

Nov. 21, 1967

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3,353,596

TUBING HANGER AND METHOD OF TESTING PACKING THEREON

Filed June 30, 1965

3 Sheets-Sheet 1

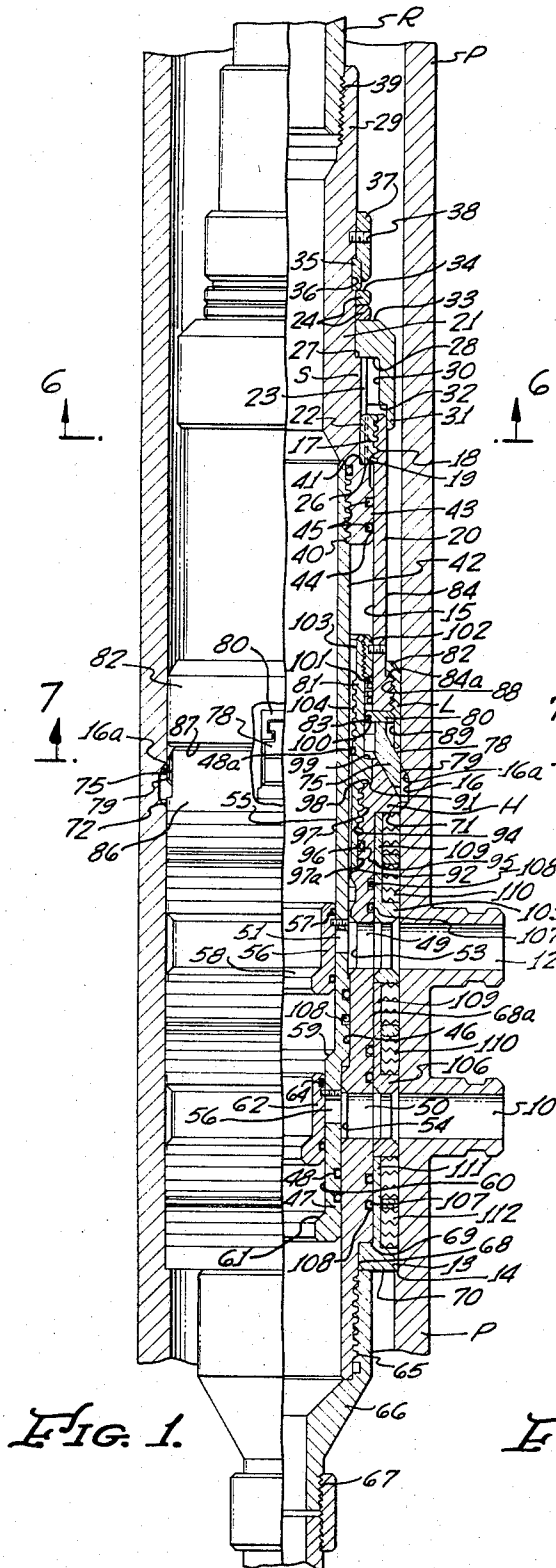


FIG. 1.

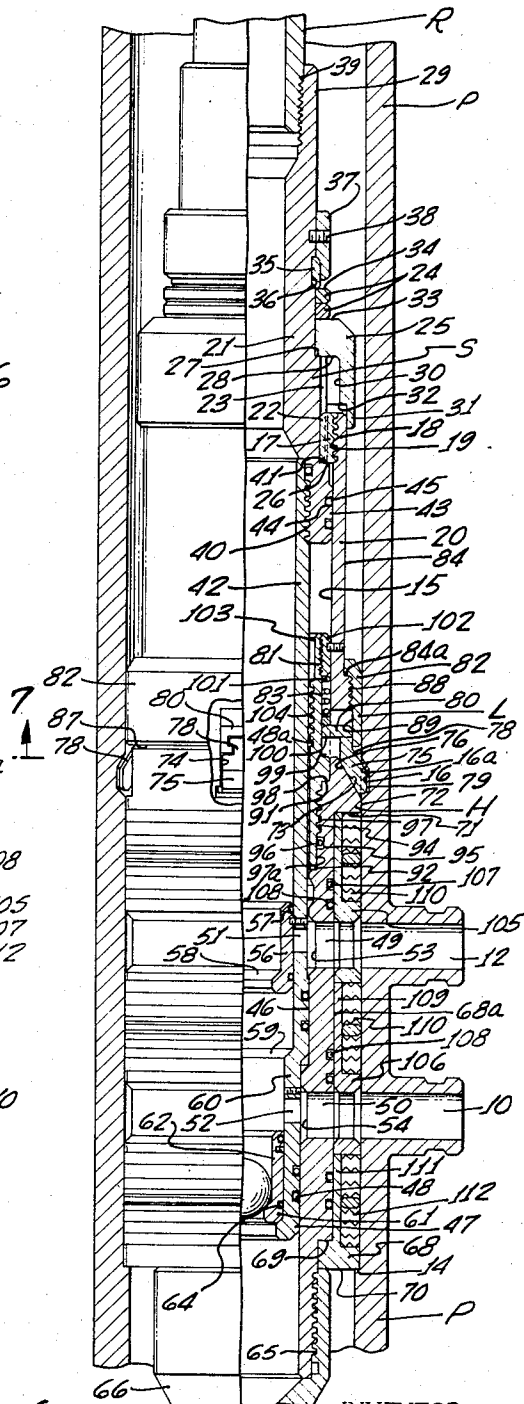


FIG. 2.

