United States Patent [19]

Hynes

[11] **3,837,684**

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[54] **SUBSEA CASING HANGER PACK-OFF APPARATUS AND METHOD**

[75] Inventor: **Joseph H. Hynes**, Ojai, Calif.

[73] Assignee: **Vetco Offshore Industries, Inc.**, Ventura, Calif.

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[52] **U.S. Cl.** **285/3**, 285/18, 285/142, 166/87

[51] **Int. Cl.** **F16l 35/00**

[58] **Field of Search** 285/3, 143, 140, 144, 142, 285/18, 24, 27; 166/88, 87, 124, 181, 182, 196

[56] **References Cited**

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3,404,736	10/1968	Nelson et al.	285/142 X
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Primary Examiner—Dave W. Arola

Attorney, Agent, or Firm—Bernard Kriegel

[57] **ABSTRACT**

A casing hanger carries a follower and a packing assembly releasably secured to the follower, the combination being lowered on a tubular running string from a drilling rig floating in water and landed in a wellhead, the running string then being removed. A setting tool is then lowered from the rig on a tubular running string into engagement with the packing assembly to release it from the follower, the setting tool and running string imposing downweight on the packing assembly to release it from the follower and expand it into sealing engagement with the wellhead and casing hanger, after which the follower is shifted into locking or holding engagement with the expanded packing assembly. The effectiveness of the seal can be pressure tested, the pressure imposed exerting an additional downward force on the packing to apply an additional pack-off force on the packing assembly, the follower being further movable into locking or holding engagement with the expanded packing assembly.

26 Claims, 6 Drawing Figures

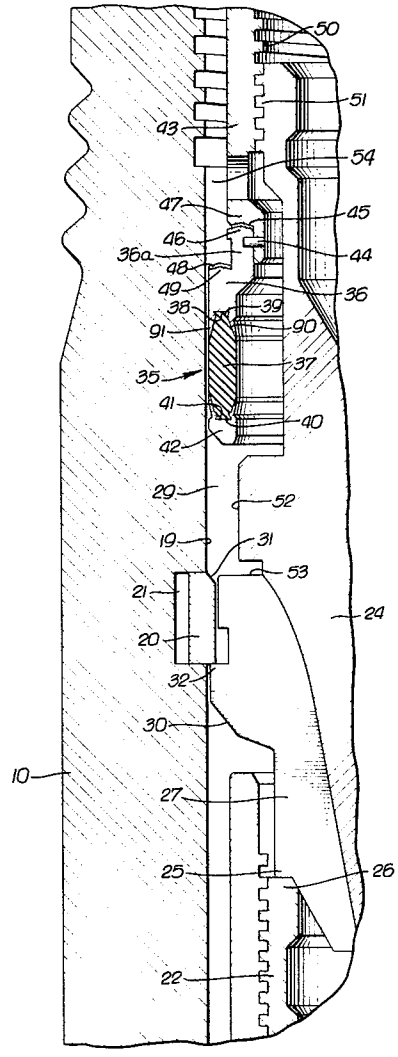


FIG. 1.

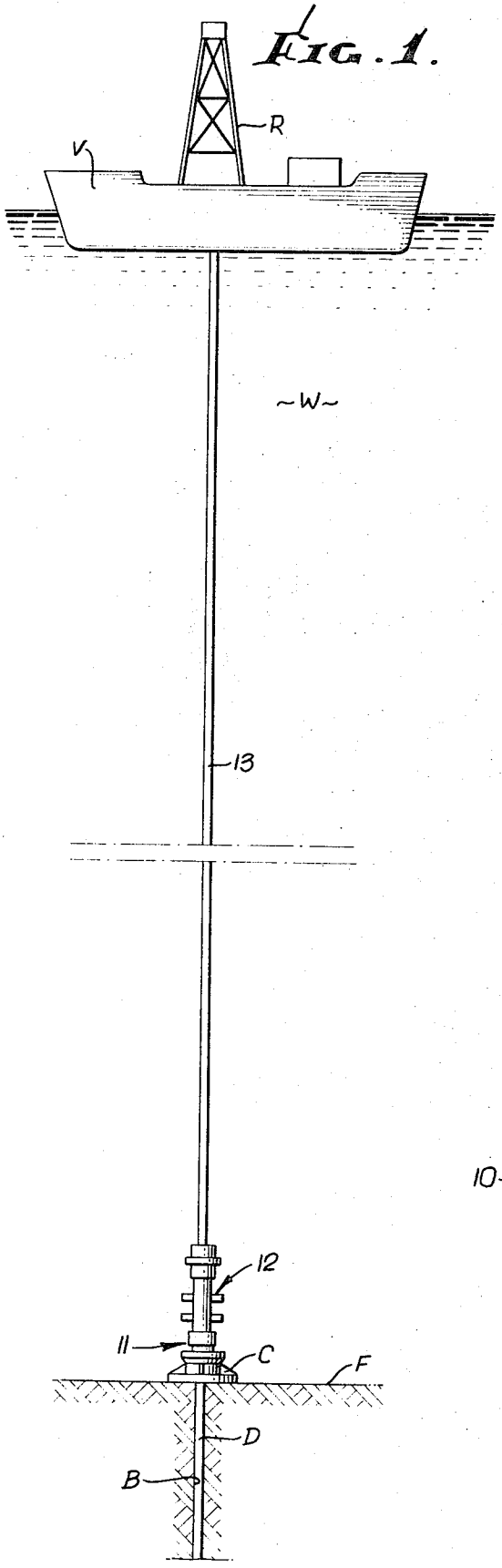

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FIG. 3.

