United States Patent

[11] 3,561,723

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[54] **STRIPPING AND BLOW-OUT PREVENTER DEVICE**
11 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **251/1,** 251/5; 277/31
[51] **Int. Cl.** **E21b 33/06**
[50] **Field of Search** 251/1, 5; 277/31, 73, 9, 11, 127; 166/82

[56] **References Cited**

UNITED STATES PATENTS

2,192,805	3/1940	Seamark	277/31
3,023,012	2/1962	Wilde	277/31
3,323,773	6/1967	Walker	251/1

FOREIGN PATENTS

868,693	5/1961	Great Britain	277/73

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ABSTRACT: Stripping and blowout preventer devices for use in well drilling operations, particularly in off shore subsea well drilling, to prevent fluid escaping from the well in the presence or absence of a well tool such as a pipe string, while rotating or stationary, or during removal of the string from the well hole.

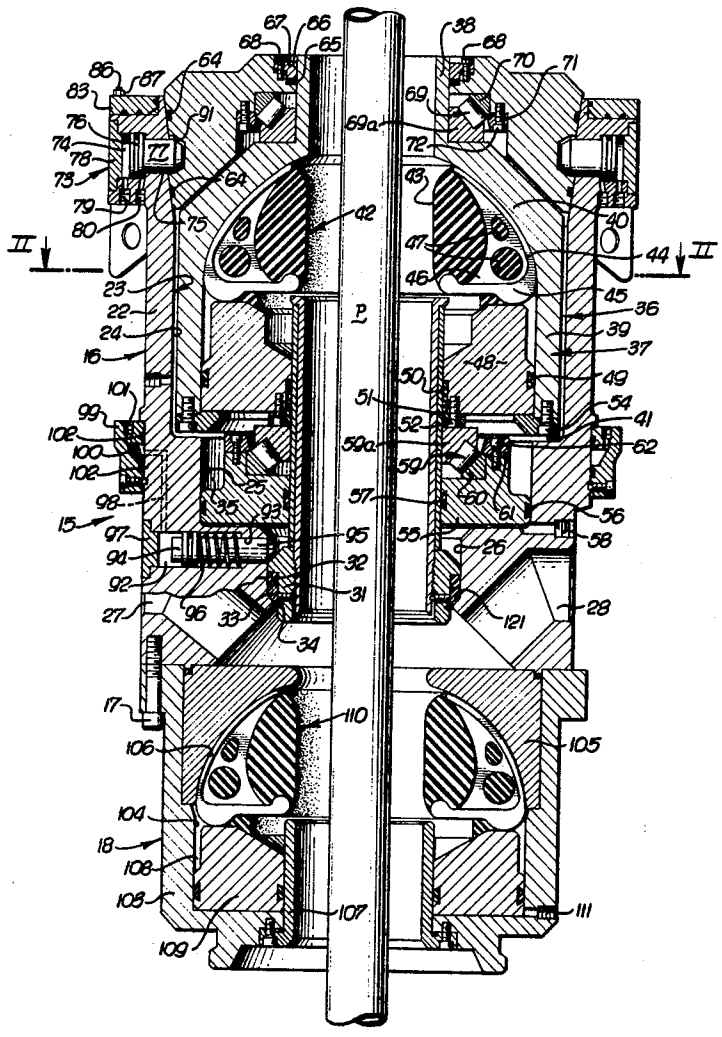
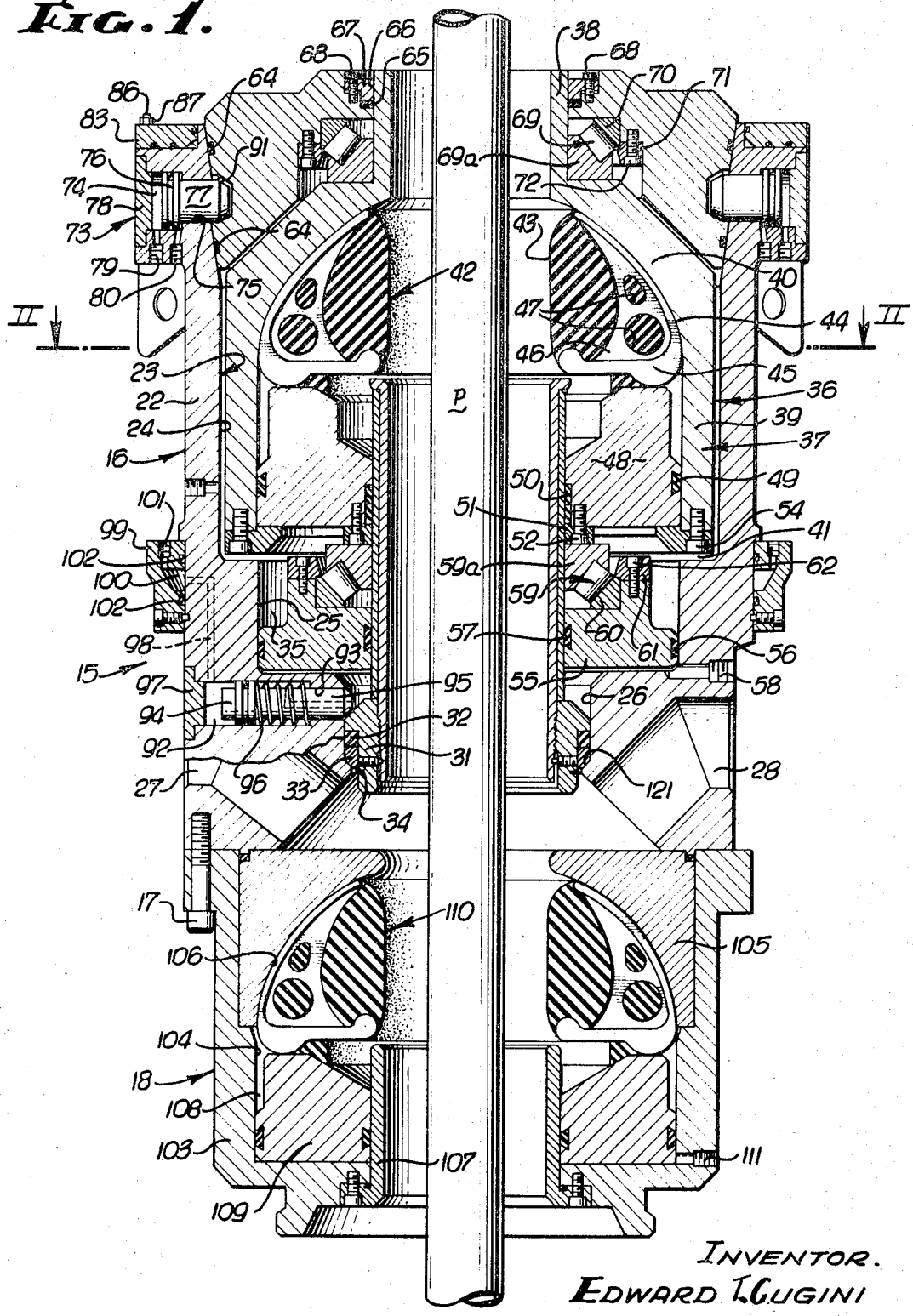