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3 Sheets-Sheet 2

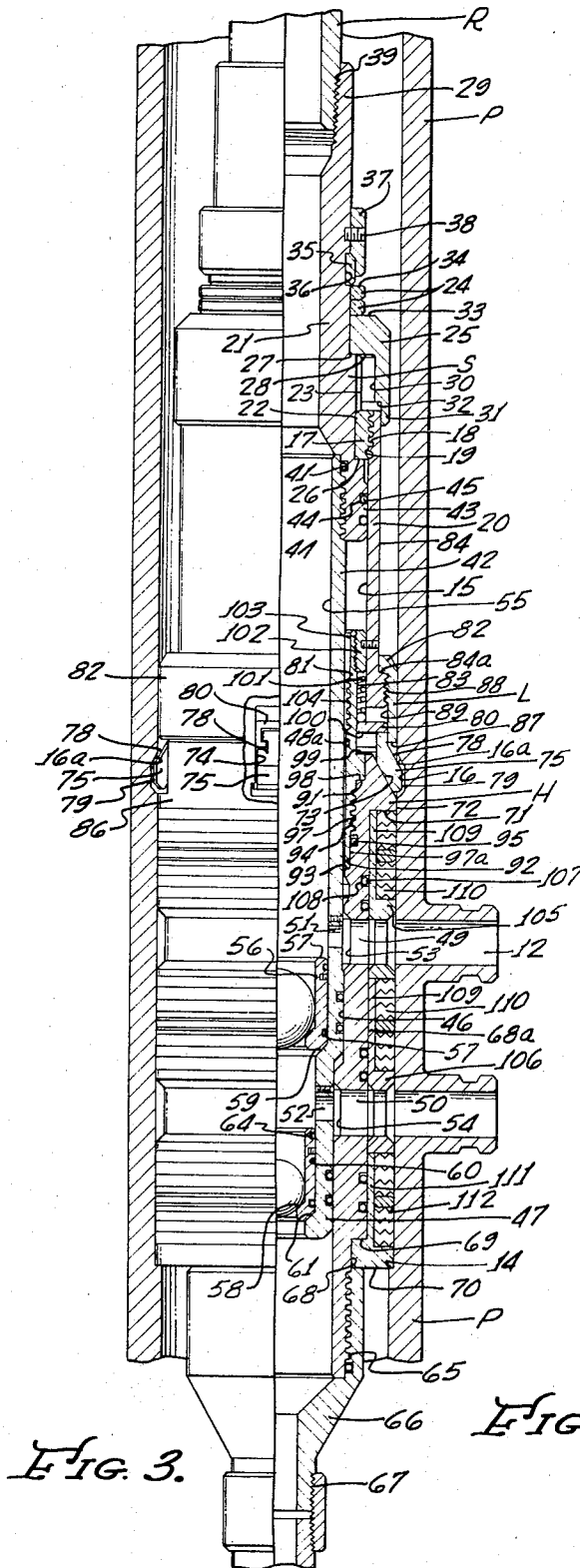


FIG. 3.

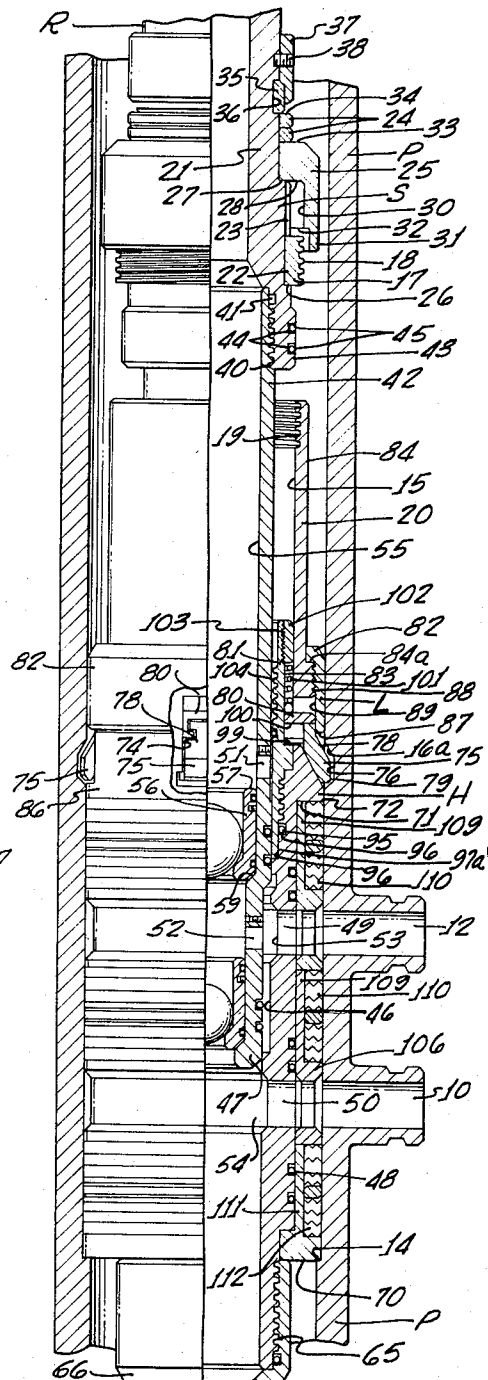


FIG. 4.