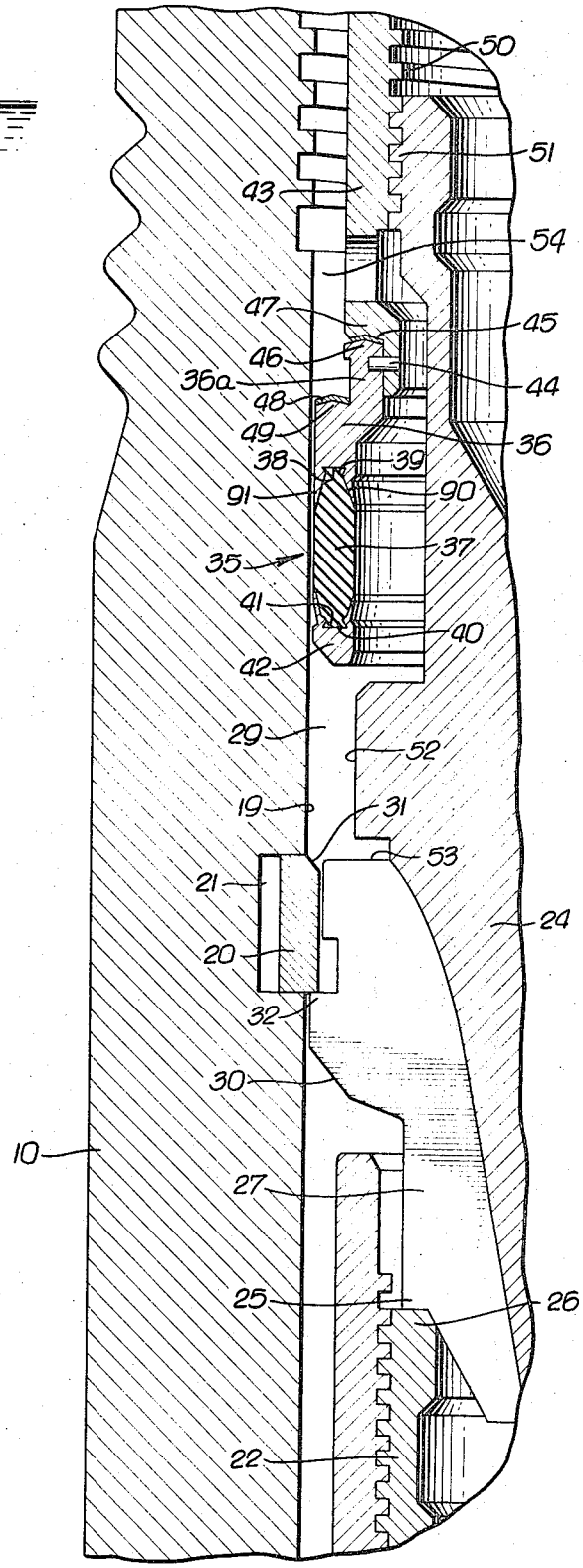

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FIG. 2.

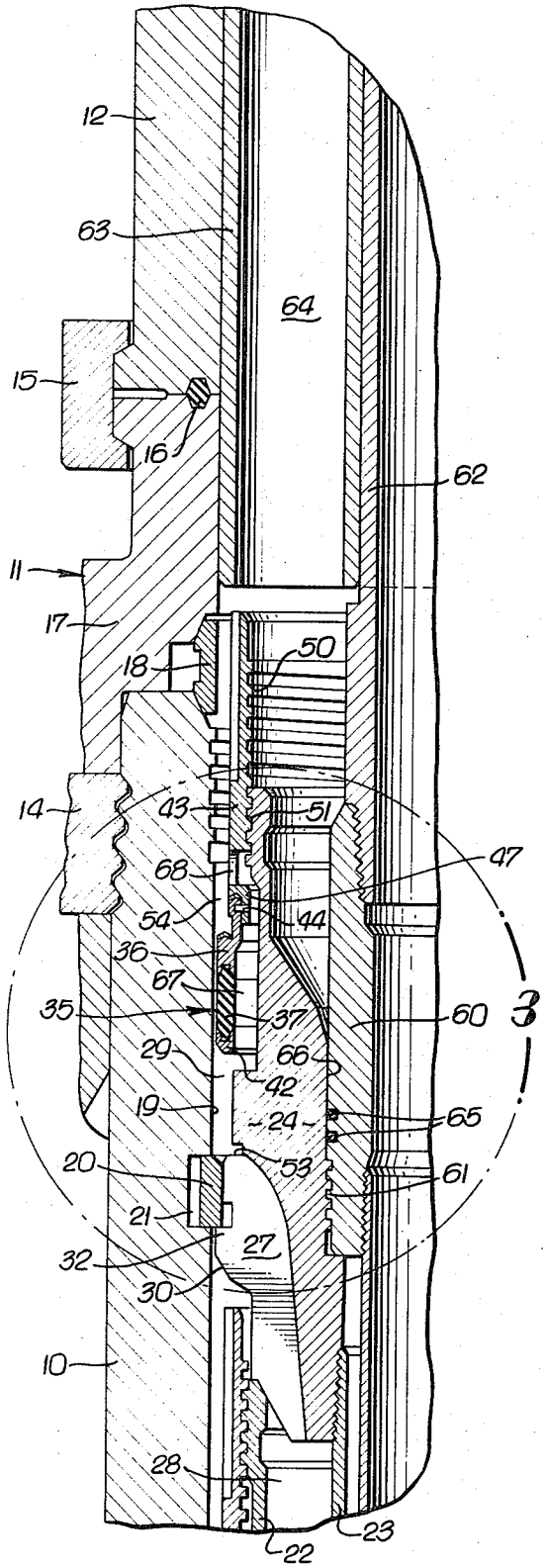

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FIG. 4.