FIG. 1.



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FIG. 3.

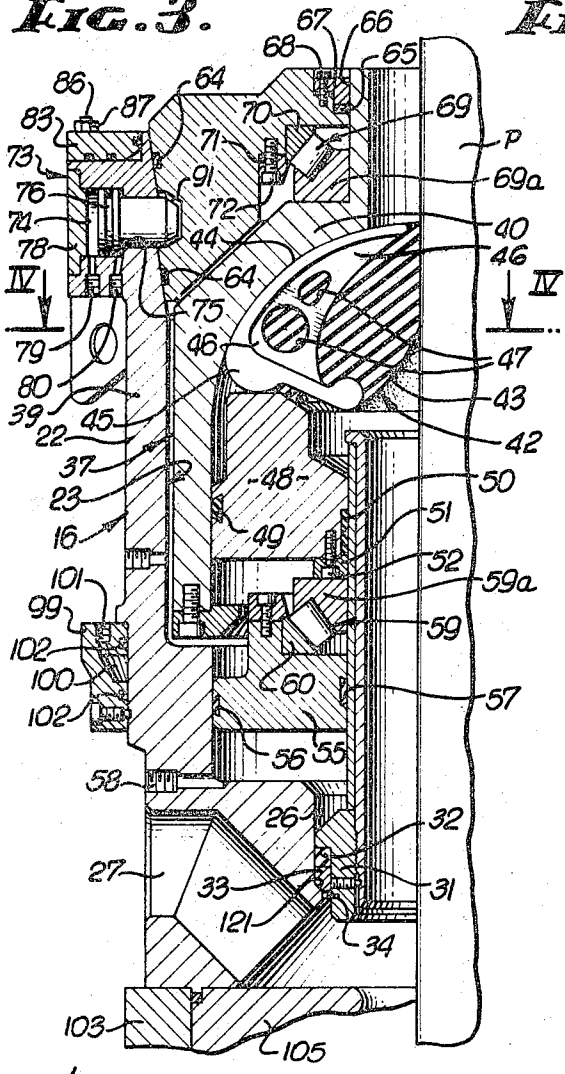


FIG. 2.