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3 Sheets-Sheet 3

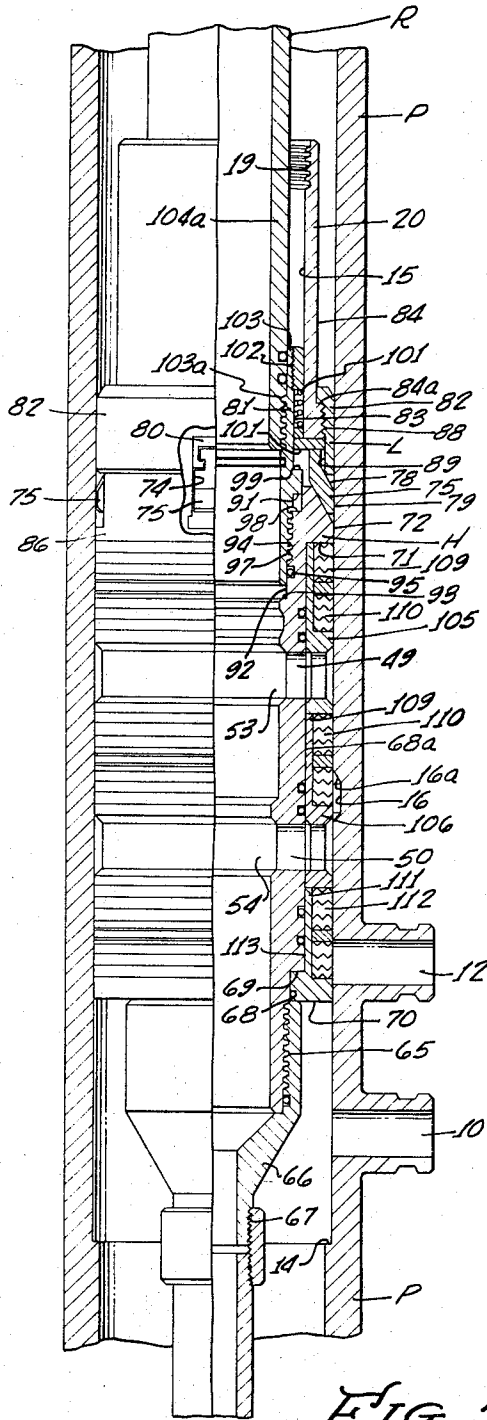


FIG. 5.

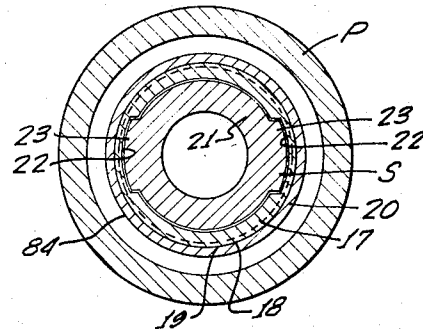


FIG. 6.

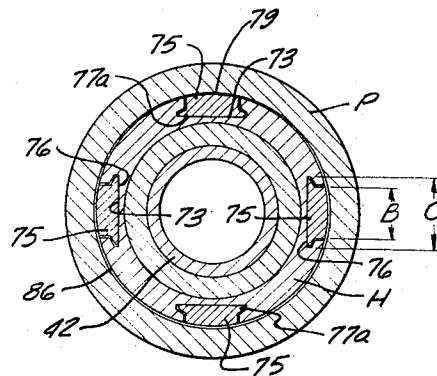


FIG. 7.

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TUBING HANGER AND METHOD OF TESTING PACKING THEREON

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Filed June 30, 1965, Ser. No. 468,377
10 Claims. (Cl. 166—6)

ABSTRACT OF THE DISCLOSURE

This application describes an underwater well head which is produced through side outlets in a production mandrel with tubing hung within the production mandrel on a tubing hanger which is automatically locked into position independent of well pressure when the tubing hanger reaches a pre-determined point by locking dogs which are held in a production mandrel internal shoulder with an inclined surface of the tubing hanger. The application also includes means for remotely testing the fluid seals in the production head annulus by dropping a ball through the tubing hanger hose to selectively isolate the seal being tested.

This invention relates to an apparatus for use at offshore wells and pertains more particularly to a tubing hanger and setting tool assembly for hanging a tubing string in a production head located adjacent the ocean floor and for sealing off the annulus between the tubing hanger and the production head in a manner to direct flow from the tubing to a side outlet on the production head, as shown in the copending applications Ser. No. 100,411, "Submarine Drilling and Production Head and Method of Installing Same," filed April 3, 1961, C. E. Wakefield, Jr., and Ser. No. 310,203, "Tubing Head Apparatus and Method," filed Sept. 20, 1963, C. C. Brown and C. E. Wakefield, Jr.

Various designs are now in use for accomplishing the above purposes; however, the tubing hanger mechanisms have been complicated and often require intricate manipulation of the tubing strings to operate and also require extra trips into the hole to actuate the hanger. In the existing designs no provisions have been made for testing the packing until after the well is completed. If a leak is discovered after the well is completed, expensive reworking of the well is required.

It is therefore one object of this invention to provide a compact and relatively simple hanger mechanism that will automatically latch and anchor the tubing hanger in the hole upon indexing the latch dogs with an annular groove in the production head.

