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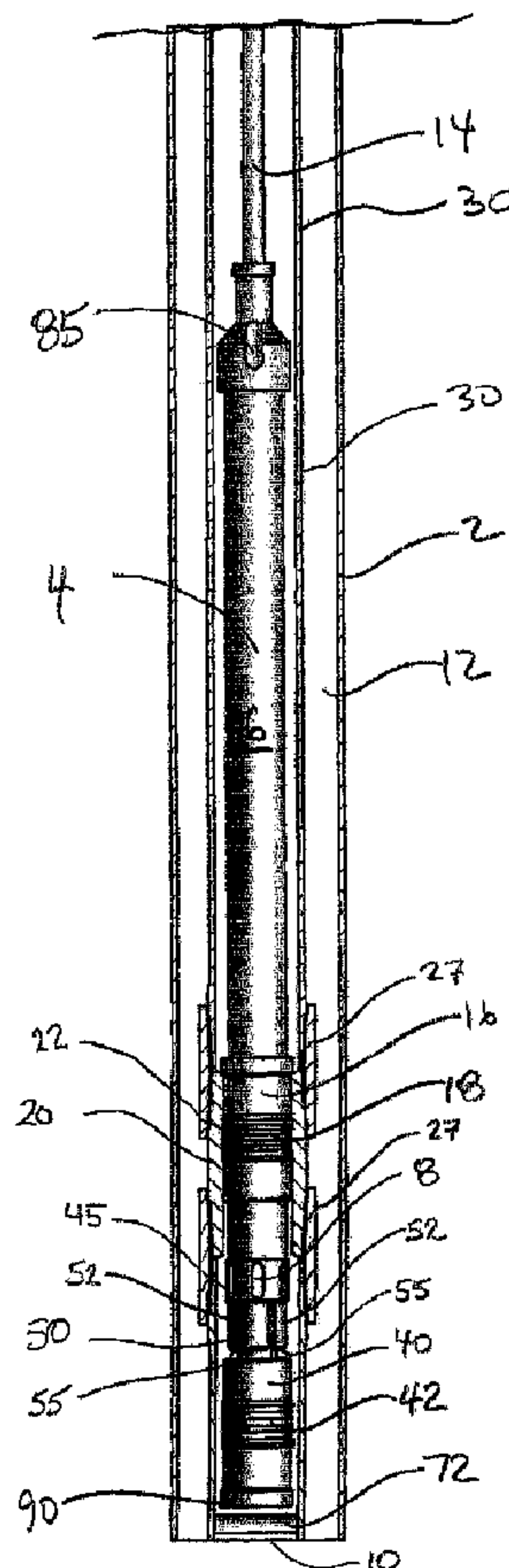
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(54) Titre : POMPE DE FOND AVEC BOUCHON D'ISOLATION DECOUPLABLE

(54) Title: DOWNHOLE PUMP APPARATUS HAVING DECOUPLEABLE ISOLATION PLUG



(57) Abrégé/Abstract:

A pump apparatus for recovering hydrocarbons from downhole wells, having a seating surface adapted to sealingly engage an interior surface of a circumferential seal member situated within production tubing when said pump is in a downhole operative



(57) **Abrégé(suite)/Abstract(continued):**

position. An isolation plug is provided, releasibly coupled to a lower end of said pump, having sealing means thereon to sealingly engage said interior surface of said circumferential seal member when the isolation plug is linearly positioned within said circumferential seal member and decoupled from the pump assembly, thereby preventing gases and fluids from fluid communication to surface when the pump is raised and removed from the well. A method for sealing a well upon removal of a pump is further disclosed.

ABSTRACT

A pump apparatus for recovering hydrocarbons from downhole wells, having a seating surface adapted to sealingly engage an interior surface of a circumferential seal member situated within production tubing when said pump is in a downhole operative position. An isolation plug is provided, releasibly coupled to a lower end of said pump, having sealing means thereon to sealingly engage said interior surface of said circumferential seal member when the isolation plug is linearly positioned within said circumferential seal member and decoupled from the pump assembly, thereby preventing gases and fluids from fluid communication to surface when the pump is raised and removed from the well. A method for sealing a well upon removal of a pump is further disclosed.

DOWNHOLE PUMP APPARATUS HAVING DECOUPLEABLE ISOLATION PLUG

FIELD OF THE INVENTION

The invention relates to downhole tools for use in pumping oil to surface, and more specifically to a downhole pump apparatus having an isolation plug which allows the well to be temporarily plugged downhole to allow removal of a downhole pump for servicing or replacement, without having to “kill” the well, namely prevent it from flowing, which would otherwise be necessary if a downhole pump was desired to be removed from the well for servicing.

BACKGROUND OF THE INVENTION AND DESCRIPTION OF THE PRIOR ART

It is a regulatory (to say nothing of a safety) requirement in producing hydrocarbons from producing wells drilled in hydrocarbon formations that when removing a downhole pump for repair or replacement, that pressurized fluids and gases coming from the drilled well, such as sour gases including toxic hydrogen sulphide gas), be isolated from surface to thereby prevent their escape to atmosphere at the surface of the well.

Specifically, downhole pump assemblies typically possess rod seats, which when the pump is installed in the operative position, typically engage circumferential seals within the casing or tubing in which the downhole pump assembly was placed and positioned, thereby preventing pressurized fluids and/or gases from flowing to surface except through the pump and thereby through the production tubing.

However, any raising of the downhole pump in the prior art for the purposes of repair or replacement of the downhole pump necessarily disengages the rod sealing seats, thereby exposing the downhole pressurized fluids and gases to surface.

To avoid this undesirable situation and to avoid communication with surface when a downhole pump assembly is being replaced, in the prior art a well would be effectively "killed" prior to pump removal, typically via pumping downhole viscous fluids to temporarily seal the well prior to BOP installation and the pump being removed.

The procedure of "killing" a well each time to service downhole components is a costly and time-consuming procedure, and further sometimes would be over-effective in that it is difficult and sometimes impossible to then "restore" the well by removing the viscous fluids, with the result in the prior art that some wells were not only temporarily "killed" but unintentionally permanently "killed" or unable to be brought back on-stream as effectively as before.

In heavy oil formations, where the produced oil contains large amounts of abrasive sand, wear on the pumps is extensive. This results in the necessity to frequently replace such pumps. Such, as indicated above, undesirably results in the need in the prior art to "kill" the well, so that pressurized fluids and gases deep in the formation are not otherwise allowed to flow directly to surface.

A real need exists for specialized apparatus and methods for removing worn or defective pumps which avoids the need to first "kill" the well, or alternatively is able to avoid pollution which otherwise results due to release of pressurized oil or gases from within the formation to surface via the open well.

SUMMARY OF THE INVENTION

In order to provide certain advantages over the prior art, it is an object of the present invention to provide a downhole tubing apparatus or downhole pump apparatus, as well as a method for removing same from a well, which avoids having

to otherwise “kill” the well when a downhole pump is desired to be removed from the well for repair or replacement in order to avoid downhole pressures in a hydrocarbon formation being exposed to surface.

5 It is a further object of the present invention to allow for casing flow in a production well to be “shut in” without breaking wellhead containment when a downhole pump is desired to be removed from the well for repair or replacement.

10 It is a further object of the invention to provide a downhole tubing apparatus to save rig time by eliminating time which would otherwise be required to “kill” the well prior to removal of a downhole pump, and to otherwise restore the rig to operation when the downhole pump assembly is reinserted and the well is desired to then be restored and brought back “on-line”.

15 It is yet a still-further object of the present invention to provide a downhole tubing apparatus which allows unseating of a rod insert pump or other pump regardless of downhole pressures or temperatures.

20 Accordingly, in a first broad aspect of the present invention comprises a downhole pump apparatus for preventing gases and fluids within a hydrocarbon formation from having fluid communication to surface upon removal of a downhole pump from within a production well, comprising:

25 a pump assembly having a pump means, further having a seating surface adapted to sealingly engage an interior surface of a circumferential seal member situated within production tubing when said pump assembly is in a downhole operative position;

30 an isolation plug, longitudinally spaced apart from said seating surface on said pump assembly, releasibly coupled to a lower end of said

pump assembly, adapted for linear movement within said production tubing, having sealing means thereon dimensioned to sealingly engage said interior surface of said circumferential seal member when said isolation plug is linearly positioned within said circumferential seal member;

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releasable latch means situated on said lower end of said pump assembly, adapted for releasibly de-coupling said isolation plug from said lower end of said pump assembly when said sealing means on said isolation plug sealingly engages said circumferential sealing member;

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wherein said pump assembly when raised from said downhole operative position is adapted to cease sealing engagement between said circumferential seal member and said seating surface and said isolation plug when simultaneously raised is adapted for said sealing means thereon to become sealingly engaged with said circumferential seal member, and said latch means may thereafter be operated to disengage said isolation plug and said isolation plug thereby remains downhole when said remainder of said pump apparatus is raised from within said production well..

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In a refinement, when said pump assembly is lowered downhole, the latch assembly is further adapted to become recoupled to said isolation plug in said production well and force said isolation plug downwardly out of sealing engagement with said circumferential seal member and allow said seating surface on said pump assembly to then re-engage in sealing relationship said circumferential seal member.