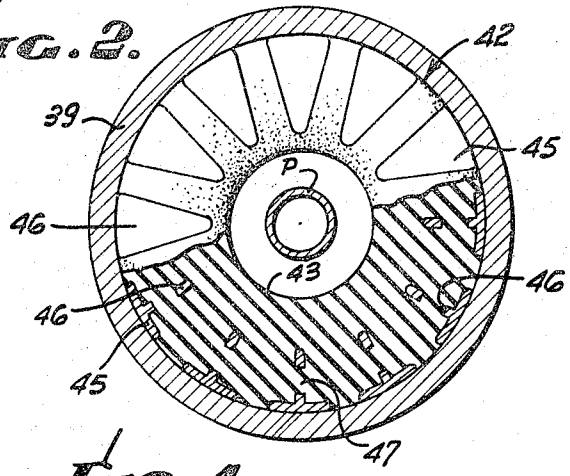


FIG. 4.

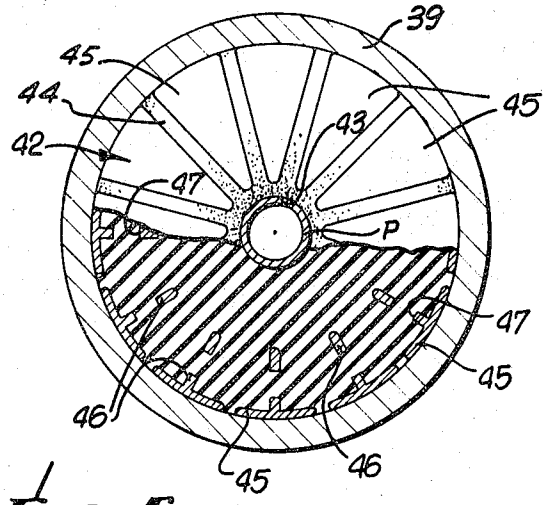


FIG. 5.

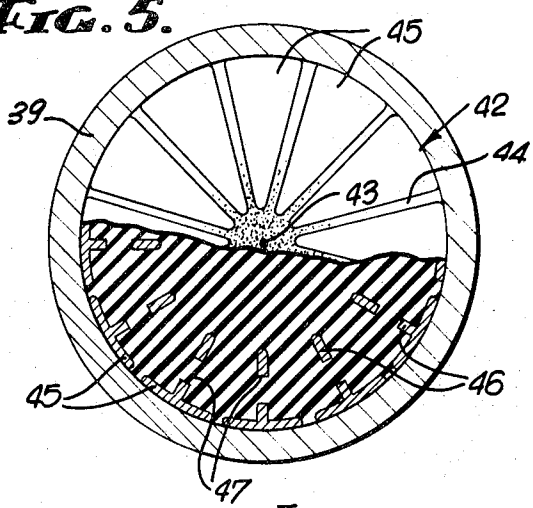
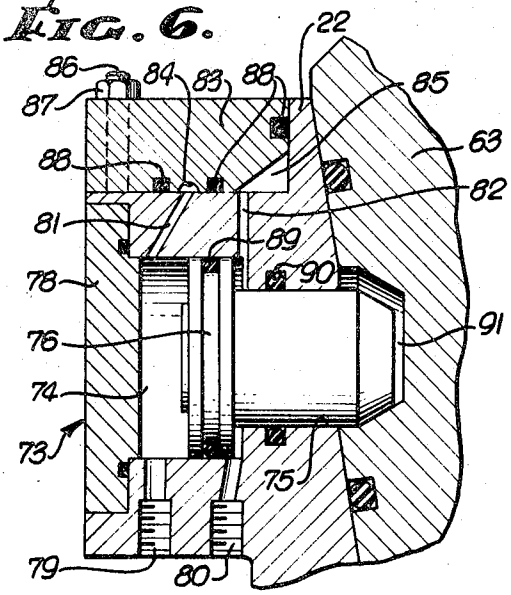


FIG. 6.



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STRIPPING AND BLOW-OUT PREVENTER DEVICE

It has long been known that it is desirable to prevent the escape of gas from a well hole during and after the drilling operation, and many types of prior art devices are available for this purpose. It has also been found that blow out preventers which are primarily adapted for use with a stationary non-rotating pipe string are generally inadequate for use during the drilling operation. The static resilient sealing material in such devices is quickly worn when used with a rotating well tool and requires continued replacement with attendant high material and labor costs.

To overcome this difficulty, prior art devices have been employed in which a resilient sealing means is rotatably mounted in a blow out preventer housing so as to rotate with the well tool. A rotary seal is then mounted to provide a seal between the stationary housing and the rotatable sealing means. In these devices, the resilient sealing means, usually comprises a rubber nipple, which is mounted on a rotatable collar to seal the well tool by virtue of the radially inwardly directed force of the resilient material. Since rotation of the sealing means and the rotatable collar depends upon frictional contact with the well tool, the gripping force of the nipple must be considerable to overcome the inertia of the rotating sealing means and collar when the well tool begins to rotate or changes speed. On the other hand, the gripping force must be sufficiently attenuated to allow the well tool to pass axially through the nipple during the stripping operation. This compromise results in frequent slipping between the well tool and the sealing means causing rapid wear and deterioration of the resilient material.

