriction formed in the upper end of section **20***a* and continued lowering of member **11** moves the heads into registry with an internal sleeve recess **20***a'*. Simultaneously, a collar **41***a* severably secured to the lower shoe **41** by a shear pin **41***b* engages an internal shoulder **22***a* formed in the retaining sleeve **22.** The downward force exerted by the positioning segment **11** overcomes the restraining force of lock ring **30** causing it to be moved radially inwardly into the receiving recess in sleeve **22** whereupon the sleeve **22** may continue to move downwardly under the force exerted by the positioning member **11.** When lip **22'** engages an inwardly developed shoulder on the setting sleeve **21,** continued downward movement of the retaining sleve draws the setting sleeve downwardly so that the ridges on the internal surface of the dogs **28** may drop into the recesses formed on the external surface of the setting sleeve **22.** In this latter position, illustrated in FIG. **5,** the anchoring member **10** is free from anchoring engagement with the recess R and the enlarged heads **45***a* are locked into the recesses **20***a'* by the sleeve **42.** The well-head pressure may then be reduced to the point required to permit

the formation pressure to drive the positioning member **11**, attached anchoring assembly **10** and equipment S to the well surface.

If the anchoring assembly **10** should become lodged in the well conduit C during this retrieval operation, the positioning member **11** may be separated and removed by increasing the surface pressure to move the positioning member back downwardly through the stationary anchoring member **10.** When sufficient force is developed, shear pins **41b** and **47** will sever permitting the sleeve **42** to continue to move downwardly until the teeth **45** engage and ratchet over the exposed teeth **48'**. This is effected when the sloping shoulders **45***d* engage the sloping shoulders **48***b* causing the split ring **48** to be moved radially inwardly. The reverse movement between the ring **48** and collar **44** is prevented by the engagement of the flat shoulders **45***c* and **48***a*. In this latter position, the reduced diameter portion **42'** of sleeve **42** is coincident with the enlarged heads **45***a* so that the heads are free to bend radially inwardly out of the recess **20***a'* thereby freeing the positioning member **11** so that it may be recovered at the surface.

FIG. **7** illustrates retrieval of the positioning member **11** and attached anchoring member **10** by means of a retrieval head **140** connected to a tubing string T. If the anchoring assembly including the positioning means **11** becomes anchored or lodged in the conduit C and cannot be moved upwardly through the conduit C under the influence of the formation pressure, the head **140** is lowered from the well surface through a suitable lubricator until a shoe **141** carried at the bottom of the retrieving head engages the frangible plate **14.** Resilient fingers **145** carried in a locking collar **144** and having enlarged heads **145***a* simultaneously latch into the recess **20***a'* in the manner previously described with reference to retrieving head **40.** The lower shoe **141** is driven against the frangible plate **14** causing it to break which in turn destroys the pressure barrier previously existing across the setting device **11.** Thereafter the positioning assembly **11** and anchoring assembly **10** may be withdrawn to the surface by raising the tubing string T.

The foregoing disclosure and description of the invention is 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 within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. An anchoring assembly for anchoring well equipment within a surrounding tubular well conduit comprising:

a. remotely operable anchoring means for engaging and disengaging the internal surfaces of said surrounding well conduit to respectively anchor and release said anchoring assembly in said well conduit, said anchoring means further including:

i. an axially extending, substantially tubular body of composite construction;

ii. radially movable engagement means carried by said body and disposed for outward radial movement into anchoring engagement with said well conduit for preventing relative axial movement between said anchoring means and said well conduit;

iii. setting means included in said body for selectively moving said engagement means radially into and out of engagement with said well conduit;

iv. locking means included in said body for locking said engagement means in the radially outwardly position in anchoring engagement with said well conduit; and

v. anchor seal means carried by said body for forming a seal between said body and said surrounding well conduit;

b. pressure responsive positioning means connected with said anchoring means for axially moving said anchoring means through said well conduit;

c. first sealing means included with said positioning means for forming a pressure seal in said conduit between the areas above and below said first sealing means; and

d. sliding seal means included with said first sealing means for forming a substantially continuous sliding seal between said positioning means and said well conduit whereby said positioning means may be driven axially through said well conduit under the influence of a pressure differential developed axially across said first sealing means.