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In a second broad aspect of the present invention, a downhole isolation plug apparatus is provided for preventing a production well from having fluid communication to surface upon removal of a downhole pump or other equipment

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from said well, comprising:

elongate tubing means, having at a distance therealong
circumferential seal means;

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an isolation plug adapted for linear movement within said tubing
means, having sealing means thereon dimensioned to permit said sealing
means thereon to sealingly engage said circumferential seal means when
said isolation plug is linearly positioned within said tubing at said distance
10 along an interior of said elongate tubing means;

10

a downhole tubing assembly coupleable to said isolation plug,
having at an upper end thereof a seating surface adapted to sealingly
engage said circumferential seal means when said tubing assembly is in a
15 downhole operative position, and having on a lower mutually opposite end
thereof latch means for releasibly engaging said isolation plug;

15

wherein said downhole tubing assembly, when raised from said
downhole operative position, is adapted to cease sealing engagement
20 between said interior circumferential seal means and said seating surface,
and said isolation plug when simultaneously raised is adapted for said
sealing means thereon to become sealingly engaged with said
circumferential seal means, and said latch means may thereafter be
operated to disengage said isolation plug and said isolation plug thereby
25 remains downhole when said remainder of said downhole tubing assembly
is raised; and

20

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wherein said downhole tubing assembly when lowered
downhole said latch assembly thereon is adapted to engage said isolation
30 plug in said downhole well and force said isolation plug downwardly out of

30

sealing engagement with said circumferential seal means and allow said seating surface on said downhole assembly to then re-engage in sealing relationship said circumferential seal means.

5 In a further aspect the present invention comprises a downhole pump apparatus for preventing a production well from having fluid communication to surface upon removal of a downhole pump from said well, comprising:

10 elongate tubing means, having at a distance therealong circumferential seal means;

15 an isolation plug, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage said circumferential seal means when said isolation plug is linearly positioned within said tubing at said distance along said interior of said tubing means;

20 a downhole pump assembly coupleable to said isolation plug, having at an upper end thereof a seating surface adapted to sealingly engage said circumferential seal means when said pump assembly is in a downhole operative position, and having on a lower mutually opposite end thereof latch means for releasibly engaging said isolation plug;

25 wherein said downhole pump assembly when raised from said downhole operative position is adapted to cease sealing engagement between said circumferential seal means and said seating surface, and said isolation plug when simultaneously raised is adapted for said sealing means thereon to become sealingly engaged with said circumferential seal means, and said latch means may thereafter be operated to disengage
30 said isolation plug and said isolation plug thereby remains downhole when

said downhole pump assembly is raised; and

5 wherein said downhole pump assembly when lowered downhole said latch assembly thereon is adapted to engage said isolation plug in said downhole well and force said isolation plug downwardly out of sealing engagement with said circumferential seal means .

10 In a further refinement of the downhole pump assembly of the present invention, such assembly comprises:

elongate tubing means, having at respective distances therealong longitudinally spaced-apart first and second circumferential seal members;

15 a downhole pump assembly, having at an upper end thereof a seating surface adapted, when said pump assembly is in a downhole operative position, to sealingly engage an interior surface of said first circumferential seal members;

20 an isolation plug, releasably coupleable to a lower end of said downhole pump assembly, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage an interior surface of said second interior circumferential seal member when said downhole pump assembly and seating surface is raised thereby disengaging
25 said seating surface from seating engagement with said first circumferential seal member;

30 latch means, situated on a lower end of said downhole pump assembly opposite said upper end thereof, adapted for releasably coupling said isolation plug to said lower end of said downhole pump assembly;

wherein said downhole pump assembly, when raised from said downhole operative position, is adapted to cease sealing engagement between said interior surface of said first circumferential seal member and said seating surface, and said isolation plug thereon when simultaneously raised is adapted to permit said sealing means thereon to become sealingly engaged with said interior surface of said second circumferential seal member so as to prevent fluid communication from a downhole side of said isolation plug to an uphole side of said isolation plug; and

wherein said latch means is adapted to permit said isolation plug when sealingly engaging said second sealing means to become uncoupled from said downhole pump assembly so as to permit said isolation plug to thereby remain downhole when said downhole pump assembly is further raised; and

wherein said downhole pump assembly when lowered downhole is adapted to sealingly re-engage said first circumferential seal member, and said latch assembly thereon is adapted to engage said isolation plug in said downhole well and force said isolation plug downwardly out of sealing engagement with said second circumferential seal member.

In another aspect of the invention, the invention comprises a method for removing a downhole pump assembly from a well which avoids undesirable flow of downhole fluids to surface upon removal of said pump assembly, such method comprising the steps of :

(a) providing first and second interior circumferential seal means along an elongate tubing means, at respective spaced-apart longitudinal distances therealong ;

(b) providing a downhole pump assembly, having at an upper end thereof a seating surface;

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(c) providing an isolation plug, releasably coupleable to a lower end of said downhole pump assembly, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage said second interior circumferential seal means when said downhole pump assembly and seating surface is raised thereby disengaging said seating surface from seating engagement with said first circumferential seal;

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(d) providing latch means, situated on a lower end of said downhole pump assembly opposite said upper end thereof, adapted for releasably coupling said isolation plug to said lower end of said downhole pump assembly;

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(e) lowering said pump assembly in a downhole operative position within said well so as to permit said seating surface thereon to sealingly engage said first circumferential seal means;

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(f) raising said downhole pump assembly thereby causing said seating means to cease sealing engagement between said first circumferential seal means and said seating surface, and simultaneously causing said isolation plug thereon to become sealingly engaged with said second circumferential seal means so as to prevent fluid communication from a downhole side of said isolation plug to an uphole side of said isolation plug; and

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(g) causing said latch means to releasibly uncouple said isolation plug from said downhole pump assembly so as to permit said isolation plug to thereby remain downhole when said downhole pump assembly is further raised and

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removed from said well.

5 In a further refinement of the method of the present invention, such method further comprises the step, after step (g), of lowering said downhole pump assembly within said well so as to permit said seating surface thereon to sealingly re-engage said first circumferential seal means, and simultaneously causing said latch assembly thereon to engage said isolation plug in said downhole well and force said isolation plug downwardly out of sealing engagement with said second circumferential seal means .

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BRIEF DESCRIPTION OF THE DRAWINGS

15 Further advantages and permutations and combinations of the invention will now appear from the above and from the following detailed description of the various particular embodiments of the invention taken together with the accompanying drawings, each of which are intended to be non-limiting, in which:

20 **FIG. 1A** is a side view of a prior art downhole tubing assembly in “top hold down” configuration, having a seating surface which is adapted to sealingly engage a circumferential seal means on the downhole tubing in a so-called “hold-down” assembly, further having a pump, wherein the pump is positioned below the hold-down assembly where it is directly exposed to the reservoir pressure;

25 **FIG. 1B** is a cross-sectional view of the prior art downhole tubing assembly of Fig. 1A, with such downhole pump assembly partially removed from the seating nipple and wherein the seating surface on the downhole tubing assembly as ceased sealing engagement with the circumferential seal means;

FIG. 1C is a cross-sectional view of the downhole tubing assembly of the prior art , with the pump and seating surface thereof removed from the well, wherein the pressure of the formation and gases in the formation are accordingly then directly exposed to surface unless the well has previously been “killed;

5

FIG. 2A is a side view of one embodiment of a downhole tubing assembly of the present invention, having an isolation plug and first and second circumferential seal means, shown in the operative position where a seating surface on the downhole tubing assembly is in sealing engagement with first circumferential seal means on the downhole tubing, thereby preventing pressure of the formation from being exposed to surface;

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FIG. 2B is a cross-sectional view of the downhole tubing assembly of Fig. 2A, showing the pump assembly in the process of being raised to surface, wherein the seating surface has thereby been caused to become dis-engaged from the first circumferential seal, and seal means on an isolation plug has been thereby caused to be brought in contact with a second circumferential seal, thereby maintaining the situation whereby pressure of the formation is prevented from being exposed to surface;

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FIG. 2C is a cross-sectional view of the downhole tubing assembly of Fig. 2B, wherein latch means which releasably couples the isolation plug to the lower end of the downhole pump assembly has been caused to release the isolation plug from coupled engagement to the lower end of the pump assembly;

25

FIG. 2D is a subsequent cross-sectional view of the downhole tubing assembly of Fig 2A-2C, wherein the pump assembly has been withdrawn, and the isolation plug remains in sealing engagement with the second circumferential seal means thereby preventing pressure of the formation from being exposed to surface;

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5 **FIG. 3A** is a side view of a further alternative prior art downhole tubing assembly in “bottom hold down” configuration, having a seating surface which is adapted to sealingly engage a circumferential seal means on the downhole tubing in a so-called “hold-down” assembly, further having a pump, wherein the pump is positioned above the hold-down assembly so as not to be directly exposed to the reservoir pressure ;

10 **FIG. 3B** is a cross-sectional view of the prior art downhole tubing assembly of Fig. 3A, with such prior art downhole assembly partially removed from the well and wherein the seating surface on the downhole tubing assembly as ceased sealing engagement with the circumferential seal means thereby allowing pressure in the formation to be exposed to surface;

15 **FIG. 3C** is a cross-sectional view of the downhole tubing assembly of the prior art shown in Figs. 3A-3B, with the pump removed for servicing or replacement, wherein the pressure of the formation and gases in the formation are accordingly then directly exposed to surface unless the well has previously been “killed”;

20 **FIG. 4A** is an alternative embodiment of the downhole tubing assembly of the present invention having an isolation plug but only one circumferential seal means, where the pump is shown in the operative position and a seating surface sealingly engages circumferential seal means on the tubing thereby preventing pressure in the formation from being in direct communication with surface;

25 **FIG. 4B** is a cross-sectional view of the downhole tubing assembly of Fig. 4A, showing the pump assembly in the process of being raised to surface, wherein the seating surface has thereby been caused to become dis-engaged from the circumferential seal, and seal means on an isolation plug has been thereby caused to be brought in contact with the circumferential seal, thereby maintaining the situation

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whereby pressure of the formation is prevented from being exposed to surface;

FIG. 4C is a cross-sectional view of the downhole tubing assembly of Fig. 4B, wherein latch means which releasably couples the isolation plug to the lower end of the downhole pump assembly has been caused to release the isolation plug from coupled engagement to the lower end of the pump assembly; and

FIG. 4D is a subsequent cross-sectional view of the downhole tubing assembly of Fig 4A-2C, wherein the pump assembly has been withdrawn, and the isolation plug remains in sealing engagement with the circumferential seal means thereby preventing pressure of the formation from being exposed to surface;

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1A shows a typical downhole pump apparatus **1** of the prior art installed in a well casing **2**, shown in the operative (pumping) position, situated within production tubing **30** in a production well **12**, comprising a pump assembly **4** having a pump **6** and a pump intake **8**.