One prior art device used to overcome the latter problem is shown in the U.S. Pat. No. 3,023,012 issued Feb. 27, 1962, to Wilde. This rotary blow out preventer comprises a stationary housing and a sealing means mounted in a rotatable assembly disposed within the housing. To prevent slipping between the well tool and the rotatable sealing means, the rotatable assembly is provided with a rotor which is driven by a variable speed pump so that the rotatable assembly may be drivingly rotated at a speed commensurate with the well tool speed.

One general characteristic common to the above-mentioned prior art rotary blow out preventers is that the sealing means is adapted to provide only a constant radially inwardly directed force on the well tool. owing to the resiliency of the sealing material, throughout the operation thereof. One variable sealing pressure prior art device that is available, although primarily adapted for use as a stationary blow out preventer is shown in U.S. Pat. No. 3,323,773, issued June 6, 1967, to Walker. The blow out preventer shown therein uses a resilient sealing member which is moveable within the stationary housing so that by applying a variable pressure to an actuating member connected to the resilient sealing member, the sealing force applied to the well tool may be varied in accordance with the operation to be performed. However as noted above, this device is designed as a static blowout preventer and consequently the capability provided by variable sealing pressure will not relieve the problem of rapid resilient material wear and deterioration when associated with a rotating tool or string.

Another problem which existed with prior art devices, particularly intrinsic to the use of the blow out preventers in off shore subsea drilling operations, is the requirement that the sealing means in a blow out preventer which is submerged in deep water or in a deep well drilled on land, must be remotely retractable in order to replace the worn sealing member. The previously mentioned U.S. Pat. No. 3,023,012, to Wilde, shows a blow out preventer in which the sealing member is axially retractable from the stationary housing of the blow out preventer from a remote location. However, there is no provision for sealing the well hole during the time in which the rotatable sealing member is withdrawn from the blow out preventer housing for replacement.

Generally, the present invention provides a blow out preventer and stripper comprising a rotary blow out preventer and a stationary blow out preventer, wherein the former includes a rotating assembly, sealing means mounted in the rotating assembly adapted to close radially when moved axially and a remotely controlled actuating means for moving the sealing means axially into one of several operative positions wherein a preselected radially inwardly directed force is exerted on the well tool as required by the particular operation being performed by the apparatus. The seal between the sealing member and the rotating well tool is thereby effected between two surfaces having no relative rotational movement therebetween.

The present invention also provides in the above-described apparatus, means for withdrawing the rotating sealing member axially from the stationary housing while simultaneously sealing the well hole by actuating a static blow out preventer which is capable of sealing the well hole in the absence of any well tool within the blow out preventer.

Accordingly, it is a general object of the present invention to provide a rotatable blow out preventer and stripper which overcomes the defects and disadvantages of the above-mentioned prior art blow out preventer devices.

Another object of the present invention is to provide a rotary blow out preventer wherein the sealing means which contacts the well tool is rotatably mounted within a stationary housing and may be axially moved into an operative position wherein a maximum radially inwardly directed force is exerted on the well tool so that the sealing means is caused to be rotated with the well tool by frictional contact therewith and also into an inoperative position wherein the well tool may be also stripped from the sealing means and rotary blow out preventer.

It is still another object of the present invention to provide a rotary blow out preventer comprising a stationary housing in which is mounted a rotating assembly carrying a sealing means for selectively exerting a radially inwardly directed force upon a well tool and wherein a rotary seal is provided between the rotating assembly and the stationary housing.

It is yet another object of the present invention to provide a rotary blow out preventer comprising a stationary housing and a rotating assembly carrying sealing means which may be selectively positioned to provide a maximum radially inwardly directed force on a well tool.

A further object of the invention is to disclose a rotary blow out preventer including a rotatable assembly and sealing means adapted to be withdrawn from an associated stationary housing after releasing locking means between the rotatable assembly and the stationary housing.

It is yet another object of the present invention to provide a rotary blow out preventer comprising a stationary housing and a rotating assembly carrying sealing means wherein the sealing means may be selectively axially moved so as to provide a radially inwardly directed force on the well tool whereby the frictional contact between the sealing means and well tool causes the sealing means and rotating assembly to rotate when the well tool is rotated, a second selective position in which the sealing means contacts the well tool with sufficient force to seal the well but allowing the well tool to be stripped through the sealing means, and a third position in which the sealing means is retracted so that a well tool may be inserted into the rotary blow out preventer.