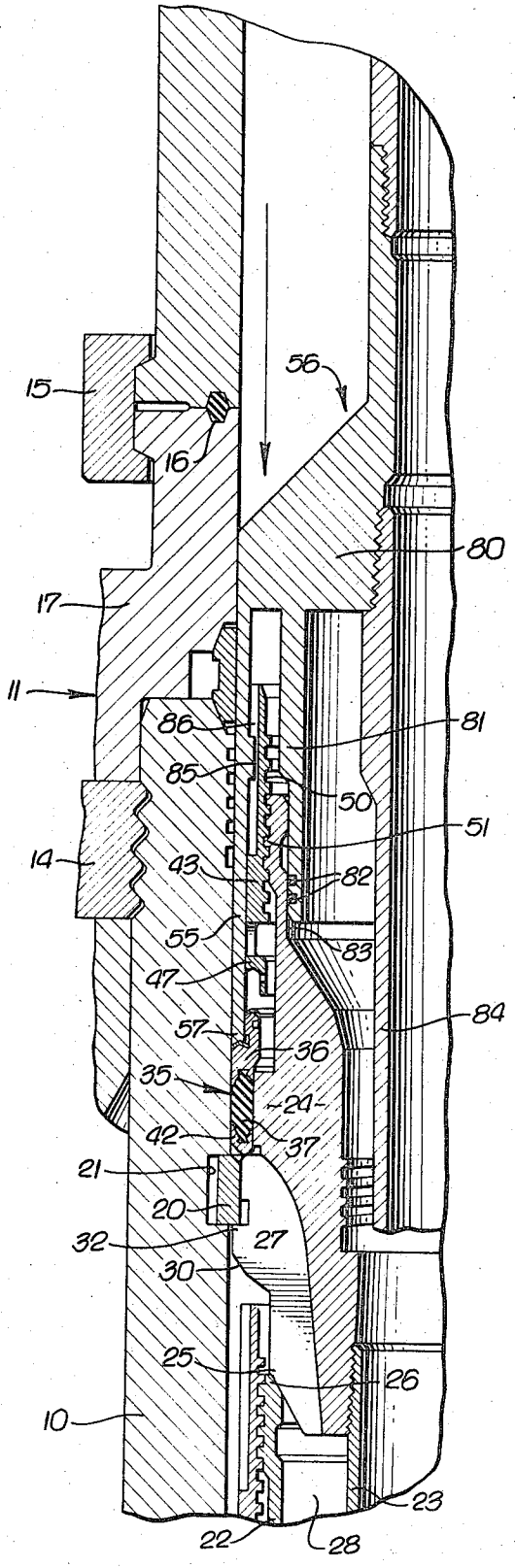

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FIG. 5.