Oil **3** being produced from bottom **10** of well **12** enters pump intake **8** and is pumped upwardly within pump assembly **4** by pump **6** so as to be forced out exit aperture **85** within a top portion of pump assembly **4** directly into production tubing **30** and thereby forced upwardly to surface.

In such operative pumping position as shown in **Fig. 1A**, pump assembly **4** is situated proximate the bottom **10** of well **12**. A seating surface **18** on hold-down member **16**, sealingly engages a circumferential seal **22** on seating nipple **20** situated within production tubing **30**, so as to prevent the unregulated flow of pressurized fluids or gases otherwise than through the pump **6** and production tubing

30 when pump apparatus **1** is in the downhole (operative) position shown in **Fig. 1A**.

In the prior art, and as shown in **Fig.'s 1A-1C**, pump **6** forming part of pump assembly **4** may comprise a rod pump, and a polish rod **14** which reciprocates up and down is provided to power pump **6**. However, rods **14** which do not reciprocate but rather use torsion to power pump **6**, wherein pump **6** is a progressive cavity pump, are alternatively used in the prior art.

The present invention is adapted for use in association with any type of downhole pump **6** used in applications shown similar to that shown in **Fig. 1A-C** for pumping viscous oil **3**.

Particularly, the present downhole tubing assembly is adapted for uses such as that shown in **Fig.s 1A-1C** where downhole pump **6** are required and which are further frequently needed (for purposes of servicing or replacement) to be removed from the well **12**.

Pumps **6** include electric submersible pumps or progressive cavity pumps, or any type of pump which may require removal for servicing and/or replacement .

The configuration shown in **Fig. 1A** is commonly referred to in the art as a "top hold down" configuration, wherein the pump assembly **4** is situated below seating nipple **20** and thus the exterior of pump **6** is disadvantageously exposed to unregulated downhole reservoir pressures during pumping.

Fig. 1B shows prior art pump apparatus **1** being removed from the well **12** for servicing or replacement.

Disadvantageously, as shown in **Fig. 1B**, when raising the pump apparatus **1** from within well **12**, seating surface **18** on hold-down member **16** is removed from, and no longer sealingly engages, circumferential seal **22** on seating nipple **20**. In

such manner pressurized fluids downhole within a hydrocarbon formation may then flow uphole in an unregulated manner (ie no longer need be required to flow in regulated manner through pump **6**, as shown by the direction of the arrows in **Fig. 1B**).

5

Even more disadvantageously with regard to this apparatus and method in the prior art of **Figs. 1A-1C**, when pump apparatus **1** is completely removed from well **12**, pressurized fluids downhole within a hydrocarbon formation are given free flow uphole in an unregulated manner, as shown by the arrows in **Fig. 1C**.

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As well, as shown in **Fig. 1A-1C**, due to the “top hold down” configuration the thin exterior of pump **6** is exposed to downhole reservoir pressures, which in high pressure reservoirs could cause damage to pump **6**.

15

Fig. 3A-3C show a modified pump apparatus **1** as also used in the prior art, in a configuration known as a “bottom hold down” configuration. In such configuration the downhole pump assembly **4** is positioned above seating surface **16** on hold-down member **18**, thereby preventing , due to the sealing engagement of seating surface **18** with circumferential seal **22** on seating nipple **20**, pressurized liquids and/or gases from within the reservoir from bypassing the pump **6** and thereby flowing to surface in unregulated manner via production tubing **30**.

20

This prior art configuration shown in **Fig.’s 3A-3C** is typically used in applications where there are concerns of excessive reservoir pressures which could possibly collapse the thin outer barrel of downhole pump **6**.

25

Disadvantageously with regard to the prior art configuration of **Figs. 3A-3C**, as was the case with the prior art apparatus shown in **Fig.’s 1A-1C**, when the pump apparatus **4**, shown in the operative pumping position in **Fig. 3A**, is begun to be raised towards the surface as shown in **Fig. 3B**, seating surface **18** on hold-down

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member **16** is raised thereby preventing its sealing engagement with circumferential seal **22** on seating nipple **20**. Such then allows, due to the lost sealing engagement of seating surface **18** with circumferential seal **22** on seating nipple **22**, downhole gases and liquids (indicated by arrows) to then be able to pass in unregulated manner uphole via production tubing **30** to surface.

Moreover, as shown in **Fig. 3C**, when the pump apparatus **1** is completely removed from the production well **12**, downhole gases and liquids (indicated by arrows) are then able to freely pass in unregulated manner uphole via production tubing **30** to surface.

In order to overcome the problems of the prior art designs and methods, in a first broad embodiment of the invention shown in **Figs. 4A-4C**, a novel pump apparatus **100** is provided for preventing gases and fluids within a production well **12** from having fluid communication to surface upon removal of such downhole pump apparatus **100** from with such well **12**.

Pump apparatus **100** comprises a pump assembly **4** having a pump **6**, in a "bottom down" configuration, where pump **6** is situated above a sealing surface **18** on a hold-down member **16**. Sealing surface **18**, when pump apparatus **100** is in the downhole operative position shown in **Fig. 4A** is adapted to sealingly engage circumferential seal **22** on seating nipple **20** which is threadably secured to production tubing **30**.

An isolation plug **40** is provided, releasably coupled (in the manner further explained below) to a lower end **45** of pump assembly **4**, having a seals **42** thereon dimensioned so as to sealingly engage circumferential seal **22** on seating nipple **20** when isolation plug **40** is linearly positioned within circumferential seal **22**.

Releasable latch means/member **50** is situated on lower end **45** of pump assembly **4** , and is adapted for releasably coupling and de-coupling isolation plug **40** from lower end **45** of pump assembly **4** in the manner further elaborated and explained on below.

5 Latch member **50** is provided to releasibly couple isolation plug **40** to pump assembly **4**. Latch member **50** may comprise and operate similar to various “on/off” tools used in the industry, wherein in one particular “on/off” tool configuration a protruding nub is releasibly insertable into a helical slot milled into an exterior surface of the latch member **50** which forms part of a “J” slot. By a well operator
 10 lowering latch member **50** onto a componet to which it is desired to become releasibly coupled (in this case isolation plug **40**) , much like the rotary motion imparted to a child’s toy top when a downward motion is imparted, engagement of a protruding lug with a milled helical groove which is part of a milled “j” slot on respectively latch member **50** and coupled component (isolation plug **40**), when
 15 downward force is applied, causes relative rotation of each component relative to the other and thus movement of the lug within the “j” slot portion of the milled “j” slot to thereby couple latch member **50** to coupled component (isolation plug **40**). To release latch member **50** from releasable securement to isolation plug **40** after the pump assembly **4** and coupled isolation plug **40** have been raised so that the
 20 isolation plug **40** is located with seating nipples **20**, **20b**, a well operator momentarily reverses the direction of movement of the pump assembly **4** from up to down, thereby again forcing latch member **50** downwardly against the then-immobile isolation plug **40** , and this time due to the action of lug within helical grooves a reverse direction of rotation of the latch member **50** relative to the isolation plug **40** is
 25 imparted, thereby removing the lug from within the “J” slot and permitting disengagement of the isolation plug **40** from latch member **50**, to thereby decouple latch member **50** from isolation plug **40**.

In a preferred embodiment, however, latch member **50** of the present invention comprises a plurality of resiliently flexible, hooked “fingers” **52**, adapted to

releasibly encircle and grasp a protruding bulbous spherical knob **60** on said isolation plug **40** which extends upwardly therefrom as shown in **Fig.s 4C & 4D**. When latch member **50** (already physically coupled to isolation plug **40** as shown in **Fig. 4A**) is raised upwardly within production tubing **30** when removing pump assembly **4**, as shown in **Fig. 4B**, due to engagement of a protruding lip **90** on isolation plug **40** with seating nipple **20**, essentially creating a "no-go" situation, the resulting resistive force due to such protruding lip **90** preventing further upward movement of isolation plug **40** causes spreading flexation of fingers **52** on latch member **50**, resulting in bulbous knob **60** on isolation plug **40** being released from engagement with fingers **52** and hook edges **55**, thereby decoupling isolation plug **40** from engagement with latch member **50**, as shown in **Fig. 4C**.

This invention is not limited to the particular preferred embodiment of the latch member **50** discussed above, and other similar latch mechanisms will now be apparent and/or known to persons of skill in the art, and are included as a means of operating this invention. The invention is not to be considered to be limited to the latch member **50** of the preferred embodiment shown in **Fig.s 2A-2D** and **Fig.s 4A-4D**, but all manner of releasably coupleable latch means are contemplated within the scope of this invention.

Specifically, when pump **6** is desired to be serviced or replaced, pump assembly **4** is first raised from the operative position shown in **Fig. 4A** to a position wherein advantageously seal **42** on isolation plug **40** sealingly engages circumferential seal **22** on seating nipple **20**.

Latch member **50** is then operated, in the manner described above, to decouple isolation plug **40** from pump assembly **4**. Thereafter, pump assembly **4** may advantageously then be raised to surface as shown in **Fig. 4D** -all downhole pressurized gases and liquids being prevented from passage to surface as a result

of the sealing engagement of seal **42** on isolation plug **40** and circumferential seal **22** on seating nipple **20**.