It is still one more object of the present invention to provide a blow out preventer comprising a stationary housing and a rotating assembly carrying sealing means, which sealing means may be selectively positioned so as to seal the well even in the absence of any well tool, drilling pipe or the like.

And yet one further object of the present invention is to provide a rotary blow out preventer in combination with a static blow out preventer wherein the rotatably carried sealing means may be axially withdrawn from the stationary housing. and the stationary sealing means may be operated so as to seal the well hole while the sealing means on the rotating assembly is being replaced after wear.

Other objects and advantages of this invention will be readily apparent from the following description when considered in connection with the appended drawings.

IN THE DRAWINGS

FIG. 1 is a longitudinal sectional view of one embodiment of the device of the present invention in open and nonsealing position with a pipe string passing therethrough, the section being taken in a longitudinal plane passing through the axis of the device;

FIG. 2 shows a partial transverse section of the device as illustrated in FIG. 1 taken along line II–II thereof part of the seal means being shown in top plane view.

FIG. 3 is a partial longitudinal sectional view of the device taken in the plane of FIG. 1 with the device in the sealing position around a well tool;

FIG. 4 shows a partial transverse section of the device similar to FIG. 2 taken along the line IV–IV thereof;

FIG. 5 is a view, partly in section, of the sealing means similar to FIGS. 2 and 4 showing the seal means in a completely closed position with no well tool therein; and

FIG. 6 is a fragmentary enlarged sectional view of a portion of the device of the present invention, showing in detail the upper lock pin assembly.

Referring now to the drawings, wherein like reference numerals designate like or corresponding parts throughout the several views, there is shown in FIG. 1 an exemplary combination rotary and static blow out preventer device 15 of the present invention as may be used in offshore subsea drilling rigs. The device comprises a rotary blow out preventer 16 and cooperably secured thereto by means of bolts 17 a static blow out preventer 18.

Rotary blow out preventer 16 comprises a stationary outer housing 22 having a cylindrical chamber indicated generally by the reference numeral 23, including an upper wall section 24, an intermediate wall section 25 of reduced diameter, and a lower wall section 26 of still further reduced diameter. At the lower end of stationary housing 22 there is provided a pair of diametrically opposed well fluid or mud passages 27 and 28 adapted to have a mud return line (not shown) secured thereto.

A sleeve 30 having a through passageway adapted to receive a well-tool P, is secured at its lower end to stationary housing 22 by means of a threaded sleeve retainer nut 31. Retainer nut 31 is carried on housing 22 by means of a resilient packer ring 32, and a metal support ring 33 is held on retainer nut 31 by means of a nap ring 34. A first annular space 35 is defined by intermediate wall section 25 and sleeve 30.

Disposed within chamber 23 of stationary housing 22 is rotatable assembly 36 comprising a generally cylindrical rotatable inner housing 37 having an upper cylindrical wall 38 defining a well-tool receiving port, a lower cylindrical wall 39 of enlarged diameter and an intermediate wall portion 40 having an internal arcuate cross section or part spherical surface merging with upper and lower walls 38, 39. The lower wall 39 defines with upper portion of sleeve 30 a second annular space 41.

A resilient sealing member, generally indicated by the reference numeral 42, is carried by rotatable assembly 36 and is adapted to be selectively moved with respect to a well-tool P between a nonsealing position (FIG. 1) and a sealing position (FIG. 3). Resilient sealing member 42 may include a continuous annular body of resilient material such as natural or synthetic rubber, and it has been found that Hycar-Buna having a Shore hardness between 50—80 is particularly suited for such a sealing material. The resilient member 42 includes an inner bore 43 and an outer surface 44 and, in the nonsealing relaxed position of FIG. 1, the diameter of the inner bore 43 of the sealing means 42 is approximately equal to the diameter of the well-tool receiving port of upper cylindrical wall 38 of rotatable housing 37. Sealing member 42 is adapted to cooperate with the curved inner surface of intermediate wall portion 40 of rotatable housing 37 for movement between sealing and nonsealing positions.

Translating means is provided for cooperating with resilient sealing member 42 and for slidably cooperating with the curved intermediate wall portion 40 of rotatable housing 37 for converting axial movement or pressure on the sealing member into a rolling inward flow of resilient material whereby a maximum radially inwardly directed sealing force is attained by the sealing member 42 adjacent and inwardly of the well-tool receiving port. Such translating means may include a plurality of curved sector shaped metallic shoes 45 bonded to the outer surface 44 of the sealing member 42. Each of the metallic shoes 45 have a radially inwardly extending gussetlike flange 46 integrally connected with shoe 45 and provided with openings 47 therein. The outer curved surfaces on each of the shoes 45 substantially conform to the curved inner surface of intermediate wall portion 40 of rotatable housing 37 and are adapted to provide mating surfaces having a minimum of sliding frictional contact during movement therebetween.