2. An anchoring assembly for anchoring well equipment within a surrounding tubular well conduit comprising:

a. remotely anchoring means for engaging and disengaging the internal surface of said surrounding well conduit to respectively anchor and release said anchoring assembly in said well conduit, said anchoring means having an axially extending, substantially tubular body of composite construction which includes:

i. an outer sleeve body;

ii. a setting sleeve body concentrically disposed within at least a portion of said outer sleeve body;

iii. a retaining sleeve body concentrically disposed within at least a portion of said setting sleeve body;

iv. engagement means including a plurality of radially movable dogs carried between said outer sleeve body and said setting sleeve body and being substantially fixed against axial movement with respect to said outer sleeve body, said dogs being operable for anchoring engagement with said well conduit for preventing relative axial movement between said anchoring means and said well conduit; and

v. locking means including cooperating recess and ridge means formed on the radially inner surfaces of said dogs and on the radially outer surface of said setting sleeve body with said setting body being movable axially with respect to said dogs to first and second axial positions where in said first position, recess means in said dogs register with ridge means in said setting body to permit said dogs to move radially inwardly and where in said second position, ridge means in said dogs register with ridge means in said setting body to retain said dogs radially outwardly in anchoring engagement with said surrounding well conduit;

b. pressure responsive positioning means connected with said anchoring means for axially moving said anchoring means through said well conduit;

c. first sealing means included with said positioning means for forming a pressure seal in said conduit

between the areas above and below said first sealing means; and

d. sliding seal means included with said first sealing means for forming a substantially continuous sliding seal between said positioning means and said well conduit whereby said positioning means may be driven axially through said well conduit under the influence of a pressure differential developed axially across said first sealing means.

3. An anchoring assembly as defined in claim **2** wherein the external surface of said dogs include radial projections for engaging the internal surface of said well conduit and for maintaining said dogs radially retracted in said anchoring means until said projections register with a recess in the wall of said well conduit.

4. An anchoring assembly as defined in claim **3** wherein:

a. said retaining sleeve body is movable between upper and lower axial positions by said positioning means; and

b. said setting sleeve body is locked in said second axial position with said dogs extended when said setting sleeve body is in said upper axial position.

5. An anchoring assembly as defined in claim **4** wherein said locking means includes a coil spring for resisting movement of said retaining sleeve body from said upper to said lower axial position.

6. An anchoring assembly as defined in claim **5** wherein said locking means further includes a resilient snap ring adapted to expand radially to further resist axial movement of said retaining sleeve from said upper axial position to said lower axial position.

7. An anchoring assembly as defined in claim **4** wherein said locking means includes a resilient snap ring adapted to expand radially to resist axial movement of said retaining sleeve from said upper axial position to said lower axial position.

8. An anchoring assembly as defined in claim **7** further including protective packing means extending radially from said tubular body to said well conduit at a point axially above said engagement means.

9. An anchoring assembly as defined in claim **8** further including second sealing means extending between said anchoring means and said well conduit for forming a seal between said anchoring means and said conduit.

10. An anchoring assembly as defined in claim **9** where said positioning means includes access means for engaging and locking into said positioning means with a mechanical linkage extending from the well surface for retrieval of said positioning means and said anchoring means by movement exerted from the well surface through said linkage.

11. An anchoring assembly for anchoring well equipment within a surrounding tubular well conduit comprising:

a. remotely operable anchoring means for engaging and disengaging the internal surfaces of said surrounding well conduit to respectively anchor and release said anchoring assembly in said well conduit; said anchoring means further including:

i. an axially extending, substantially tubular body of composite construction;

ii. radially movable engagement means carried by said body and disposed for outward radial movement into anchoring engagement with said well conduit for preventing relative axial movement between said anchoring means and said well conduit;

iii. setting means included in said body for selectively moving said engagement means radially into and out of engagement with said well conduit;

iv. locking means included in said body for locking said engagement means in the radially outwardly position in anchoring engagement with said well conduit; and

v. protective packing means extending radially from said tubular body to said well conduit at a point axially above said engagement means;

b. pressure responsive positioning means connected with said anchoring means for axially moving said anchoring means through said well conduit;

c. first sealing means included with said positioning means for forming a pressure seal in said conduit between the areas above and below said first sealing means; and

d. sliding seal means included with said first sealing means for forming a substantially continuous sliding seal between said positioning means and said well conduit whereby said positioning means may be driven axially through said well conduit under the influence of a pressure differential developed axially across said first sealing means.

12. An anchoring assembly for anchoring well equipment within a surrounding tubular well conduit comprising:

a. remotely operable anchoring means for engaging and disengaging the internal surfaces of said surrounding well conduit to respectively anchor and release said anchoring assembly in said well conduit;

b. pressure responsive positioning means connected with said anchoring means for axially moving said anchoring means through said well conduit;

c. access means included in said positioning means for engaging and locking on to said positioning means with a mechanical linkage extending from the well surface for retrieval of said positioning means and said anchoring means by movement exerted from the well surface through said linkage;

d. first sealing means included with said positioning means for forming a pressure seal in said conduit between the areas above and below said first sealing means, said first sealing means further including seal opening means operable by said mechanical linkage for permitting pressure equalization across said first sealing means; and

e. sliding seal means included with said first sealing means for forming a substantially continuous sliding seal between said positioning means and said well conduit whereby said positioning means may be driven axially through said well conduit under the influence of a pressure differential developed axially across said first sealing means.