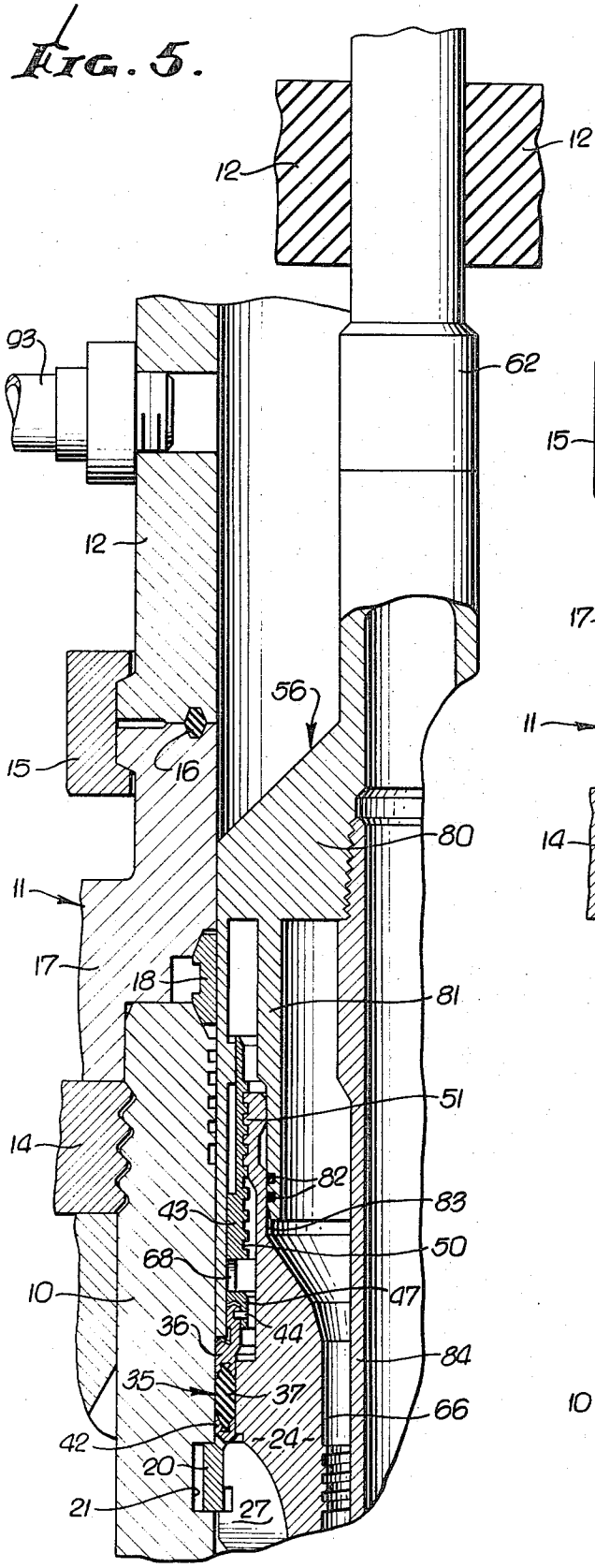
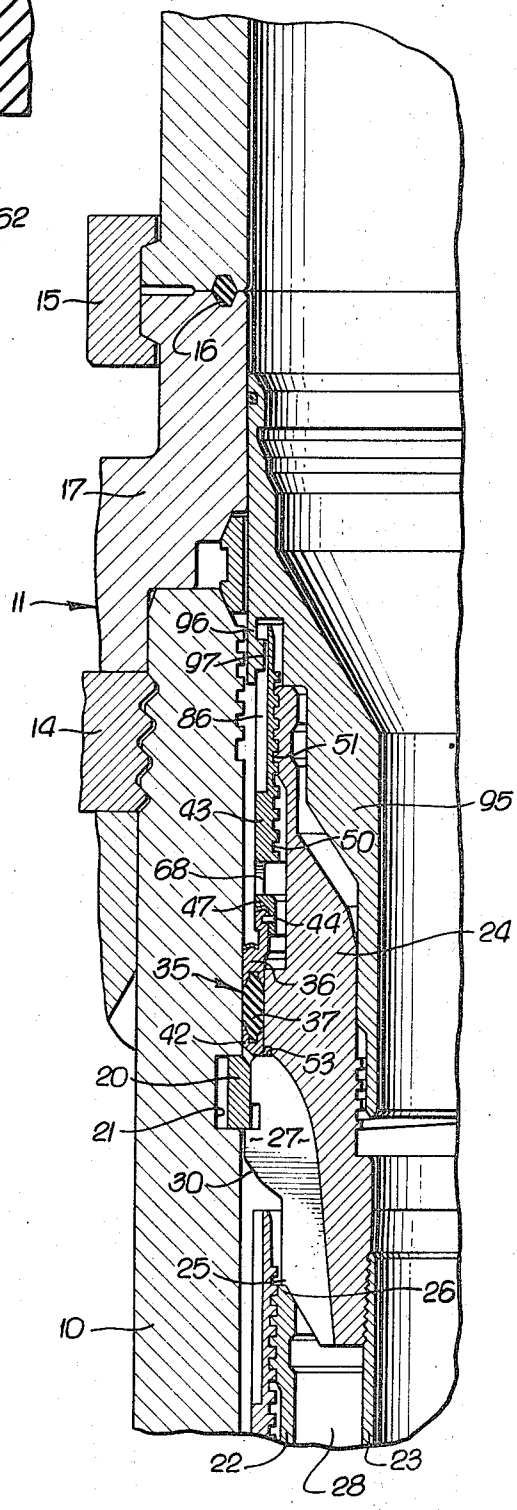

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FIG. 6.


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SUBSEA CASING HANGER PACK-OFF APPARATUS AND METHOD

The present invention relates to underwater well bore equipment, and more particularly to casing hangers adapted to be installed in a wellhead at the floor of an ocean or other body of water.

A casing hanger apparatus of the type shown and described in U.S. Pat. No. 3,492,026 is lowered to and landed in an underwater wellhead, after which a packing assembly is expanded into engagement with the casing hanger and wellhead to effect a pack-off or seal therebetween by applying torque to a nut or follower member threadedly mounted on a casing hanger body. This action effects a squeeze on an elastomer packing element, to shorten its length and force it laterally into sealing engagement with the casing hanger body and the subsea wellhead.

Although the apparatus illustrated in the above patent has proved successful, such success might become less assured as the size of the packing assembly increases, the working pressure increases, and the water depths increase in which drilling operations are occurring.

By virtue of the present invention, an improved subsea casing hanger pack-off apparatus and a method of operating the same are provided in which successful operation of the packing assembly into appropriate sealing engagement with the casing hanger body and surrounding subsea wellhead housing is assured. The pack-off of the assembly against the wellhead housing and the casing hanger is secured through the direct application of downweight thereon, and without the necessity for transmitting torque through a tubular running string onto the assembly. The pack-off force can be further increased merely by the direct application of fluid pressure, such as that imposed in the annulus surrounding the tubular running string and below the blowout preventers in testing the efficacy of the seal, the additional pack-off force being retained by moving a suitable follower downwardly against the packing assembly.

An apparatus is provided in which the packing assembly and follower can be lowered together with the casing hanger from the drilling rig to the subsea wellhead housing, assurance being had that such assembly and follower will be in appropriate relation to the casing hanger body when the latter is landed in the wellhead. The packing assembly is released from the follower merely by the downward application of weight through a tubular running-in string and the setting tool attached thereto, the setting tool bearing against the packing assembly. This setting tool is also placed in appropriate relation to the follower, which may comprise a nut threaded onto the casing hanger body. The nut is rotatable through the running string and setting tool toward and into engagement with the packing assembly after the latter has been packed-off between the hanger body and the wellhead housing. In the event an additional pack-off has been secured when the blowout preventers are closed around the running string, and fluid pressure is imposed on the assembly in the annulus surrounding the running string, the follower nut can be further rotated by the running string to ensure its contact and blocking engagement with the upper portion of the pack-off assembly. When assurance is had that the desired pack-off has been achieved, the running tool and setting tool can be readily removed and elevated to the derrick.

This invention possesses many other advantages and has other purposes which may be made more clearly apparent from a consideration of a form and method embodying the invention. This form and method are shown and described in the present specification and in the drawings accompanying and constituting a part thereof. They will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense.