Advantageously, when a new or re-serviced pump **6** and pump assembly **4** is desired to be re-inserted downhole, the latch member **50** at a lower end of pump assembly **4** may be lowered in production tubing **30** and lowered onto bulbous spherical knob **60** on isolation plug **40**, in a reversal of the procedure shown in **Fig.s 4A-4D**, namely the procedure of **Fig.s 4D-4A**. While typically the frictional engagement between the seals **42** and circumferential seal **22** will assist in allowing the latch member **50** to be re-coupled to isolation plug **40**, in any event a "stop" bar **72** is provided at bottom **10** of well **12**, against which the isolation plug **40** comes to rest against to definitively allow latch member **50** to be pressed onto (and fingers **52** thereon flex sufficiently to allow hook edges **55** thereof to hook and become releasibly coupled to) bulbous knob **60** on isolation plug **40** so as to allow latch member **50** to be again releasibly coupled to isolation plug **40**.

Fig.'s 2A-2D show an alternative embodiment of the pump apparatus **1** of the present invention, wherein two seating nipples **20a, 20b** provide, respectively, first (**22a**) and second (**22b**) circumferential seals.

In this embodiment of the invention shown in **Fig.s 2A-2D**, the pair of seating nipples **20a, 20b** each have respective first and second circumferential seals **22a, 22b**, and are provided at spaced distances along production tubing **30**. Seating nipples **20a, 20b** may be threadably coupled to production tubing **30** via threaded couplings **27** as shown in **Fig.s 2A-2D**, although other alternative means of securement of seating nipples **20a, 20b** to production tubing **30**, such as welding, may be used.

Forming part of pump assembly **4** is a hold-down member **18**, having a seating surface **18** thereon. Seating surface **18** is adapted to sealingly engage first

circumferential seal **22a** on sealing nipple **20a** when pump apparatus **100** is in operative pumping position, as shown in **Fig. 2A**.

Isolation plug **40** is releasibly coupled to a lower end **45** of pump assembly **4**, isolation plug **40** having seals **42** thereon which are adapted to sealingly engage circumferential seal **22b** when pump assembly **4** is raised from operative position to the position shown in **Fig. 2B** when desiring to remove pump apparatus **100** from well **12**.

Latch member **50** is provided as described above, to allow isolation plug **40** to be releasably coupled thereto and thus releasably coupled to pump assembly **4**.

The method for removing the pump apparatus of **Fig. 2A-2D** from well **12** and from the operative pumping position as shown in **Fig. 2A** comprises the steps of firstly raising the pump assembly **4** to a position shown in **Fig. 2B**, thereby causing the seating surface **18** to cease sealing engagement with seating nipple **22a**, but simultaneously causing seal **42** on isolation plug **40** to become sealingly engaged with seating nipple **20b** and corresponding circumferential seal **22b**, thereby preventing fluid communication from a downhole side of isolation plug **40** from being able to pass to an uphole side of isolation plug **40**.

Upon further raising of pump assembly **4**, due to protruding lip **90** on isolation plug **40** contacting lower edge of seating nipple **20b** and being thereby prevented from further upward movement, flexible fingers **52** and hook edges **55** thereon encircling bulbous spherical knob **60** on isolation plug **40** are caused to resiliently spread or flex, thereby causing latch member **50** to be decoupled from engagement with isolation plug **40**, as shown in **Fig. 2C**, thereby allowing pump assembly **4** to be further raised and removed from production well **12**. Advantageously isolation plug **40** remains in sealing position with second seating nipple **20b**, as shown in **Fig. 2D**, thereby preventing migration of any pressurized

gas or liquids from travelling up production well **30** to surface when pump assembly **4** is absent from the well **12**.

Conversely, when lowering a new or serviced pump **6** back into well **12** and production tubing **30**, the reverse series of steps is followed, namely the steps illustrated in the sequence of **Figures 2D-2A**, so as result in a pump assembly **4** positioned in the operative pumping position as shown in **Fig. 2A**.

Specifically, pump assembly **4** is lowered in production tubing **30**, so that seating surface on hold-down member **16** sealingly re-engages and contacts first circumferential seal **22a** on first seating nipple **20a**. Latch member **50** is forced downwardly on isolation plug **40**, moving it downwardly and out of sealing engagement with seating nipple **20b**, until further downward movement of isolation plug **40** is arrested due to isolation plug **40** contacting "stop" member **72**, whereupon resilient flexing of flexible fingers **52** and hook edges **55** on latch member **50** permits fingers **52** and hook edges **55** to then surround bulbous knob **60** and thereby re-couple latch member **50** to isolation plug **40**.

By isolation plug **40** having been moved out of sealing engagement with second seating nipple **20b**, oil **3** is then permitted access to pump inlet/intake **8** and may then be pumped to surface.

The foregoing description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Specifically, various modifications to those embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein, but is to be accorded the full scope consistent with the claims, wherein reference to an element in the singular, such as by use of the article "a" or "an" is not intended to

mean "one and only one" unless specifically so stated, but rather "one or more". In addition, where reference to "fluid" is made, such term is considered meaning all liquids and gases having fluid properties.

For a complete definition of the invention and its intended scope, reference is to be made to the summary of the invention and the appended claims read together with and considered with the disclosure and drawings herein.

We claim:

1. A downhole pump apparatus for preventing gases and fluids within a hydrocarbon formation from having fluid communication to surface upon removal of a downhole pump from within a production well, comprising:

a pump assembly having a pump means, further having a seating surface adapted to sealingly engage an interior surface of a circumferential seal member situated within production tubing when said pump assembly is in a downhole operative position;

an isolation plug, longitudinally spaced apart from said seating surface on said pump assembly, and releasibly coupled to a lower end of said pump assembly, adapted for linear movement within said production tubing, having sealing means thereon dimensioned to sealingly engage said interior surface of said circumferential seal member when said isolation plug is linearly positioned within said circumferential seal member;

releasable latch means situated on said lower end of said pump assembly, adapted for releasibly de-coupling said isolation plug from said lower end of said pump assembly when said sealing means on said isolation plug sealingly engages said circumferential sealing member;

wherein said pump assembly when raised from said downhole operative position is adapted to cease sealing engagement between said circumferential seal member and said seating surface, and said isolation plug when simultaneously raised is adapted for said sealing means thereon to become sealingly engaged with said circumferential seal member, and said latch means may thereafter be operated to disengage said isolation plug and said isolation plug thereby remains downhole when said remainder of said pump apparatus is further raised from within said production well..

2. The downhole pump apparatus as claimed in claim 1,

wherein said latch assembly thereon, when said pump assembly is lowered downhole, is adapted to engage said isolation plug in said production well and force said isolation plug downwardly out of sealing engagement with said circumferential seal member and allow said seating surface on said pump assembly to then re-engage in sealing relationship said circumferential seal member.

3. A downhole pump apparatus for preventing a production well from having fluid communication to surface upon removal of a downhole pump from said well, comprising:

elongate tubing means, having at a distance therealong an interior circumferential seal member;

an isolation plug, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage said interior circumferential seal means when said isolation plug is linearly positioned within said tubing at said distance along an interior of said elongate tubing means;

a downhole pump assembly coupleable to said isolation plug, having at an upper end thereof a seating surface adapted to sealingly engage said circumferential seal member when said pump assembly is in a downhole operative position, and having on a lower mutually opposite end thereof latch member for releasibly engaging said isolation plug;

wherein said downhole pump assembly when raised from said

downhole operative position is adapted to cease sealing engagement between said interior circumferential seal means and said seating surface, and said isolation plug when simultaneously raised is adapted for said sealing means thereon to become sealingly engaged with said circumferential seal means, and said latch means may thereafter be operated to disengage said isolation plug and said isolation plug thereby remains downhole when said downhole pump assembly is raised; and

wherein said downhole pump assembly when lowered downhole said latch assembly thereon is adapted to engage said isolation plug in said downhole well and force said isolation plug downwardly out of sealing engagement with said circumferential seal means .

4. The downhole pump apparatus as claimed in claim 3, further comprising a stop member within said production tubing proximate a bottom of said production well , against which the isolation plug may abut, to allow said latch means when lowered onto said isolation plug to be forceably coupled to said isolation plug.

5. A downhole pump apparatus for preventing a production well from having fluid communication to surface upon removal of a downhole pump from said well, comprising:

elongate tubing means, having at respective distances therealong longitudinally spaced-apart first and second circumferential seal members;

a downhole pump assembly, having a seating surface adapted when said pump assembly is in a downhole operative position to sealingly engage and interior surface of said first circumferential seal member;

an isolation plug, releasably coupleable to a lower end of said

downhole pump assembly, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage an interior surface of said said second circumferential seal member when said downhole pump assembly and seating surface is raised thereby disengaging said seating surface from seating engagement with said first circumferential seal member;

latch means, situated on a lower end of said downhole pump assembly opposite said upper end thereof, adapted for releasably coupling said isolation plug to said lower end of said downhole pump assembly;

wherein said downhole pump assembly, when raised from said downhole operative position, is adapted to cease sealing engagement between said first circumferential seal member and said seating surface, and said isolation plug thereon when simultaneously raised is adapted to permit said sealing means thereon to become sealingly engaged with said second circumferential seal member as to prevent fluid communication from a downhole side of said isolation plug to an uphole side of said isolation plug; and

wherein said latch means is adapted to permit said isolation plug when sealingly engaging said second sealing means to become uncoupled from said downhole pump assembly so as to permit said isolation plug to thereby remain downhole when said downhole pump assembly is further raised; and

wherein said downhole pump assembly when lowered downhole is adapted to sealingly re-engage said first circumferential seal member, and said latch assembly thereon is adapted to engage said isolation plug in said downhole well and force said isolation plug downwardly out of sealing engagement with said second circumferential seal member .