Another object of this invention is to provide a tubing hanger that will be automatically latched by merely setting the hanger down on its landing shoulder in the production head and that can be checked for holding by merely picking up on the running string.

Still another object of this invention is to provide a means or method of testing the packings of the tubing hanger selectively before completing the well.

Other objects and a more complete understanding of our present invention may be had by reference to the following specification taken in conjunction with the appended claims and the drawings, wherein:

FIG. 1 is a view, partly in section and partly in elevation, showing the tubing hanger as it is lowered into the hole by the setting tool and just prior to landing against the indexing shoulder in the production head;

FIG. 2 is a view, partly in section and partly in elevation, showing the tubing hanger landed and latched into the production head and also showing the lower packer

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testing valve shifted to a position to test the two lowermost packings;

FIG. 3 is a view similar to FIG. 2 showing the upper packer testing valve shifted to a position to test the two uppermost packings;

FIG. 4 is a view, partly in section and partly in elevation, showing the setting tool being removed from the tubing hanger;

FIG. 5 is a view, partly in section and partly in elevation, showing the tubing hanger being released and removed from the hole with a releasing tool;

FIG. 6 is a transverse sectional view taken at 6—6 of FIG. 1;

FIG. 7 is a transverse sectional view taken at 7—7 of FIG. 1.

Referring to the drawings generally, a production mandrel P is attached at its lower end to a casing string (not shown) cemented in the hole. H designates a tubing hanger to be landed in the production mandrel P, the primary purpose being to hang a tubing string for producing oil or gas through its bore and to direct this flow through the lower outlet 10 of the production mandrel. Outlet 10 may be connected by a flexible hose (not shown) to a flow line or to a nearby storage facility. Outlet 12 is provided to communicate with the bore of a subsequent smaller tubing string (not shown) that is landed by its tubing hanger inside the tubing hanger H by the same means as the larger tubing hanger which will hereinafter be explained. A third outlet (not shown) may also be provided, as in the aforementioned copending applications, to communicate with the tubing-casing annulus.

Referring to the drawings more specifically, FIG. 1 shows the tubing hanger H being run in the hole on the running string R connected to a setting tool S just prior to landing the tubing hanger on its shoulder 14 in the production mandrel. The latch means L at this point is retracted inside the bore of the production mandrel just prior to expanding outwardly into the annular groove 16 provided in the production mandrel to anchor the hanger therewith. FIG. 2 shows the position of the assembly after the latch means 75 has expanded into groove 16 and the tubing hanger anchored in the production mandrel against downward movement because the tubing hanger is landed against shoulder 14 in the production mandrel, and against upward movement due to the expansion or biasing of the latch dogs 75 into the annular groove 16 of the production mandrel, and the fact that dogs 75 are locked in groove 16 by cone head 9.

The setting tool S is attached to the tubing hanger by the means of a floating nut 17 which is threaded on its outside diameter with an acme left-hand thread 18 and is connected to a mating left-hand box thread 19 cut in the body 20 of the tubing hanger. The engagement of spline grooves 22 in floating nut 17 with mating splines 23 cut in the setting tool body connect the floating nut 17 to the setting tool body 21. Enough axial movement is designed into the length of the splines 23 to allow limited axial movement of the floating nut so that during the release of the setting tool from the tubing hanger, the weight of the tubing may be applied to bearing 24 and thence through thimble 25 against the top of body 20. This construction allows the floating nut to be rotated out of engagement with the tubing hanger without any axial load against the connecting threads. The limits of the axial movement of the floating nut on the setting tool body are fixed by shoulder 26 formed at the lower ends of splines 23 and by the counterbore face 28 of the thimble 25 which is mounted on the body 21 abutting shoulder 27 which is formed by a reduced diameter section 29 formed on the upper section of the body 21. The

thimble 25 is a cylindrical shaped member having a bore that has enough clearance to slip over the reduced section 29. The lower end of the thimble is counterbored at 31 to form a shoulder 32 which abuts the upper face of the body 20 when the setting tool and the tubing hanger are assembled together. Another counterbore 30, smaller than counterbore 31 is provided in the lower bore of the thimble to define shoulder 27. Shoulder 28 of the thimble abuts shoulder 27 on the body 21 when assembled. When the thimble is thus assembled on the body 21, bearings 24 are mounted about the reduced section 29 to bear against the upper face 33 of the thimble. Just above upper face 34 of the bearings a snap ring 35 is mounted in groove 36 to retain the bearings and the thimble in place. To insure that the snap ring stays in its groove a retainer ring 37 having a downwardly facing counterbore is slipped over the reduced section 29 and set screwed 38 to the body with the counterbore extending over and confining the snap ring from expanding out of its groove 36.

Provided in the bore of body 21 at the upper end is a box thread 39 for attaching the running pipe R. A box thread 40 and suitable seal 41 are provided in the bore of the lower end of the setting tool body 21 in order to attach the extension member 42 to the body 21. Below shoulder 26 of the body is a slightly enlarged diameter surface 43 which fits closely inside the bore of the body 20. Seals 45 may be provided in grooves 44 in the enlarged diameter surface 43 to seal off the setting tool 21 within the tubing hanger body 20.