It is preferred that the resilient sealing member 42 and metallic shoes 45 are molded together as a unit for assembly with the rotatable housing 37. In the event of wear, the unitary assembly of sealing member 42 and metallic shoes 45 can be easily replaced by another similar unit. In nonsealing relaxed position, metallic shoes 45 are so constructed as to be spaced radially and circularly from each other and tend to contract and move toward each other to form a virtually closed reinforcing wall when the seal 42 is moved into the sealing position as seen best in FIGS. 4, 5.

Disposed within and carried by the rotatable assembly 36 is a follower means comprising an annular follower member 48 disposed within the second annular space 41, supporting resilient sealing member 42, and having an internal seal element 45*a* in sealing engagement therewith. Follower member 48 carries a seal 49 on its outer surface to seal against wall portion 39. The follower 48 slidably sealingly engages sleeve 30 by means of a chevron packing gland 50 positioned in an annular groove on the inner surface of follower 48 and engaging the outer surface of sleeve 30. Packing gland 50 is secured to follower 48 by means of a retainer 51 and a plurality of cap screws 52. Follower 48 which is free to move axially within rotatable housing 37 is retained therein by means of a follower retainer ring 53 and a plurality of cap screws 54.

Remotely controlled and axially movable actuating means for follower 48 is positioned in annular space 41 defined by wall section 25. The actuating means may comprise a piston 55 having a first sealing ring 56 engaging wall section 25 and a second sealing ring 57 engaging sleeve 30. A port 58 in stationary housing 22 communicates with first annular space 35 in which piston 55 is disposed, so as to allow fluid under pressure to be introduced below piston 55 to move the piston axially. Upward movement of piston 55 causes follower 48 to be axially upwardly displaced so as to press resilient sealing member 42 against wall portion 40 and thereby cause radial inward flow of the resilient material toward the axis and toward the well-tool.

Rotatable assembly 36 is rotatably supported in the stationary housing 22 by upper and lower tapered roller bearing means 59 and 69. Lower bearing means 59 is fixedly mounted on the top surface of piston 55 and comprises an upper race 59*a* in seating engagement with packing gland retainer ring 51. Lower bearing means 59 also comprises a lower race 60 seated on and secured to piston 55 by means of a bearing retainer 61 and a plurality of cap screws 62.

Before describing the upper bearing means, reference is first made to the rotating assembly annular retainer plate 63 positioned above rotatable assembly 36 and secured to stationary housing 22 by means to be described hereinafter. Retainer plate 63 has an inner diameter slightly larger than the outer diameter of the upper cylindrical wall portion 38 of the rotatable housing 37 to fit thereover. Suitable O-rings or other fluid sealing means 64 are carried on an outer inwardly tapered stepped surface of retainer plate 63 to seal against a corresponding outwardly flared surface on the upper wall of stationary housing 22. Plate 63 is sealed with respect to the upper wall 38 of housing 37 by a split Teflon seal 65 secured in an upper inner rabbeted edge portion 66 in plate 63 by seal retainer ring 67 and a plurality of cap screws 68.

The upper bearing means **69** is positioned in an internal inner rabbeted edge portion of retainer plate **63** and comprises a lower race **69***a* seated in the juncture of upper wall portion **38** and intermediate arcuate wall portion **39**. The upper bearing means **69** also includes an upper race **70** secured to plate **63** by means of a retainer ring **71** and a plurality of cap screws **72**.

The rotary blow out preventer **21** also includes remotely controlled hydraulically actuated upper and lower lock pin assemblies for facilitating assembly and disassembly of plate **63** and rotatable housing **37** with stationary housing **22**. An upper group of lock pin assemblies comprises a plurality of identical individual lock pin assemblies, one of which is generally indicated by the reference number **73** and shown in detail in FIG. **6**. Lock pin assemblies of the upper group are circumferentially spaced and carried by the upper portion of housing **22** (FIG. **1**). Lock pin assembly **73** comprises an opening in stationary housing **22** defining a first chamber **74** and a second chamber **75** of smaller diameter. A lock pin in the opening includes a piston body portion **76** disposed in first chamber **74** and a pin portion **77**, having a chamfered end, extending through second chamber **75**. A cap **78** is secured to stationary housing **22** to close first chamber **74**. A pair of ports **79** and **80** are formed in stationary housing **22** at opposite ends of first chamber **74** for directing fluid to opposite ends of chamber **75** so as to reciprocally move the piston body portion **76** of the lock pin. Ports **79** and **80** are in fluid communication with a remotely located hydraulic pump (not shown). Two passages **81** and **82** are also formed in stationary housing **22** at the opposite ends of first chamber **74** and communicate with a manifold member **83** having two annular passages **84** and **85**. Manifold member **83** is secured to stationary housing **22** by a plurality of studs **86** and nuts **87**. Each of the annular passages **84** and **85** may be sealed by suitable O-rings or other fluid sealing means **88**. Piston body portion **76** of the lock pin may be sealed within first chamber **74** by suitable O-rings **89** and pin portion **77** may be sealed within second chamber **75** by O-rings **90**.