6. A method for removing a downhole pump assembly from a well which avoids undesirable flow of downhole fluids to surface upon removal of said pump assembly, comprising the steps of :

(a) providing first and second interior circumferential seal means along an elongate tubing means, at respective spaced-apart longitudinal distances therealong ;

(b) providing a downhole pump assembly, having at an upper end thereof a seating surface;

(c) providing an isolation plug, releasably coupleable to a lower end of said downhole pump assembly, having sealing means thereon and dimensioned to permit said sealing means thereon to sealingly engage said second interior circumferential seal means when said downhole pump assembly and seating surface is raised thereby disengaging said seating surface from seating engagement with said first circumferential seal;

(d) providing latch means, situated on a lower end of said downhole pump assembly opposite said upper end thereof, adapted for releasably coupling said isolation plug to said lower end of said downhole pump assembly;

(e) lowering said pump assembly in a downhole operative position within said well so as to permit said seating surface thereon to sealingly engage said first circumferential seal means;

(f) raising said downhole pump assembly thereby causing said seating means to cease sealing engagement between said first circumferential seal means and said seating surface, and simultaneously causing said isolation plug thereon to become sealingly engaged with said second circumferential seal means so as to prevent fluid communication from a downhole side of said

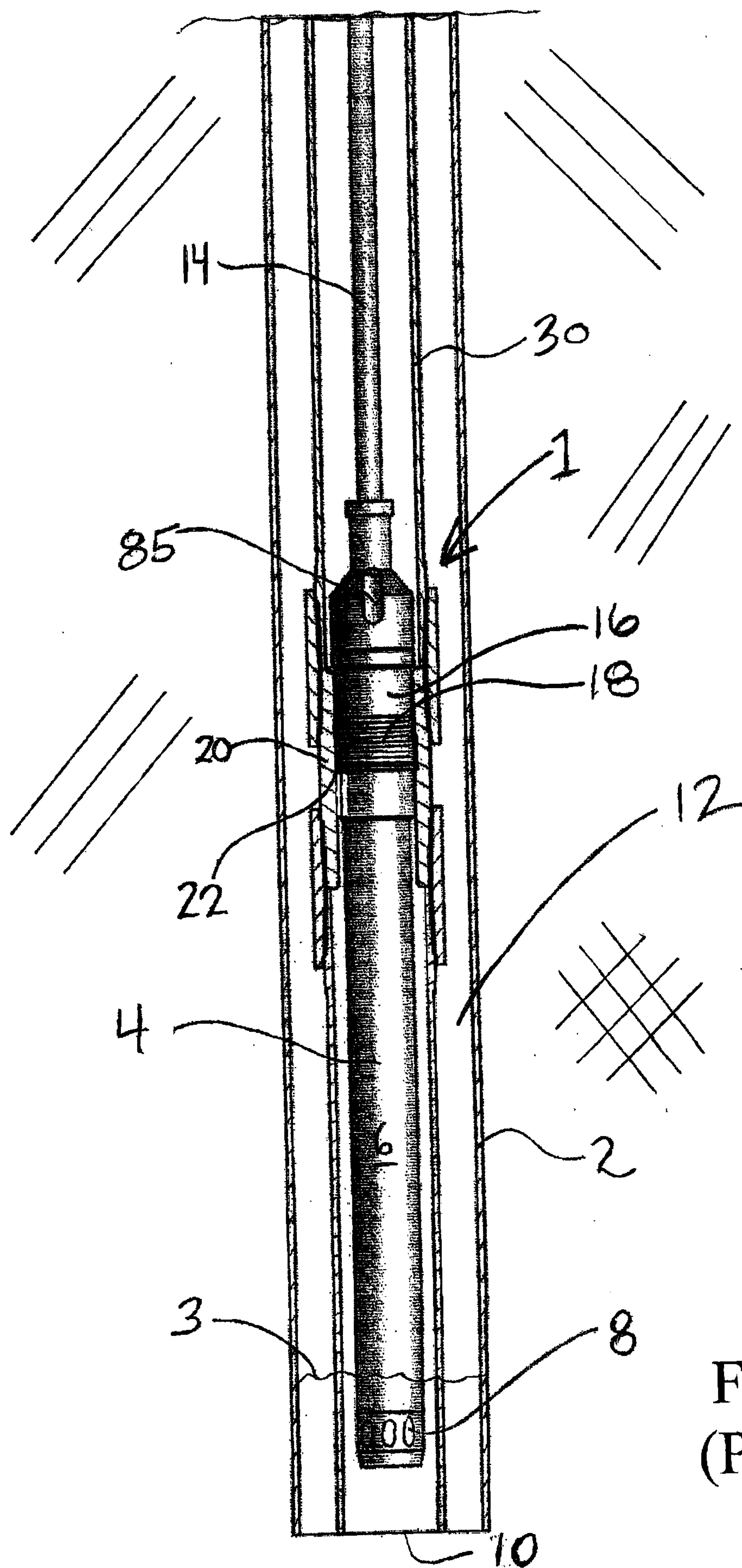
isolation plug to an uphole side of said isolation plug; and

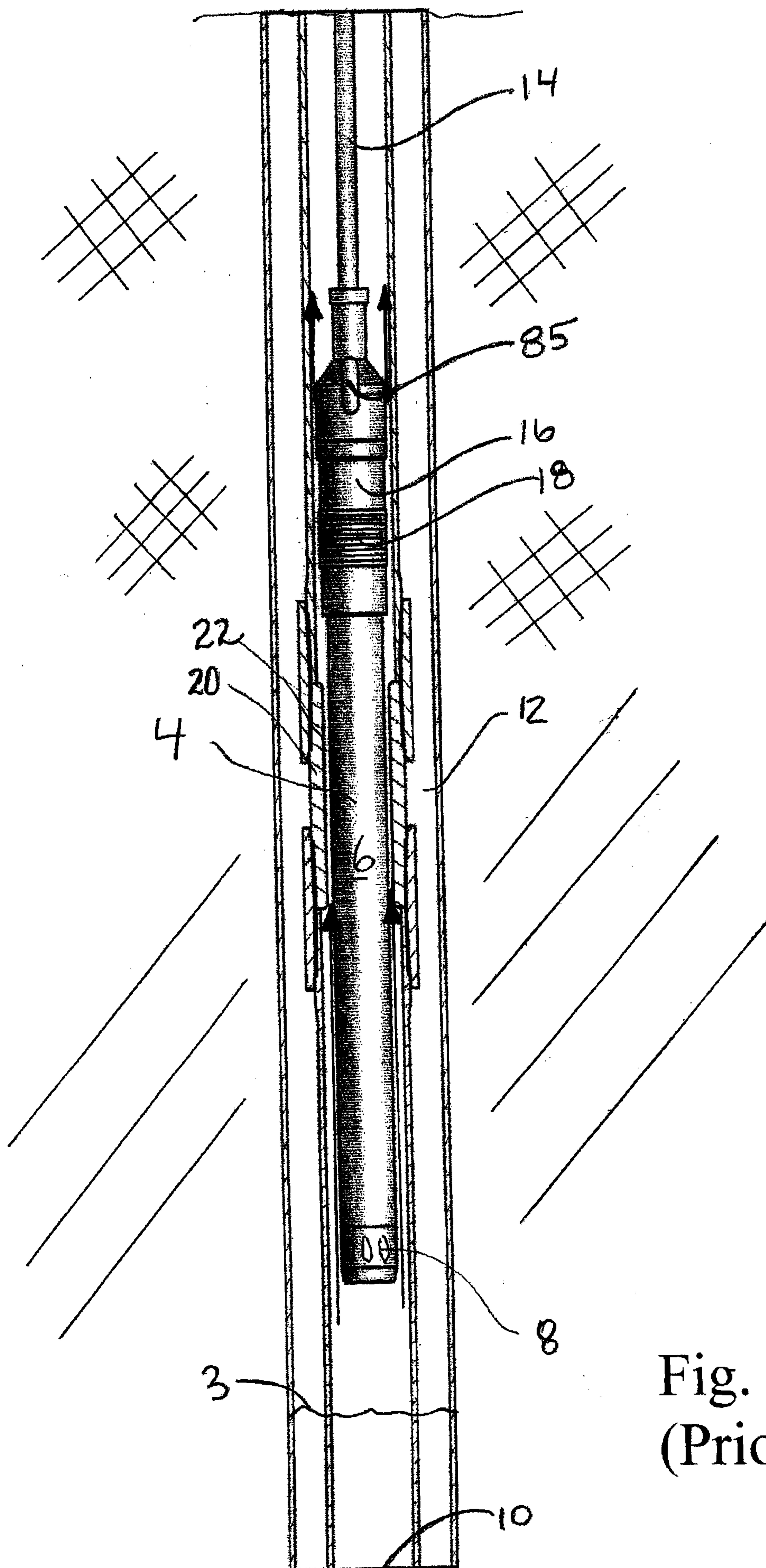
(g) causing said latch means to releasibly uncouple said isolation plug from said downhole pump assembly so as to permit said isolation plug to thereby remain downhole when said downhole pump assembly is further raised and removed from said well.

7. The method as claimed in claim 6, further comprising the steps, after step (g), of:

lowering said downhole pump assembly within said well so as to permit said seating surface thereon to sealingly re-engage said first circumferential seal means and simultaneously causing said latch assembly thereon to engage said isolation plug in said downhole well; and

forcing said isolation plug downwardly out of sealing engagement with said second circumferential seal means .