The extension member 42 is a tubular member extending downwardly from the threaded connection 40 to the setting tool body. The outside diameter of the extension member fits closely within the bore 46 of the tubing hanger body while the lower end of the extension member has a reduced diameter 47 to fit closely in the lower reduced bore of the tubing hanger body 20. Suitable seals such as 48 and 48a are provided either in the extension member or the bore of the tubing hanger body to seal off the extension member with the tubing hanger body on all sides of the lateral openings 49 and 50 in the tubing hanger body 20. Ports 51 and 52 are provided in the extension member to index axially with the lateral ports 49 and 50 in the tubing hanger body. Annular grooves 53 and 54 are provided in the bore of the body 20 indexed with the lateral openings to provide a bypass for fluid flow from ports 51 and 52 to ports 49 and 50, respectively, when the ports are circumferentially out of index. The upper end of the extension member is counterbored at 55 to a point lower than port 51, e.g. shoulder 59, and provided therein is a sleeve 56 shear pinned in place to cover port 51. Suitable seals as 57 are provided to seal off the port from the bore of the extension member on both sides of the port. The upper end of the sleeve 56 is counterbored to define shoulder 58. Shoulder 58 provides a seat for a ball, the purpose of which will hereinafter be explained. Below shoulder 59 is counterbore 60 and shoulder 61 adjacent the lower end of the extension member. A sleeve 62 similar to sleeve 56 but with a smaller bore and counterbore than sleeve 56, is provided within counterbore 60. A ball may thus drop through the bore of sleeve 56 and seat on shoulder 63, as will be hereinafter explained. This sleeve 62 has suitable seals 64 to seal off the port 52 with the bore of the extension member.

As previously explained, the top of the tubing hanger body is provided with an acme box thread 19 for attaching to the setting tool. The lower end of the body is provided with a male thread 65 for attaching thereon a reducer bushing 66. Bushing 66, at its lower end, has a male thread 67 for attaching production tubing therebelow. A land 68 of a diameter the same as thread 65 is provided a short distance above thread 65 to provide a place to retain the lower seal body 70 between shoulder 69 defined by the land 68, and the top of the reducer

bushing 66 when it is assembled on the tubing hanger body. Above land 68 a slightly larger diameter 68a than land 68 is provided up to shoulder 71 to provide a section to mount the seal bodies. Above shoulder 71 the diameter of the tubing hanger body is of a diameter 72 to fit closely inside the bore 15 of the production mandrel P. A short distance above shoulder 71, leaving room for the inclined surfaces 73, a plurality of rectangular shaped windows 74 are milled through the diameter 72 into the bore of the tubing hanger body 20. Between the lower edges of these windows at a point just above shoulder 71 a plurality of flat inclined surfaces are milled the same width and in registry with the windows 74. Dove-tail guides 77a are provided to a width C indicated in FIG. 7 to act as retainers for the dogs 75 that are mounted on the inclined surface 73. The dogs 75 are provided with mating inclined surfaces 76 and the width of the dogs have a width to give clearance inside the width of the windows 74 and inclined surfaces 73. The mating dove-tails 77 on the inclined sides of the dogs (FIG. 7) also fit into the dovetails 77a of the inclined surfaces cut in the tubing hanger body. The outside diameter of the dogs have an arcuate surface 79 of substantially the same diameter as the annular groove 16. At approximately the middle of the dogs a conically shaped outside surface 78 is provided. This surface mates with the inwardly inclined end-wall 16a of the annular groove 16 when the dogs are in the expanded position shown in FIG. 2. The upper ends of the dogs 75 are provided with T-heads over which are inserted, from the outside after the dogs are assembled on their respective inclined surface, T-slot members 80. The T-slot members are designed in width to have clearance within the side-walls of the rectangular shaped windows 74. The outside diameter of these members is arcuate and smaller than the bore of the production mandrel to allow a retainer 82 to be installed over them to retain them in the tubing hanger body. The inside diameters of the T-slot members are arcuate and slide over the tubular surface 83 of a releasing member 81. The length of the windows is longer than the length of the T-slots so as to allow limited axial movement of the T-slots within the windows designed to allow expansion and retraction of the dogs upon their respective inclined surfaces.

To provide a place to install the aforementioned retainer 82, as shown in FIG. 3, a reduced diameter section 84 is turned on the upper outside diameter of the tubing hanger body 20 to a distance downward to shoulder 84a. Below shoulder 84a a slightly larger diameter 86 is provided downward to the bottom surface 87 of retainer 82. Retainer member 82 is installed on the tubing hanger body with a male thread and a mating box thread 88. The downward facing counterbore of the thread 88 extends to and abuts the T-slot member 80. Installed in this manner, the counterbore 89 extends over the T-slot members and retains them in the tubing hanger body against radial outward movement. Radial inward movement of the T-slot is prevented by the releasing member 81 which is installed in the bore of the tubing hanger body behind the rectangular windows 74.