A plurality of recesses, one of which is shown at **91**, are formed in the outer flared surface of retainer plate **63** in registry with second chambers **75** of the openings in stationary housing **22** when plate **63** is positioned on the stepped flared surfaces of chamber **23** of the housing. It will be readily appreciated that the upper group of lock pin assemblies may be employed to releasably secure retainer plate **63** to the stationary housing **22** in a manner to be described in detail more fully hereinafter.

A lower group of lock pin assemblies engage the lower portion of stationary housing **22**. As seen best in FIG. **1**, each of the identical lower lock pin assemblies comprises an opening in stationary housing **22** including a first chamber **92** and a second reduced diameter chamber **93**. A lock pin is disposed in the opening and comprises a piston head portion **94** disposed in first chamber **92** and a pin portion **95**, having a chamfered end, extending into second chamber **93**. The lock pin is biased outwardly in retracted position within the chambers by a spring **96** seated on the shoulder between the chambers and against the piston head. A cap **97** is secured over the open end of first chamber **92** by a plurality of cap screws to sealingly close the chambers.

Adjacent the outer end of first chamber **92**, a passage **98** is formed in stationary housing **22** so as to connect chamber **92** with an external manifold collar **99**. Collar **99** is secured against the outer surface of stationary housing **22** by a plurality of cap screws and includes an annular passage **100** and a port **101** therein, adapted to be connected to a remotely located source of hydraulic pressure (not shown). Annular passage **100** is sealed by suitable O-rings **102**. It will be seen that the chamfered end of pin portion **95** of the lock pin, when extended from second chamber **93**, will engage the upper inclined shoulder of sleeve retainer nut **31** to prevent axial movement of the sleeve, in a manner to be described more fully hereinafter.

Stationary blow out preventer **18** is secured to the stationary housing **22** of rotary blow out preventer **16**, as previously described, by a plurality of bolts **17**. The exemplary stationary blow out preventer which may be used in the invention is of the type shown in U.S. Pat. No. 3,323,773, issued Jun. 6, 1967 to Walker though, it will be understood that other types of stationary blot out preventers may also be used. Stationary blow out preventer **18** generally comprises a fixed housing **103** having a bore **104** defining a generally cylindrical inner wall to which is attached an upper member **105** having a spherical or curved wall surface **106**. A sleeve **107** is fixedly mounted at the lower portion of fixed housing **103** and defines an annular passage **108** between the outer surface of sleeve **107** and the bore **104** of fixed housing **103**. Disposed in the annular passage **108** is a remotely controlled axially movable actuating member **109** the upper surface of which engages a resilient sealing ring, generally designated by the reference numeral **110**, constructed identically with the rotary blow out preventer resilient sealing ring **42**. A hydraulic port **111** is formed in the lower portion of fixed housing **103** so that hydraulic fluid may be introduced from a remote source to axially movable actuating means **109**.

Prior to describing the operation of present invention in its assemblied form, there follows a brief description of the remote assembly and disassembly feature of the above described rotary blow out preventer. The remote assembly and disassembly feature constitutes an important part of the present invention since in subsea drilling, when the resilient sealing member **42** and stripper become worn, it is necessary to replace this unit from a barge or ship which is at the water surface.

To understand the remote assembly and disassembly feature, it should first be noted that chamber **23** of stationary housing **22** has a largest diameter at the upper portion of the stationary housing and decreases in diameter towards the lower end of the housing. In this manner, it will be seen that the rotating and stationary elements of rotatable assembly **36** and plate **63** comprise a removable unitary subassembly positionable within the chamber **23** and axially upwardly movable out of stationary housing **22** without interference from the stationary housing.

The rotary blow out preventer elements which are axially moveable out of the stationary housing are assembled by sleeving the follower **48**, piston **55**, and bearing means **59** over the sleeve **30** and threadedly engaging the sleeve retainer nut **31** so as to secure these elements together in said slidable relation on sleeve **30**. The sealing member **42** is then seated on follower **48**, the rotatable housing **37** placed over the assembly and secured therewith by retainer ring **53**. Upper bearing **69** and plate **63** are then placed on housing **37**. When this subassembly of plate **63**, sealing member **42**, follower **48**, piston **55**, sleeve and washpipe **30**, and retainer nut **31** is inserted into housing **22**, the support ring **33** is landed on the inclined shoulder **121** on the housing and the tapered stepped circumferential edge face of plate **63** is landed on the complementary outwardly flared stepped face at the upper end of housing **22**. When this subassembly is positioned in chamber **23**, it is locked in place by the upper and lower lock pin assemblies. The sleeve **30** is releasably secured to the stationary housing by hydraulically actuating the lower lock pin pistons so as to force the pin **95** inwardly whereby the chamfered end of the pin portion **95** will engage the upper inclined surface of sleeve retainer nut **31**. It will be readily seen that the sleeve is thereby prevented from axial movement with respect to stationary housing **22**.