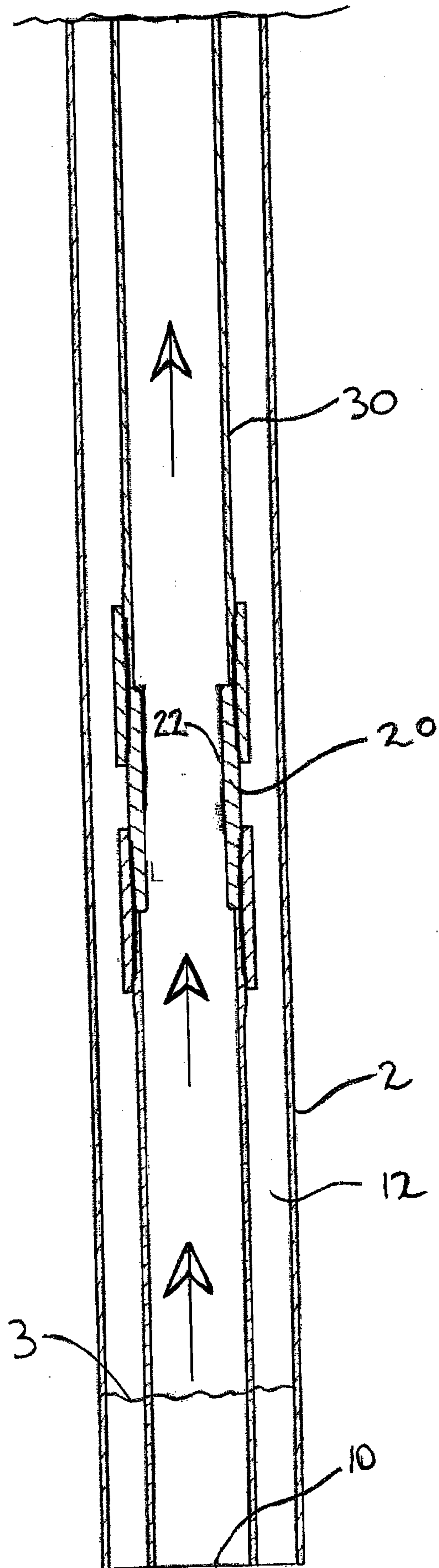


Fig. 1C
(Prior Art)