13. An anchoring assembly as defined in claim **12** further including a frangible plate included in said seal opening means and adapted to be broken by said mechanical linkage for permitting pressure equalization across said first sealing means.

14. An anchoring assembly for well equipment comprising:

a. a tubular body for supporting a well tool in a well conduit;

b. friction means carried by said body for frictionally engaging said well conduit;

c. anchor elements mounted about said body for radial movement between extended and released positions respectively effecting anchoring engagement with and release from said well conduit;

d. a setting sleeve cooperating with said anchor elements carried by said body for relative axial movement therewith between positions extending and releasing said anchor elements;

e. pressure movable positioning means connected with said body for moving said body through said well conduit, said positioning means including access means for engaging and locking into said positioning means with a mechanical linkage extending from the well surface for retrieval of said positioning means and said body by movement exerted from the well surface through said linkage;

f. connecting means included with said positioning means for releasably connecting said positioning means to said tubular body;

g. first sealing means included with said positioning means for forming a seal between the areas in said well conduit above and below said first sealing means, said first sealing means further including a frangible plate adapted to be broken by said mechanical linkage for permitting pressure equalization across said first sealing means;

h. sliding seal means included with said first sealing means for forming a substantially continuous sliding seal between said positioning means and said well conduit whereby said positioning means may be driven axially through said well conduit under the influence of a pressure differential developed axially across said first sealing means;

i. safety latch locking elements initially securing said connecting means to said tubular body and only releasable from said connecting means to release and positioning means from said tubular body upon axial movement of said setting sleeve to said position extending said anchor elements into anchoring engagement with said well conduit; and

j. pressure movable retrieving means engageable with said body and including means for moving said setting sleeve axially to said position releasing said anchor elements from anchoring engagement with said well conduit whereby said tubular body may be moved axially through said well conduit by said retrieving means

15. An anchoring assembly as defined in claim **14** wherein said friction means includes packing means extending between said body and said well conduit.

16. An anchoring means as defined in claim **14** wherein said safety latch locking elements include frangible locking means securing said connecting means to said setting sleeve for preventing release of said positioning means from said tubular body until said anchoring elements are in anchoring engagement with a recess in the wall of said well conduit.

17. A system for anchoring equipment in an elongate well conduit extending from a wellhead to a subsurface formation comprising:

a. a plurality of tubular conduit segments connected together at their ends to form an elongate well conduit having internal recesses at the juncture between adjoining segments;

b. a remotely operable anchoring means having radially movable dog means projectable into said recesses to prevent longitudinal movement of said anchoring means through said elongate conduit;

c. pressure driven positioning means movably disposed within said elongate well conduit and releasably secured to said anchoring means for moving said anchoring means through said elongate conduit;

d. actuating means included with said anchoring means for urging said dog means radially outwardly when said positioning means and said attached anchoring means are moved upwardly through said elongate conduit whereby said dog means are projected into one of said recesses;

e. locking means operable when said dog means have projected into one of said recesses for retaining said dog means in a radially extended position in anchoring engagement with said elongate conduit;

f. release means operable after said dog means project into one of said recesses for releasing said positioning means from said anchoring means whereby said positioning means may be moved through said elongate conduit to the wellhead;

g. access means included with said positioning means for engaging said locking onto said positioning means with a mechanical linkage extending from the well surface for retrieval of said positioning means by movement exerted from the well surface through said linkage; and

h. selectively openable seal opening means included in said pressure driven positioning means for selectively permitting pressure equalization across said positioning means.

18. A system as defined in claim **17** wherein said selectively openable seal opening means comprises a frangible plate adapted to be broken by said mechanical linkage.

19. A system as defined in claim **17** further including pressure movable retrieving means engageable with said anchoring means for releasing said anchoring means from said elongate well conduit whereby said anchoring means may be moved axially through said elongate conduit by said retrieving means.

20. A system as defined in claim **19** wherein said retrieving means includes access means for engaging and locking onto said retrieving means with a mechanical linkage extending from the well surface.

21. A system as defined in claim **20** wherein said retrieving means includes selectively openable seal opening means for selectively permitting pressure equalization across said retrieving means.

22. A system as defined in claim **21** wherein said seal opening means in said retrieving means includes a frangible plate means adapted to be broken by said last mentioned mechanical linkage.

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