The tubing hanger body is counterbored at substantially the same bore as the box acme thread 19 to a point below the rectangular windows 74. This counterbore leaves a shoulder 91 below which a smaller counterbore 92 is provided to define shoulder 93. Counterbore 92 is threaded with a left-hand acme thread 94. A groove 95 is provided in counterbore 92 below the thread 94 in which is provided a suitable seal 96 to seal off with the turned end 97a of male thread 97 which is to be made up in the female thread 94. The male thread 97 is provided on the lower end of the releasing member 81. A shoulder 98 above the male thread 97 lands against shoulder 91 in the tubing hanger body. Above shoulder 98 a reduced diameter surface 83 is provided defining shoulder 99. Shoulder 99 is flush with the lower surfaces of

the windows 74 when the releasing member is made up in its thread in the tubing hanger body. An annular bearing ring 100 is mounted about the reduced diameter surface 83. The lower face of the bearing ring rests against the upper face of the T-slot member 80. Coil spring 101 is mounted about the reduced diameter surface above the bearing ring with its lower coil resting against the upper face of the bearing ring. The coil spring is compressed and retained on the releasing member 81 by a retainer nut 102 which is threaded to the upper outside diameter of the releasing member assembled as described above, the spring urging the T-slot member downward, thus pushing or biasing the dogs downward and outward upon their respective inclined surfaces, into locking position in groove 16.

The upper bore of the releasing member is counter-bored at 103 and right-hand threaded 104 to provide a means of releasing the latch assembly. When it is desired to release the tubing hanger from the production head the releasing tool 104a is run into the tubing hanger. The lower end of this tool is threaded with a right-hand thread 103a so that it may be connected to the releasing member by right-hand rotation. When the tool is fully made up and rotation continues, the releasing member 81 will begin rotating. Since the threads 94 in the releasing tool are left-hand, this rotation will cause the member to move upward in relation to the tubing hanger causing the shoulder 99 on the releasing member to force the T-slot member upward. This movement will cause the dogs to be drawn upward as they are connected to the T-slot member by their T-head, and this causes the dogs to retract. The tubing hanger may then be pulled from the hole suspended from the thread on the releasing tool. The upper end of the releasing tool (not shown) is provided with a box thread for connecting to the running pipe.

Directing our attention again to the lower end of the tubing hanger, a series of seal carriers such as 105 are provided about the surface 68a for the purpose of sealing off the tubing hanger body with the production mandrel bore and to provide lateral openings in registry with the lateral opening in the production mandrel and the extension member. Seal carrier 105 is an annular member having an outside diameter for clearance inside the production mandrel and an inside diameter to clear surface 68a of the tubing hanger. The upper end of this member has a reduced diameter 109 to provide a place to mount seal 110 to seal off between the production mandrel and the seal carrier against pressure differentials both from above and below. Grooves similar to 108 are cut in the tubing hanger body and provided with suitable seals 107 to seal off between the hanger body and the seal carriers. These seals are provided on all sides of the lateral openings so that flow in those openings will be confined thereto. The lower thick portion of the seal carriers 105 is provided with lateral openings in registry with openings 51 and 52. The outside diameter and inside diameter adjacent these openings are provided with annular grooves to provide flow between the lateral openings of the various members if circumferentially out of registry. Abutting the lower face of seal carrier 105 is member 106 which is identical in structure and function as seal carrier 105 except member 106 has lateral openings in registry with openings 10 and 52. Abutting the lower end of seal carrier 106 is seal carrier and retainer member 70. The upper outside diameter 111 is reduced to provide a place to mount seal 112 which seals off between the production mandrel and the seal carrier. Seals similar to 107 seal off this counterbore with the tubing hanger body surface 68a. Carrier 70 is retained on the tubing hanger body as the reducer bushing 66 makes up against the lower surface of carrier 70 and shoulder 69a of the carrier stopped against shoulder 79 of the tubing hanger body.

In the use of the apparatus shown in FIGS. 1-5, the

apparatus is run in the hole connected to the running pipe R until the shoulder 14a of the tubing hanger lands against shoulder 14 of the production mandrel P. At this time the spring loaded dogs 75 will latch into the annular groove 16 so that the inclined surface 16a will retain the tubing hanger from moving upward because the shoulders 78 of the dogs are retained against shoulder 16a by the conical surface 9 of the tubing hanger.

Although not shown herein, additional tubing strings can be hung within the production head, either concentrically within the tubing T, as shown in copending application Ser. No. 100,411, filed April 3, 1961, of Charles E. Wakefield, Jr., or parallel thereto.

After landing the apparatus in the production mandrel it is important to test the packings of the apparatus. The packings around the lower lateral openings are tested by dropping a ball through the running pipe and pumping it to the seat 63 in the lower sleeve 62. Pressure is then applied through the running pipe against closure effected by the ball sealed in the sleeve seat. This will cause the shear pins 62a to shear and the sleeve will shift downward until stopped by shoulder 61 on the extension member. This will open ports 52 and allow the pump pressure to be directed through the lower lateral openings. With a valve at the surface connected by a flexible hose to lateral opening 10 closed, and with a similar valve connected to opening 12 open, the running pipe is pressured. Returns through opening 12 indicates that the packing above the opening 10 is leaking. If no leak is detected, the valves on both 10 and 12 are closed at the surface and the running pipe pressured up again. If the pressure, as determined by means of a pressure gage connected to the running pipe at the surface, remains constant, the packing below the lateral opening 10 must be holding.

In order to test the packings on both sides of lateral opening 12 (the upper opening) a larger ball is dropped and pumped to seat at 58 in the upper sleeve 56. Pressure in the running string will shear pins 56a and the upper lateral opening 12 will be opened by the movement of sleeve 56 past opening 51. With the external valve (not shown) on port 12 closed and the valve on port 10 open, the running pipe is pressured. If there are no returns through opening 10, the packing below lateral opening 12 is holding. A valve is then opened on the annulus between the running pipe and the casing riser to determine whether there are any returns through the annulus between the running pipe and the production head which would indicate that the upper packings are leaking.