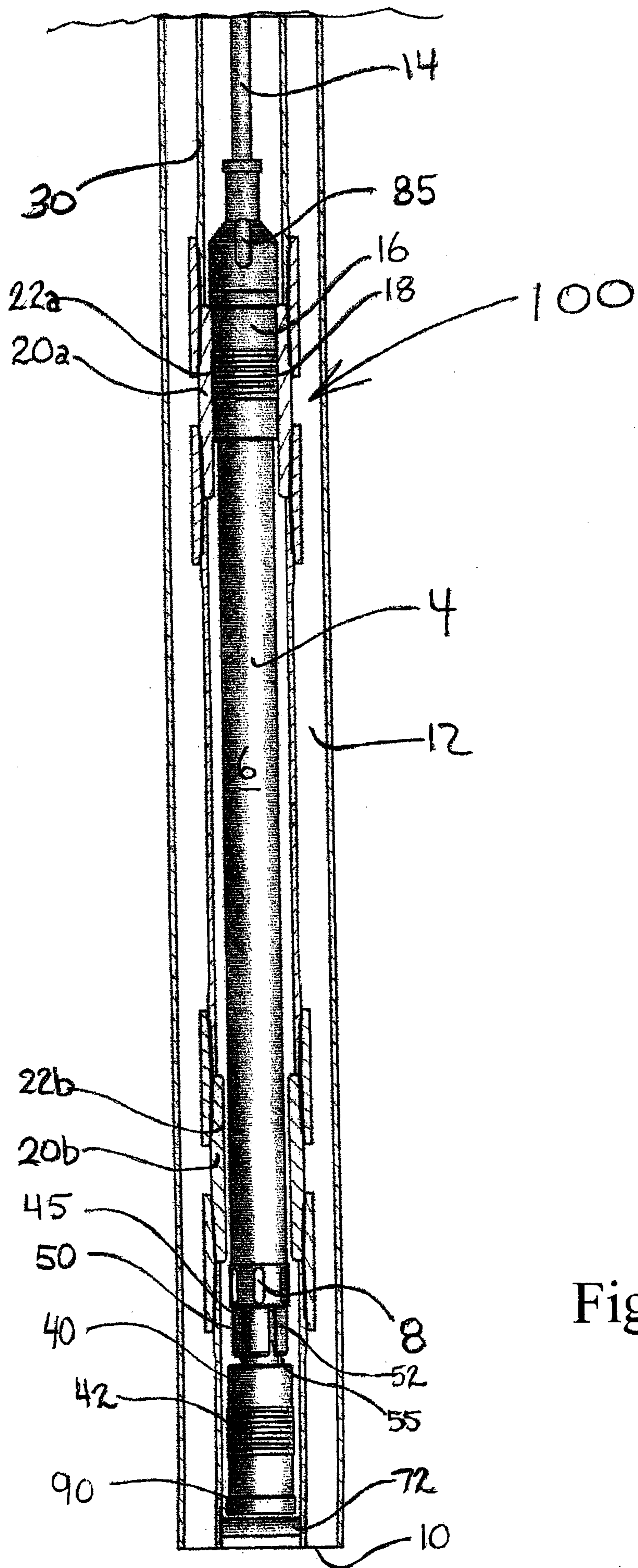


Fig. 2A

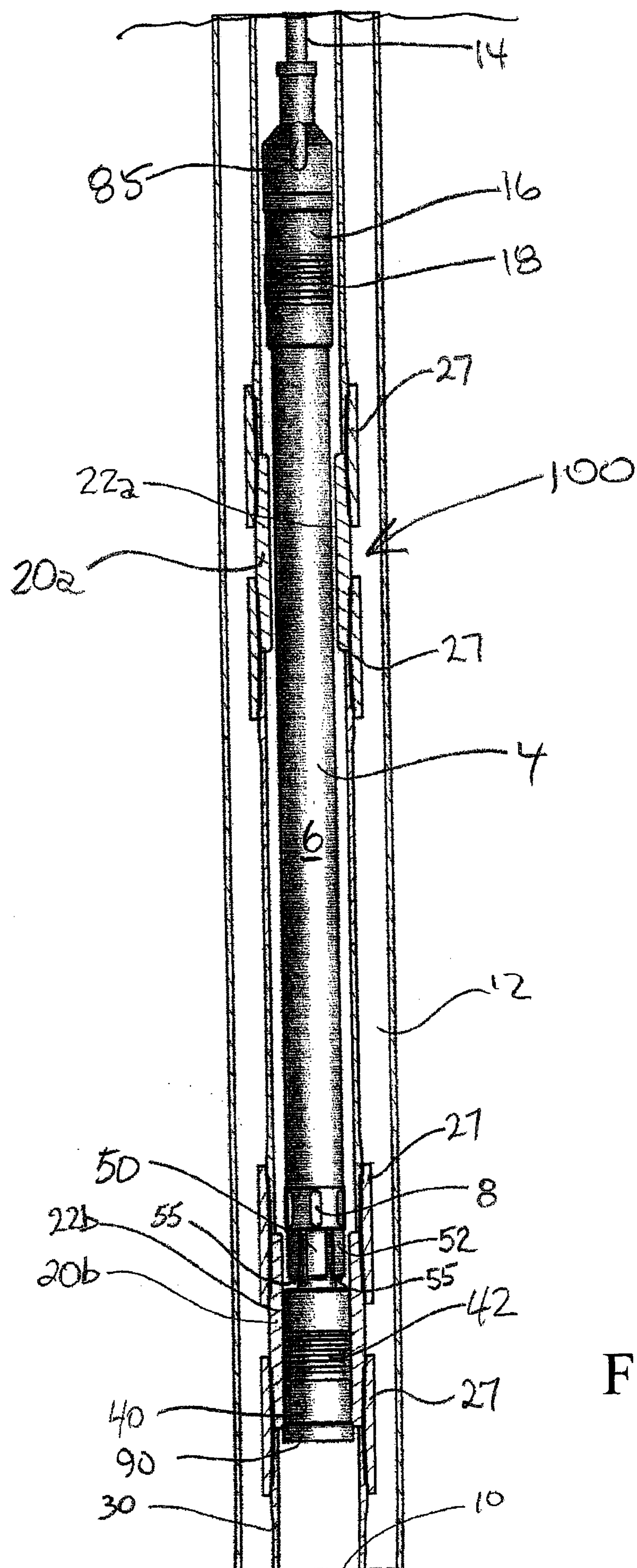


Fig. 2B

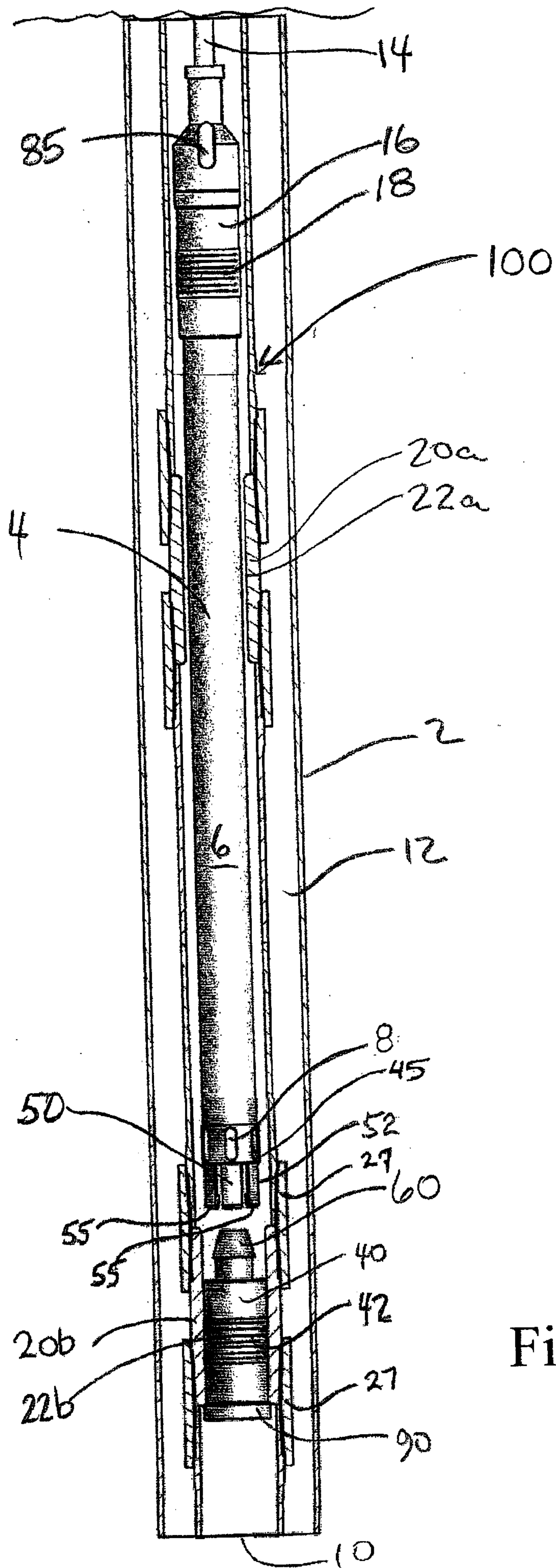


Fig. 2C

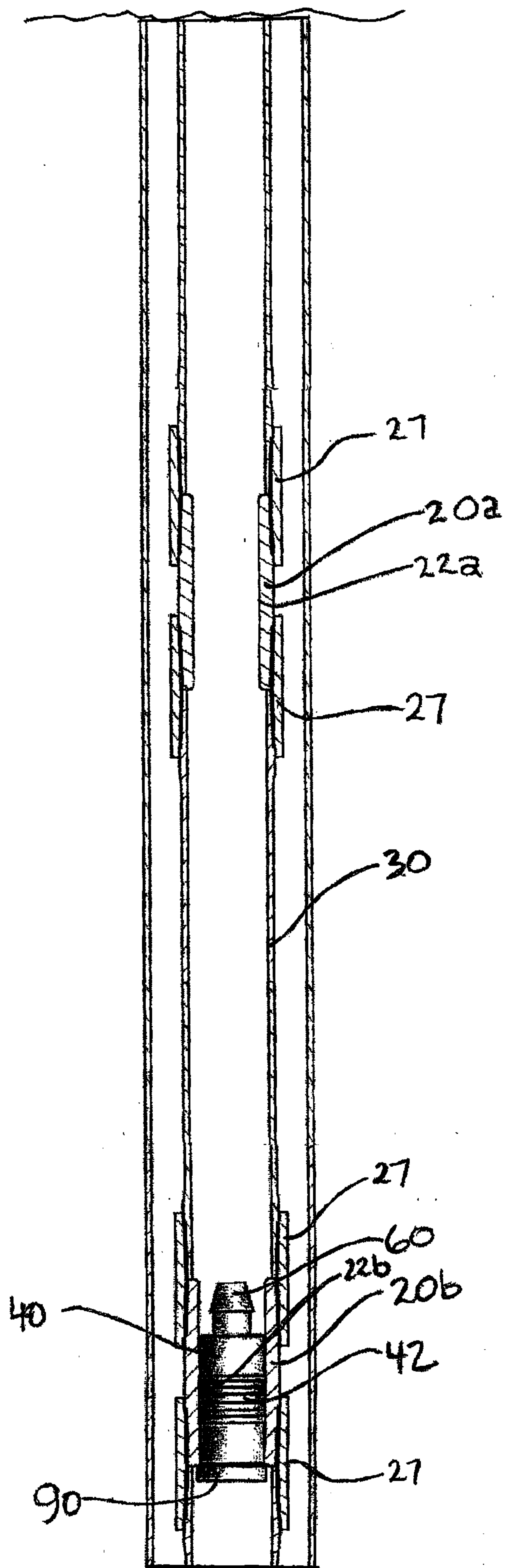


Fig. 2D

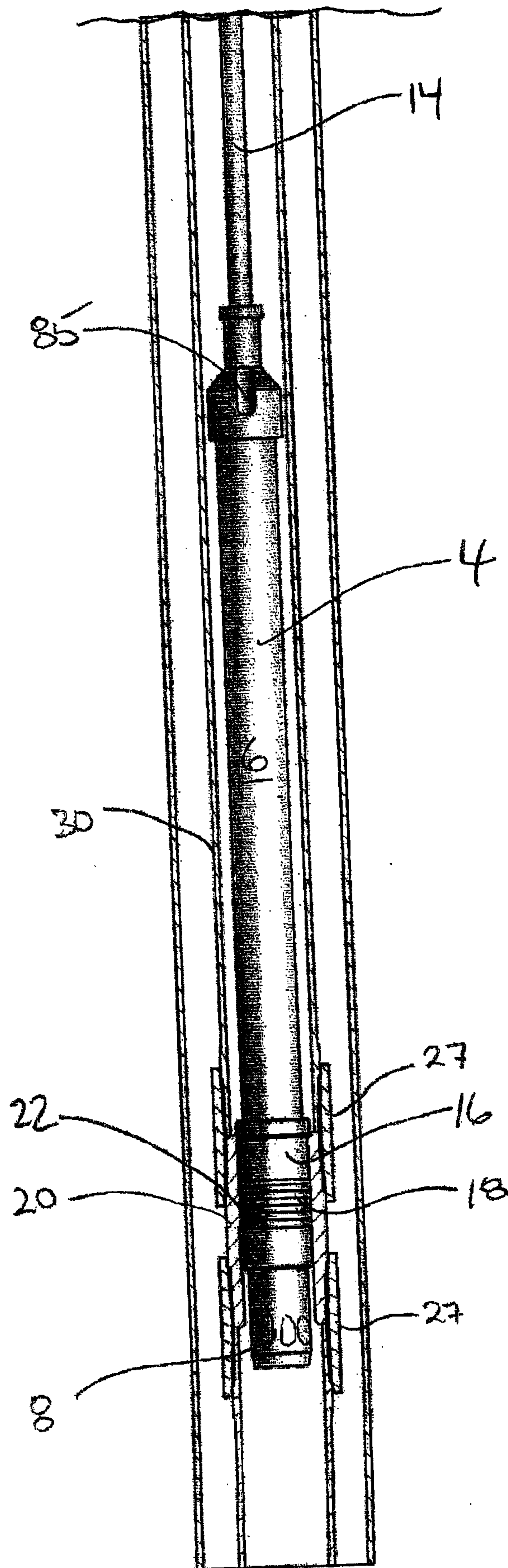


Fig. 3A
(Prior Art)

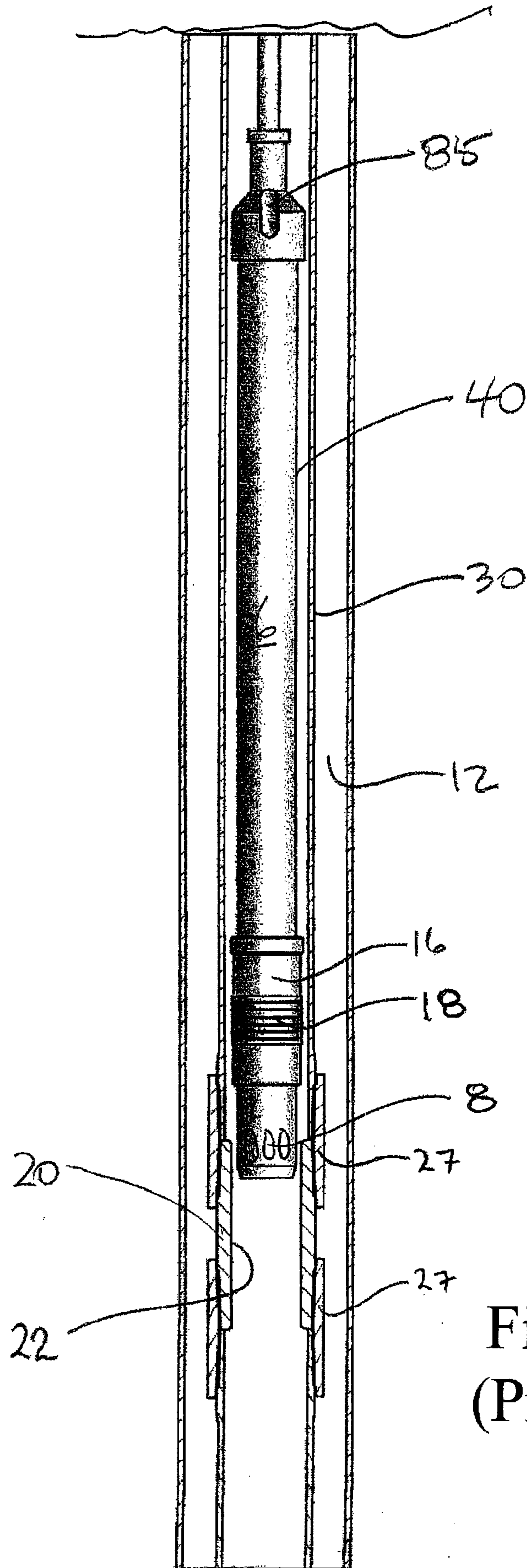


Fig. 3B
(Prior Art)