Referring to the drawings:

FIG. **1** is a diagrammatic view of a well bore underlying a body of water and associated apparatus extending from the ocean floor to a drilling vessel floating in the water thereabove;

FIG. **2** is a quarter longitudinal section through casing hanger apparatus embodying the invention and landed in a surrounding wellhead body or housing, the parts being illustrated in the initial condition which they occupy during lowering from the drilling rig and preparatory to pack-off of the assembly between the casing hanger and surrounding wellhead housing;

FIG. **3** is an enlarged view of the encircled region marked "3" in FIG. **2**;

FIG. **4** is a view similar to FIG. **2** disclosing the packing assembly packed-off between the casing hanger body and the surrounding wellhead housing;

FIG. **5** is a view similar to FIG. **4** disclosing the follower nut having been rotated into holding engagement with the packing assembly therebelow, the apparatus being arranged for performing a pressure test to test the pack-off; and

FIG. **6** is a view similar to FIG. **5** with the setting tool portion of the apparatus removed and the casing hanger pack-off operation completed, a suitable wear member having been installed in place.

As illustrated in the drawings, a well bore B is being drilled, underlying an ocean or other body of water W, the well bore extending downwardly from the ocean floor F. A suitable base structure C is supported on the ocean floor, being suitably connected to an outer casing D extending into the well bore. An appropriate wellhead housing **10** is mounted within the base structure, which is attached through a suitable connector **11** to a blowout preventer stack **12**, which is, in turn, secured to a conduit string **13**, or marine riser, extending upwardly through the water to a drilling vessel V floating in the water. As disclosed in FIGS. **2, 4, 5** and **6**, the wellhead or housing **10** is secured to the connector **11** by means of dogs or latches **14** of a known type, such as illustrated and described in U.S. Pat. No. 3,321,217, the connector being secured to the stack of blowout preventers **12** through a suitable and known coupling ring **15**, a gasket **16** preventing leakage between the blowout preventer stack and the upper connector member **17**.

A seal ring **18** prevents leakage between the upper coupling member **17** and the upper end of the wellhead housing **10**, the wellhead housing having an inner cylindrical wall or sealing surface **19** and a split contractible lock ring **20** mounted in an internal circumferential groove **21** opening through its inner wall. A lower casing hanger **22** may have been previously landed in the wellhead housing **10**, supporting a string of well casing (not shown) of a particular diameter extending down-

wardly therefrom, this lower casing hanger resting upon a seat (not shown) in the wellhead housing **10,** but illustrated in the above-identified U.S. Pat. No. 3,492,026.

It is desired to lower and support another string of well casing **23** within the previously installed casing string or strings (not shown), this support being effected by suitably securing the upper end of the casing string to a casing hanger body **24** having a downwardly facing shoulder **25** adapted to come to rest upon the upper end **26** of the lower casing hanger **22,** as illustrated in FIGS. **2** to **6.** This casing hanger body **24** has a plurality of spaced circulation grooves or fluid passages **27** extending upwardly from its lower end and opening outwardly of the body, which establish communication between the annular space **28** between the inner casing string and the casing string suspended from the lower casing hanger **22** and the space **29** between the casing hanger body **24** and housing **10.** The body has a downwardly tapering external surface **30** adapted to engage a companion upper bevel surface or corner **31** on a lock ring **20** to expand the lock ring substantially fully within its companion groove **21,** permitting the hanger body shoulder **25** to land upon the upper end **26** of the lower casing hanger **22,** the lock ring then contracting inherently inwardly to a position immediately above an upwardly facing shoulder **32** on the hanger body **24,** latching or locking the hanger body and preventing upward movement of the body and the casing **23** suspended therefrom.

A packing assembly **35** is initially supported by the casing hanger body **24** and is adapted to be lowered therewith from the drilling rig R on the vessel V. As shown, the packing assembly includes an upper supporting ring **36** carrying an elastomer packing sleeve **37** that depends therefrom. The specific configuration of the packing assembly forms no part of the present invention and is shown and described in the U.S. application of Joseph H. Hynes, et al, Ser. No. 193,312, filed Oct. 28, 1971, now U.S. Pat. No. 3,797,864. The upper supporting ring **36** has a downwardly opening dovetail groove **38** receiving a companion dovetail portion **39** of the elastomer packing sleeve **37** to connect the ring and packing sleeve together. The lower end of the packing sleeve has a dovetail **40** fitting within a companion dovetail groove **41** in a lower abutment ring **42.**

The packing assembly **35** is initially releasably secured to the lower portion of a follower sleeve **43** by one or more shear pins **44,** an annular thrust bearing element **45,** preferably of inverted V-shaped cross-section, being disposed between the upper end **46** of the upper supporting ring and an opposed downwardly directed surface **47** of the follower. It is to be noted that another thrust bearing ring **48** of inverted V-shaped cross-section is also mounted upon an upwardly directed shoulder **49** on the upper supporting ring **36,** this latter thrust bearing having larger external and internal diameters than the other thrust bearing ring **45.** The follower **43** is in the form of a nut having an internal right-hand thread **50** meshing with a companion external right-hand thread **51** on the upper portion of the casing hanger body **24,** the nut initially occupying an upper position to support the packing assembly therebelow with the lower abutment ring **42** spaced above an external cylindrical sealing surface **52** on the casing hanger body, which has a diameter substantially less than the diameter of the inner wall **19** of the wellhead housing **10,** so as to provide the annular space **29** therebetween into which the packing assembly can move, with the lower abutment coming into contact with an upwardly facing shoulder **53** on the casing hanger body **24** below its cylindrical sealing surface **52.** It is further to be noted that the follower nut **43** has an external diameter substantially less than the diameter of the inner wall **19** of the wellhead housing to provide an annular space **54** therebetween into which a portion **55** of a setting tool **56** can be inserted for engagement of its lower end **57** with the thrust bearing ring **48,** as described hereinbelow.