After testing and determining that the packings are holding, the setting tool S may be released from the tubing hanger. With enough weight of the running pipe slacked off on bearing 33 so that there is no upward strain of shoulder 26 on the traveling nut 17, we commence right-hand rotation of the running pipe. This will rotate the setting tool within the tubing hanger. Since the setting tool body is splined to the traveling nut, it will also be rotated and will move upward on the splines 23 and into the counterbore 30 of the thimble 25. When the traveling nut is disengaged from the tubing hanger, it is only necessary to pick up on the running string to pull the extension member from the bore of the tubing hanger and release the setting tool from the tubing hanger.

Although our present invention has been described with a certain degree of particularity, the scope of the invention is not limited to the details set forth, but is the full breadth of the appended claims.

I claim:

1. An underwater tubing head apparatus for producing a well drilled in a formation underlying a body of water, comprising in combination:

a first tubular member having a side outlet and a second tubular member having a side outlet in axial registry with the side outlet of said first tubular member, said second tubular member being disposed within said first tubular member,

means including a locking member for automatically locking said second tubular member against axial movement as said second tubular member is lowered to a position where said side outlet of said second tubular member are in axial registry with said side outlet of said first tubular member,

means for biasing said locking member to locking position, and

means independent of well pressure engageable with said locking member to hold said locking member in said locking position.

2. An underwater tubing head apparatus for producing a well drilled in a formation underlying a body of water, comprising in combination:

a first tubular member having a side outlet and an internal shoulder,

a second tubular member having a side outlet adjacent the side outlet of said first tubular member, said second tubular member being disposed within said first tubular member and of a configuration to form an annulus between said first and second tubular members, said second tubular member being arranged and constructed to hang a tubing string thereon within said well,

means for sealing said annulus about said outlets,

locking means arranged with said second tubular member to move outwardly into locking relationship in said first tubular member shoulder automatically as said second tubular member is lowered into a position where the side outlets of said second tubular member are in axial registry with the side outlets of said first tubular member, and said locking means having a surface inclined from the vertical and engaging a mating incline surface on said second tubular member, said locking means being arranged and constructed to move on said mating inclined surface into locking engagement with said shoulder of said first tubular member.

3. The apparatus of claim 2 wherein said locking member is dovetailed and engages mating dovetailed grooves on said mating inclined surface of said second tubular member.

4. An underwater tubing head apparatus for producing a well drilled in a formation underlying a body of water, comprising in combination:

a first tubular member having a side outlet and an internal shoulder,

a second tubular member having a side outlet adjacent said side outlet of said first tubular member, said second tubular member having means for connecting a tubing string thereto and being disposed within said first tubular member and of a configuration such that an annulus exists between said first and second tubular members, means for sealing said annulus about said outlets, a T-head locking member arranged with said second tubular member to move into locking relationship in said first tubular member shoulder automatically as said second tubular member is lowered into a position where the side outlets of said second tubular member are in axial registry with the side outlets of said first tubular member, said second tubular member having an opening therein and an outwardly tapered surface at the lower portion of said opening, said locking member having an inclined surface mating said tapered surface of said locking member whereby said locking member may move outwardly on said tapered surface through said opening into said shoulder of said first tubular member when said side outlets are axially registered,

T-slot means engaging said T-head locking member, said T-slot member being spring biased downwardly to urge said locking member outwardly, and

means for moving said T-slot member upwardly with respect to said second tubular member to retract said locking members from said shoulder.

5. An apparatus for remotely testing seals in an underwater production head in the annulus between a production mandrel and a tubing hanger mandrel supported therein, around longitudinally indexed lateral openings in said mandrels, the combination comprising:

a tubular member having a lateral port therein,

means for supporting said tubular member within said tubing hanger mandrel with said port longitudinally indexed with said lateral openings,

a sleeve positionable within said tubular member and having a sealing seat in the bore thereof,

means for affixing said sleeve to said tubular member in a position to cover said lateral port and thereby close the interior of said tubular member to said lateral openings, said seat arranged and constructed to receive a sealing member dropped through said tubular member to seal off said sleeve and said tubular member below said seat,

means for pressurizing said tubular member sufficiently to move said sleeve downwardly thereby uncovering said port and opening said indexed lateral openings to the interior of said tubular member,

means below said lateral port for supporting said sleeve in said tubular member in said uncovered position, and

means for exteriorly closing said production mandrel lateral opening.

6. The apparatus of claim 5 for testing a production head apparatus having a second pair of longitudinally indexed lateral openings in said mandrels including a second lateral port in said tubular member longitudinally indexed with said second openings and a second sleeve affixed to said tubular member adjacent said second lateral port to cover said port and thereby close off the interior of said tubular member to said second lateral openings, said second sleeve having a sealing seat therein larger than the sealing seat of said first sleeve, said seat arranged and constructed to receive a second larger sealing member dropped through said tubular member to seal off said second sleeve and said tubular member below said seat, and means in said tubular member between said lateral ports for supporting said second sleeve in said uncovered position.