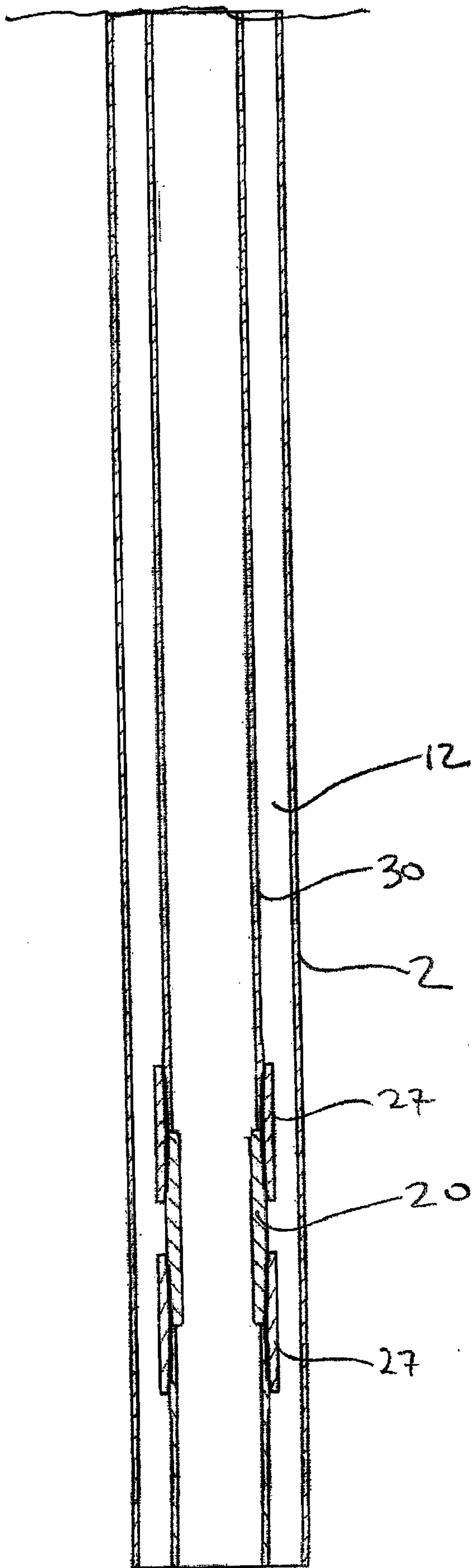


Fig. 3C
(Prior Art)

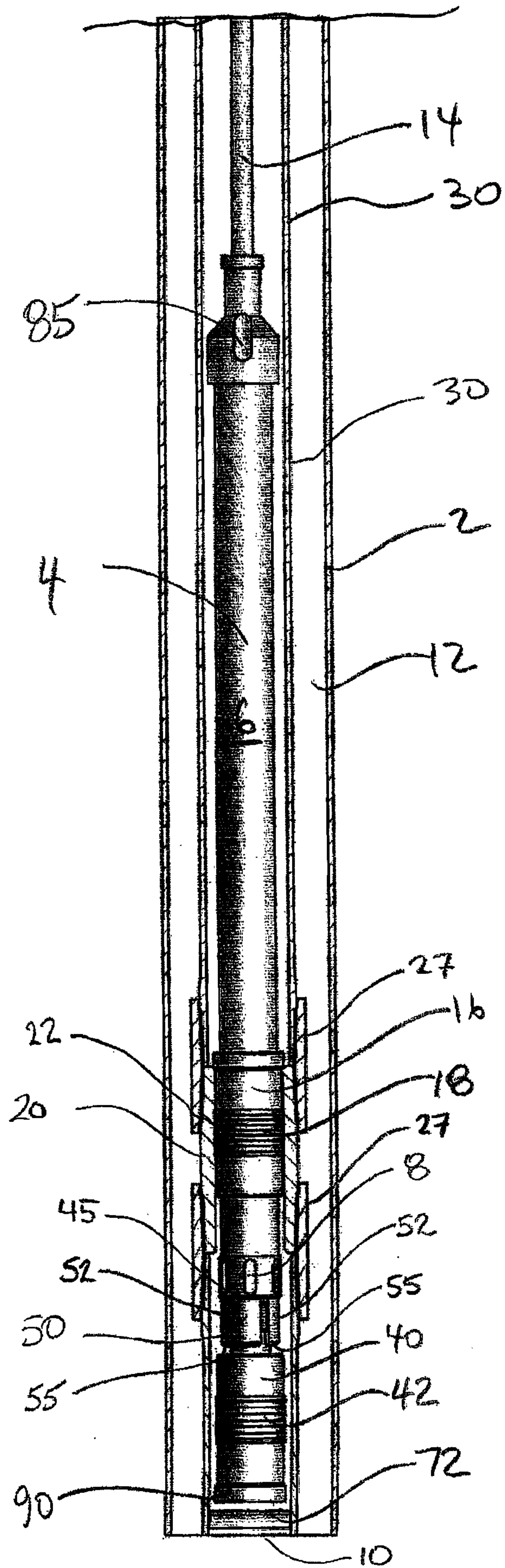


Fig. 4A

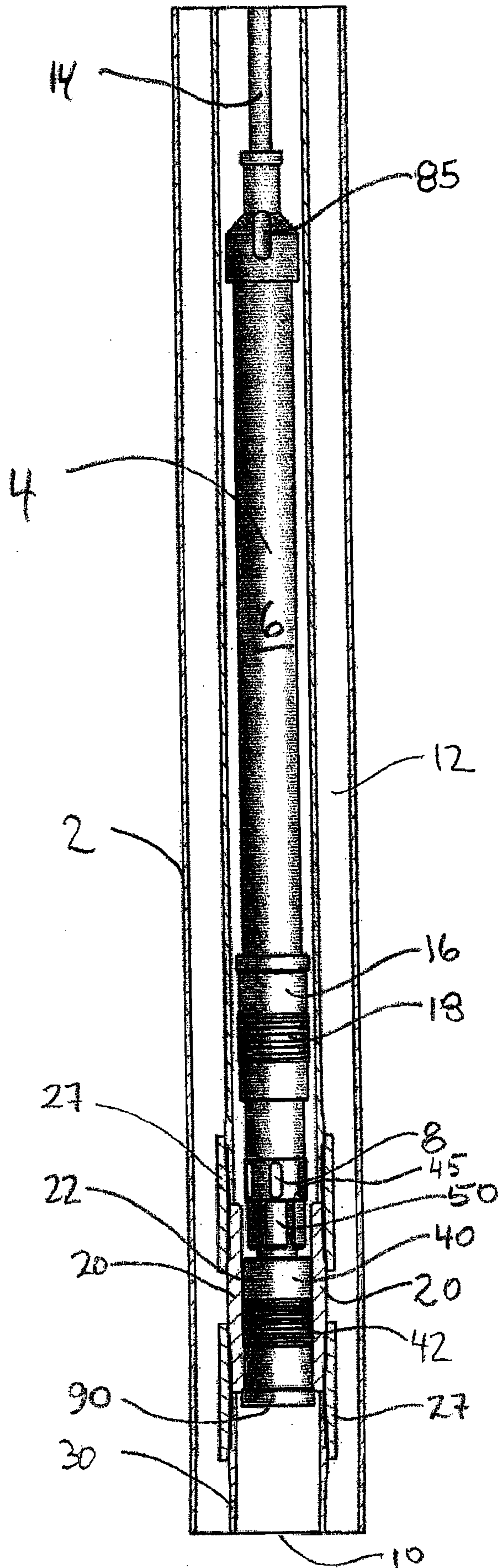


Fig. 4B

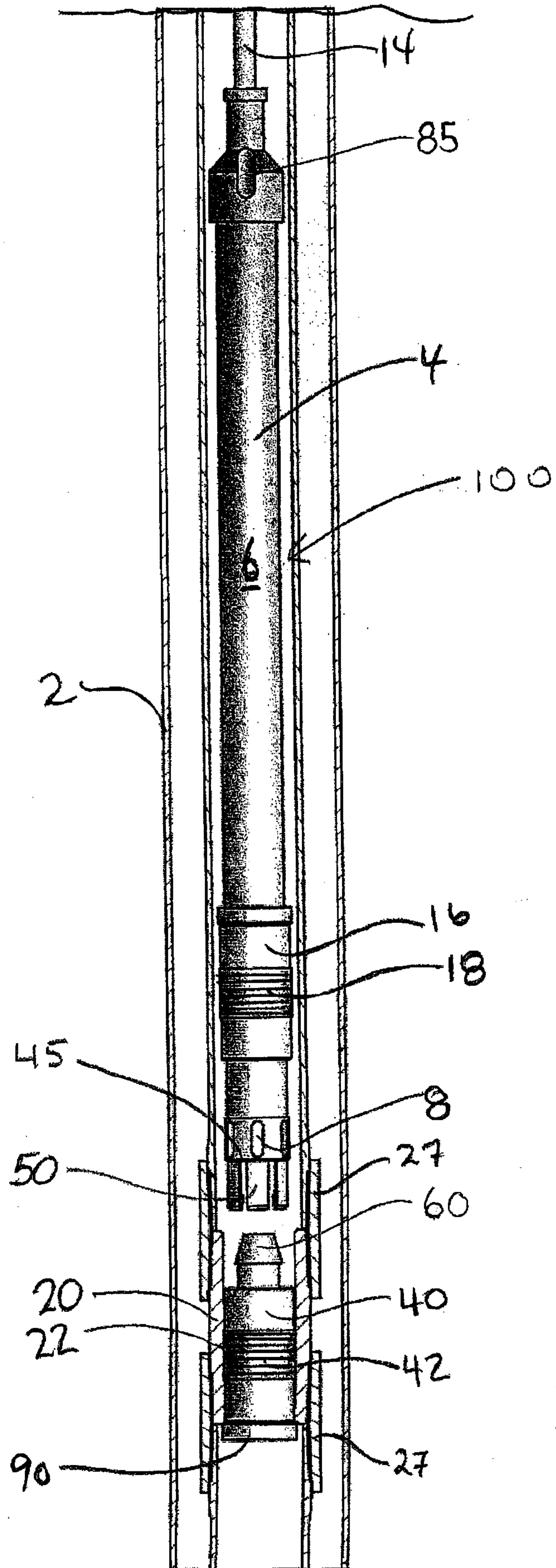


Fig. 4C

Fig. 4D