The packing assembly **35** connected to the follower member or nut **43** by the shear pin **44** is mounted on the casing hanger body **24** and the follower nut threaded a short distance downwardly along the upper portion of the hanger body (FIGS. **2, 3**). The hanger body is threadedly secured to the upper end of the casing string **23,** which has been lowered from the drilling rig to some extent into the well bore B. The continued lowering of the casing string and of the hanger body **24** occurs through use of a running tool **60** secured to the hanger body **24** by left-hand threads **61,** the running tool being threadedly secured to the lower end of a tubular running string **62** extending to the drilling rig (FIG. **2**). If desired, a suitable centering sleeve **63** may be mounted on the running string **62** for the purpose of ensuring appropriate centering of the hanger body **24,** packing assembly **35,** and packing nut **43** with respect to the wellhead housing **10,** the centering sleeve having a plurality of circumferentially spaced openings **64** therethrough to facilitate lowering of the apparatus through the marine riser **13** and the blowout preventers **12** above the wellhead housing. Suitable seal rings **65** are also preferably provided on the casing hanger running tool **60** for sealing against the inner cylindrical wall **66** of the hanger body. The lowering occurs until the hanger body shoulder **25** comes to rest against the upper end of the lower casing hanger **22,** with the upwardly facing lock shoulder **32** of the body **24** disposed below the lock ring **20** which, as described above, will contract inherently inwardly across that shoulder to lock the casing hanger **24** and casing **23** suspended therefrom against upward movement.

Following landing of the casing hanger body **24** in the wellhead housing **10,** and upon the lower casing hanger **22,** circulation can be established through the running string **62** and well casing **23,** followed by a required amount of cement slurry, or the like, the circulation and cementing operations being permitted by the fact that the fluid passages **27, 29** are in the open condition, as disclosed in FIG. **2,** fluids being capable of flowing through the space **67** between the packing assembly **35** and hanger body **24** and through the ports **68** in the follower nut into the space **54.** After the cementing operation has been completed, the running tool **60** is released by rotating the running string **62** to the right to unthread the running tool from the casing hanger body **24,** the running tool being elevated a short distance from the body **24,** which then permits the area above the casing hanger **24** to be flushed by pumping flushing liquid down the running-in string **62.** If any cement slurry has passed upwardly through the by-pass passages **27** and through the open space **67** between the packing assembly and casing hanger **24,** and out

through the ports **68** in the follower nut, such cement slurry will also be flushed to the drilling rig.

After the running string **62** and running tool **60** have been removed to the drilling rig, the setting tool **56** is suitably attached to the lower end of the tubular running-in string **62** and lowered toward the casing hanger **24** and wellhead housing **10.** As disclosed in FIGS. **4** and **5**, the setting tool includes an upper portion **80** from which an inner sleeve **81** depends, this inner sleeve carrying one or a plurality of elastomer side seal rings **82** in its peripheral portion adapted to seal within a companion cylindrical internal sealing surface **83** in the upper portion of the casing hanger body **24.** A suitable weight can be threadedly, or otherwise suitably, attached to the setting tool **56,** such as drill collars **84,** or the like, of an appropriate length that will extend downwardly through the casing hanger body **24** and freely into the casing string **23** suspended therefrom. Also secured to the upper portion of the packing setting tool is an outer thrust sleeve **55** of appropriate internal and external diameters as to be movable downwardly through the annular space **54** between the inner wall **19** of the wellhead housing **10** and the external diameter of the follower nut or sleeve **43** and the upper portion **36a** of the upper supporting ring **36** of the packing assembly, the lower end **57** of the thrust sleeve being shaped to conform to the outer bearing ring **48.** This thrust sleeve also carries one or a plurality of keys **85** extending radially inwardly thereof and adapted to slide along companion longitudinal elongate grooves **86** formed in the exterior of the follower nut **43.**

The setting tool **56** and drill collars **84** suspended therefrom are lowered on the tubular running string **62** until the thrust sleeve **55** of the setting tool shifts into the annular space **54** between the follower nut and the wellhead housing, the lower end **57** of the thrust sleeve engaging the thrust bearing ring **48** on the upper supporting ring **36** of the packing assembly **35.** The imposition of sufficient downweight will shear the pins **44** and permit the packing assembly **35** to drop downwardly into the annular space **29** between the external and internal cylindrical sealing surfaces **52, 19,** the lower abutment ring **42** coming to rest upon the upwardly facing body shoulder **53.** The follower nut remains in its initial position (FIG. **2** position), and its lower portion will then be spaced above the upper end of the packing assembly **35.** Sufficient downweight can be imposed on the setting tool **56** and through the drill string **62,** or it can be provided by the weight of the drill collars **84,** or the like, suspended from the upper portion **80** of the setting tool, this downward weight being transmitted through the thrust sleeve **55** and the bearing ring **48** upon the upper supporting ring **36,** which will move toward the lower abutment ring **42,** held stationary by the body shoulder **53,** to shorten the elastomer packing sleeve **37** and expand it outwardly and inwardly to form a sealing engagement with the internal and external surfaces **19, 52** of the wellhead housing **10** and casing hanger body **24** (FIG. **4**). Although forming no part of the present invention, the upper support ring **36** and lower abutment ring **42** may have inner and outer circumferential malleable metallic sleeve portions **90, 91** encompassing the upper and lower portions of the elastomer packing sleeve, in order that the expansion of the latter, when compressed, between the upper and lower abutment rings will deflect the inner and outer sleeve portion **90, 91** inwardly and outwardly into engagement with the external and internal cylindrical walls **52, 19,** thereby providing back-up metal-to-metal seals against such walls.