7. An apparatus for remotely testing seals in an underwater production head in the annulus between a production mandrel and a tubing hanger mandrel supported therein, around longitudinally indexed lateral openings in said mandrels, the combination comprising:

a tubular member having a lateral port therein,

means for supporting said tubular member within said tubing hanger mandrel with said port longitudinally indexed with said lateral openings,

a sleeve positionable within said tubular member and having a sealing seat in the bore thereof,

shear pin means for affixing said sleeve to said tubular member in a position to cover said lateral port and thereby close the interior of said tubular member to said lateral openings, said seat arranged and constructed to receive a sealing member dropped through said tubular member to seal off said sleeve and said tubular member below said seat,

means for pressurizing said tubular member sufficiently to shear said shear pin means and move said sleeve downwardly thereby uncovering said port and opening said indexed lateral openings to the interior of said tubular member,

means below said lateral port for supporting said sleeve in said tubular member in said uncovered position, and

means for exteriorly closing said production mandrel lateral opening.

8. A method for remotely testing the seals in an underwater production head annulus between the tubing hanger mandrel and a production mandrel in which said tubing

hanger mandrel is supported, around a lateral opening in said production mandrel and a lateral opening in said tubing hanger mandrel longitudinally indexed with said production mandrel opening, comprising the steps of:

5 inserting a tubular member having a lateral port therein into said tubing hanger mandrel until said tubular member is seated on said tubing hanger mandrel internal shoulder and said port longitudinally indexed with said openings,
 10 said tubular member having a sleeve therein movably affixed to said tubular member adjacent said port to thereby close off said lateral openings and port to the interior of said tubular member,
 dropping a ball through said tubular member to seat in the lower portion of said sleeve and seal said tubular member against the passage of fluids below said seated ball,
 exerting pressure through said tubular member against said seated ball to move said sleeve downwardly in said tubular member thereby opening said indexed port to the interior of said tubular member,
 20 exteriorly closing said production mandrel lateral opening, exerting fluid pressure through said tubular member, determining any drop in said pressure, and subsequently determining the existence of return through said annulus.

9. A method for remotely testing the seals in an underwater production head annulus between the tubing hanger mandrel and a production mandrel in which said tubing hanger mandrel is supported, around an upper and a lower lateral opening in said production mandrel and an upper and lower lateral opening in said tubing hanger mandrel which is longitudinally indexed with said production mandrel openings, comprising the steps of:

30 inserting a tubular member having upper and lower lateral ports therein into said tubing hanger mandrel until said ports are longitudinally indexed with said lateral openings in said tubing hanger mandrel and said production mandrel,
 said tubular member having an upper and a lower sleeve therein movably affixed to said tubular member adjacent said ports to thereby close off said lateral openings and said ports to the interior of said tubular member,
 dropping a ball through said tubular member to seat in the lower sleeve and seal said sleeve against the passage of fluids below said seated ball,
 45 exerting sufficient pressure through said tubular member against said ball to move said sleeve downwardly in said tubular member past said lower port thereby opening said indexed lower lateral openings and port to the interior of said tubular member,
 exteriorly closing said production mandrel lower lateral opening,
 exerting a fluid pressure through said tubular member, detecting the presence of returns through said upper production mandrel opening,
 50 exteriorly closing said upper production mandrel lateral opening,
 exerting fluid pressure through said tubular member, detecting any drop in said pressure,
 dropping a second larger ball through said tubular member to seat in said upper sleeve,
 55 exerting sufficient pressure through said tubular member against said seated second ball to move said second sleeve downwardly in said tubular member

past said upper port thereby opening said indexed upper lateral openings and port to the interior of said tubular member,

opening said production mandrel lower opening to determine the presence of returns therethrough, and determining the existence of returns through said annulus.

10. A method for remotely testing the seals in an underwater production head annulus between the tubing hanger mandrel and a production mandrel in which said tubing hanger mandrel is supported, around an upper and a lower lateral opening in said production mandrel and an upper and lower lateral opening in said tubing hanger mandrel which is longitudinally indexed with said production mandrel openings, comprising the steps of:

inserting a tubular member having upper and lower lateral ports therein into said tubing hanger mandrel until said ports are longitudinally indexed with said lateral openings in said tubing hanger mandrel and said production mandrel,
 said tubular member having an upper and a lower sleeve therein shear pinned to said tubular member adjacent said ports to thereby close off said lateral openings and said ports to the interior of said tubular member,
 dropping a ball through said tubular member to seat in the lower sleeve and seal said sleeve against the passage of fluids below said seated ball,
 exerting sufficient pressure through said tubular member against said ball to shear the shear pin supporting said sleeve to said tubular member and thereby move said sleeve downwardly in said tubular member past said lower port thereby opening said indexed lower lateral openings and port to the interior of said tubular member,
 35 exteriorly closing said production mandrel lower lateral opening,
 exerting a fluid pressure through said tubular member, detecting the presence of returns through said upper production mandrel opening,
 40 exteriorly closing said upper production mandrel lateral opening,
 exerting fluid pressure through said tubular member, detecting any drop in said pressure,
 dropping a second larger ball through said tubular member to seat in said upper sleeve,
 45 exerting sufficient pressure through said tubular member against said seated second ball to shear the shear pin connecting said upper sleeve to said tubular member and move said second sleeve downwardly in said tubular member past said upper port thereby opening said indexed upper lateral openings and port to the interior of said tubular member,
 opening said production mandrel lower opening to determine the presence of returns therethrough, and determining the existence of returns through said annulus.

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