With the appropriate weight imposed on the packing assembly **35,** the running string **62** and setting tool **56** can then be rotated to the right, which will thread the follower nut **43** in a downward direction until its lower end **47** firmly engages the thrust bearing ring **45** on the upper part of the upper supporting ring **36.** The follower nut can thread downwardly to substantially its full extent with very little effort required, the lower end **57** of the thrust sleeve **55** sliding rotationally around the thrust bearing **48** (FIG. **5**).

Rotation of the follower nut **43** to substantially its final position ensures that it will hold the packing assembly **35** in its packed-off condition, in view of its threaded engagement with the hanger body **24.**

With the packing assembly **35** in its packed-off condition, it will be noted that the seals **82** on the inner sleeve **81** will be in engagement with the inner cylindrical wall **83** of the hanger body. Accordingly, the lower portion of the annular space above the packing assembly is closed against downward flow of fluid. The rams **12** can then be closed, in a known manner, but illustrated diagrammatically in FIG. **5,** and the desired test pressure imposed on the fluid in the annular space through a choke/kill line **93** attached to the apparatus below the closed rams **12,** for the purpose of proving the efficacy of the pack-off or seal **35.** This test pressure not only indicates the effectiveness of the seal, but it also supplies a downwardly directed hydraulic force on the packing assembly **35,** tending to further squash or shorten the packing element **37** and increase its sealing force against the opposed sealing surfaces **52, 19** on the hanger body **24** and the wellhead housing **10.** Assuming that the pack-off is proper, an additional medium amount of right-hand torque can be applied to the running string **62** and setting tool **56** to effect an additional downward threading of the follower nut **43** to further tighten it against the packing assembly **35,** thereby retaining such assembly in its packed-off condition. The tightening action may occur after the test pressure has been applied.

With the rams **12** opened, the running string **62** can be elevated to elevate the setting tool **56** from the wellhead housing **10** for withdrawal through the blowout preventers **12** and through the marine riser **13** to the drilling rig R, the parts being in the condition illustrated in FIG. **6.**

Following the completion of the pack-off operation, a suitable wear or protective member **95** can be lowered from the drilling rig and run into place, as illustrated in FIG. **6,** in order that further operations can be performed without damaging the casing hanger **24** or other portions of the apparatus. As shown, the wear member has an outer portion **96** movable behind the follower nut **43** and which has a key member **97** fitting within a longitudinal groove **86** in the follower nut. If later required, this wear sleeve can have torque applied to further rotate the follower nut **43** to the right, and additionally move the upper supporting ring **36** toward the lower supporting ring **42** to further axially load the elastomer packing sleeve **37.**

It is, accordingly, apparent that an apparatus and method have been provided, in which a seal is effected merely by the direct application of weight to the packing assembly **35,** and without the necessity for applying

any torque thereto. The seal assembly is maintained in its packed-off configuration merely by spinning the follower nut **43** downwardly along the casing hanger body **24** to lock the seal assembly **35** in its packed-off condition. The efficacy of the pack-off can be tested without retrieving the setting tool, the test pressure being utilized to further load the seal and assure its effectiveness.

I claim:

1. In well bore casing apparatus: an inner casing hanger body adapted to be disposed within an outer hanger body for suspending a casing within a well bore; follower means mounted on said inner body; a packing structure releasably connected to said follower means; said inner body having connector means for releasably securing said inner body to a running string for lowering said inner body and casing, with said follower means and packing structure mounted on said inner body, with respect to said well bore to seat said inner body within the outer hanger body with said packing structure disposed within the outer hanger body; a setting tool movable downwardly into engagement with said packing structure to release said packing structure from said follower means and shift said packing structure downwardly with respect to said follower means to seal the space between said inner body and the outer body; and coengaging means on said setting tool and follower means for shifting said follower means downwardly toward and against said packing structure to retain the packing structure in position sealing the space between said inner body and the outer body.

2. In apparatus as defined in claim **1**; means providing a threaded connection between said follower means and inner body; said setting tool being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

3. In apparatus as defined in claim **1**; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space, said setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

4. In apparatus as defined in claim **1**; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space.

5. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body.

6. In apparatus as defined in claim **1**; shearable means releasably connected said packing structure to said follower means to be sheared by said setting tool to release said packing structure from said follower means.

7. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body; means providing a threaded connection between said follower means and inner body; said setting tool being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

8. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space, said setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

9. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space, said setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure, shearable means releasably connecting said packing structure to said follower means to be sheared by said setting tool to release said packing structure from said follower means.

10. In apparatus as defined in claim **1**; means providing a seal between said setting tool and inner hanger body to enable pressure to be imposed on fluid in the annular space between said inner body and the outer body above the packing structure to test the packing structure for leakage when sealing the space between said inner and outer bodies.

11. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means to shift said packing structure downwardly to seal said space, said setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure; means providing a seal between

said setting tool and inner hanger body to enable pressure to be imposed on fluid in the annular space between said inner body and the outer body above the packing structure to test the packing structure for leakage when sealing the space between said inner and outer bodies.

12. In apparatus as defined in claim **1**; said inner body having a shoulder engaged by said packing structure upon downward shifting of said packing structure by said setting tool to shorten and expand said packing structure into sealing engagement with said inner body and the outer hanger body; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space, said setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure; means providing a seal between said setting tool and inner hanger body to enable pressure to be imposed on fluid in the annular space between said inner body and the outer body above the packing structure to test the packing structure for leakage when sealing the space between said inner and outer bodies; shearable means releasably connecting said packing structure to said follower means to be sheared by said setting tool to release said packing structure from said follower means.

13. The method of sealing the annular space between an outer well bore hanger body and an inner casing hanger body, comprising releasably securing a packing structure to a follower mounted on the inner hanger body, lowering the inner hanger body with the follower and packing structure supported thereby into the outer body and seating the inner body within the outer body, releasing the packing structure from the follower for downward movement from the follower within the annular space to seal the same, then shifting the follower downwardly toward and against the packing structure to retain the packing structure in its position sealing the annular space.

14. The method as defined in claim **13**; releasably attaching a running string to the inner body for jointly lowering the inner body, follower and packing structure into the outer body to seat the inner body within the outer body, removing the running string, then lowering a setting tool on a running string into engagement with the packing structure to effect said release of the packing structure from the follower and sealing of said annular space by said packing structure, then manipulating the setting tool to effect downward shifting of the follower toward and against the packing structure.

15. The method as defined in claim **13**; releasably attaching a running string to the inner body for jointly lowering the inner body, follower and packing structure into the outer body to seat the inner body within the outer body, removing the running string, then lowering a setting tool on a running string into engagement with the packing structure to effect said release of the packing structure from the follower and sealing of said annular space by said packing structure, then manipulating the setting tool to effect downward shifting of the follower toward and against the packing structure; applying pressure to fluid in the annular space above the packing structure to test the effectiveness of the packing structure in sealing the annular space, and removing the setting tool and running string.

16. The method as defined in claim **13**; the follower being mounted on the inner body by a threaded connection, releasably attaching a running tool to the inner body for jointly lowering the inner body, follower and packing structure into the outer body to seat the inner body within the outer body, removing the running string, then lowering a setting tool on a running string into engagement with the packing structure to effect said release of the packing structure from the follower and sealing of said annular space by the packing structure, then rotating the running string and setting tool to thread the follower downwardly of the inner body toward and against the packing structure.

17. The method as defined in claim **13**; the follower being mounted on the inner body by a threaded connection, releasably attaching a running tool to the inner body for jointly lowering the inner body, follower and packing structure into the outer body to seat the inner body within the outer body, removing the running string, then lowering a setting tool on a running string into engagement with the packing structure to effect said release of the packing structure from the follower and sealing of said annular space by the packing structure, then rotating the running string and setting tool to thread the follower downwardly of the inner body toward and against the packing structure, applying pressure to fluid in the annular space above the packing structure to test the effectiveness of the packing structure in sealing the annular space, and removing the setting tool and running string.

18. Well bore casing apparatus: comprising an inner casing hanger body adapted to be disposed within an outer hanger body for suspending a casing within the well bore; said inner body having connector means for releasably securing said inner body to a running string for lowering said inner body and casing with respect to said well bore to seat said inner body within the outer hanger body; follower means adapted to be mounted on said inner body; a packing structure below and releasably connected to said follower means; a setting tool movable downwardly into engagement with said packing structure to release said packing structure from said follower means and shift said packing structure downwardly with respect to and independently of movement of said follower means to seal the space between said inner body and outer body; and coengaging means on said setting tool and follower means for shifting said follower means downwardly toward and against said packing structure to retain the packing structure in position sealing the space between said inner body and the outer body.

19. Apparatus as defined in claim **18**; means providing a threaded connection between said follower means and inner body; said setting tool being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

20. Apparatus as defined in claim **18**; means providing a threaded connection between said follower means and inner body; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space, said

setting tool then being rotatable to rotate said follower means on said inner body and feed said follower means downwardly of said inner body and into engagement with said packing structure.

21. Apparatus as defined in claim **18**; said connector means comprising a spline connection whereby said setting tool is movable downwardly and without rotation to release said packing structure from said follower means and to shift said packing structure downwardly to seal said space.

22. Apparatus as defined in claim **18**; shearable means releasably connecting said packing structure to said follower means to be sheared by said setting tool to release said packing structure from said follower means.

23. Apparatus as defined in claim **18**; means providing a seal between said setting tool and inner hanger body to enable pressure to be imposed on fluid in the annular space between said inner body and the outer body above the packing structure to test the packing structure for leakage when sealing the space between said inner and outer bodies.

24. The method of sealing the annular space between an outer well bore hanger body and an inner casing hanger body, comprising providing a packing structure releasably secured to a follower adapted to be mounted on the inner casing hanger body, lowering the inner hanger body into the outer body and seating the inner body within the outer body, releasing the packing structure from the follower for downward movement away from the follower within the annular space to seal the same, then shifting the follower downwardly toward and against the packing structure to retain the packing structure in its position sealing the annular space.

25. The method as defined in claim **24**; effecting a threaded connection between the follower and inner body, lowering a setting tool on a running string into engagement with the packing structure to effect said release from the packing structure and sealing of said annular space by the packing structure, then rotating the running string and setting tool, whereby said threaded connections thread the follower downwardly of the inner body toward and against the packing structure.

26. The method as defined in claim **24**; effecting a threaded connection between the follower and inner body, lowering a setting tool on a running string into engagement with the packing structure to effect said release from the packing structure and sealing of said annular space by the packing structure, then rotating the running string and setting tool, whereby said threaded connection threads the follower downwardly of the inner body toward and against the packing structure, applying pressure to fluid in the annular space above the packing structure to test the effectiveness of the packing structure in sealing the annular space, and removing the setting tool and running string.

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