To secure rotatable housing **37** within housing **22** the upper lock pin assemblies are also actuated so as to engage retainer plate **63**. Specifically, hydraulic pressure is introduced through port **79** so as to force piston **76** inwardly to project the pin portion **77** into chamber **91** of the retainer plate thereby securing retainer plate **63** against the axial movement out of the rotatable housing **37**.

To remove the subassembly from the stationary housing when the sealing member **42** has become worn, from a remote location, the lower lock pin assemblies are released by relieving the hydraulic pressure on piston head **94** so that spring **96** will cause the pin portion **95** to be retracted from second chamber **93**, thereby allowing retainer nut **31**, and sleeve **30**, to move axially. Simultaneously, the upper group of lock pin assemblies are released by relieving hydraulic pressure in the outer portion of first chamber **74** and through port **79** and directing hydraulic fluid under pressure through port **80** to the inward side of piston body portion **76** so as to retract the lock pin from chamber **91** in retainer plate **63**, thereby freeing retainer plate **63** for axial movement. The subassembly may then be raised to the water surface where the barge or ship is located.

The operation of the assembled apparatus **15** may now be described. The hydraulic passage **58** in stationary housing **22** communicating with the first annular space **35** below piston **55** is connected by hydraulic lines to a hydraulic pressure accumulator located on a barge at the surface. Fluid pressure applied to the piston **55** may be adjustable from zero through a selected maximum pressure and may selectively position the resilient sealing member **42** in a well non sealing position, a pipe string stripping position, or a drilling pipe rotatable position. When no fluid pressure is applied to the piston, the sealing member will be in open relaxed position as shown in FIG. **1** and a drill-string may be inserted into apparatus **20** through the well-tool receiving port formed by upper cylindrical wall **38**.

During a drilling operation sufficient fluid pressure is applied to piston **55** through passage **58** into the annular space **35** so as to force piston **55** and follower **48** upwardly to urge the resilient sealing member **42** upwardly, causing the shoes **45** to slidably engage the inner curved rotatable housing surface **44**. Thus the shoes **45** move upwardly and inwardly towards the axis of the housing and translates the axial motion of sealing member **42** into an inward flow and contraction of the resilient material of the sealing member into a closed sealing position. When such pressure forces the resilient sealing member to exert a strong radially inwardly directed force upon the well-tool, rotation of the drill string will cause rotation of the rotatable assembly **36** due to the frictional contact between the string and the sealing member. A constant pressure seal is thus provided between the sealing member **42** and the string. This pressure seal is maintained while the drilling string is rotating and while pipe couplings, collars or other projecting portions of the drill string are being passed through the sealing member **42**.

During a stripping operation, that is retraction or withdrawal of a well-tool or pipe through the sealing member, an intermediate fluid pressure is selected so that the resilient sealing member **42** remains in selected pressure sealing contact with the well-tool while it is being withdrawn from the stationary housing, even when collars or other portions of the drill string are pulled through the sealing member **42**. However, the pressure need not be so great that the rotating assembly would rotate with the well-tool without any slippage.

It will therefore be seen that the rotary blow out preventer provides a rotatable resilient sealing member which may exert a varying pressure upon a well-tool to form a desired seal selected by controlling the fluid actuating pressure commensurate with the operation to be performed, i.e., nonsealing, stripping, or rotation. Unlike various prior art devices, however, the rotary blow out preventer of this invention, because of a selective pressure which may be applied between the resilient sealing member and the well-tool, will avoid rapid deterioration and wear of the resilient sealing mass of material, since by applying maximum pressure to the sealing means prior ro commencing rotation of the well-tool there will be little slippage between the well-tool and sealing means when overcoming inertia of the rotatable assembly. Furthermore, the rotary blow out preventer provides a simple efficient seal between the rotatable assembly and the stationary housing as well as between the resilient material and the well-tool.

Another important feature of the present invention is the novel cooperation between static blow out preventer **18** and the rotary blow out preventer **16** during operation. It will be understood that the resilient sealing member, which may identical in the rotary and the static blow out preventers, can be used to provide a complete shutoff of the well hole. The position of the resilient sealing members in full shutoff position is illustrated in FIG. **5**, and is described in U.S. Pat. No. 3,323,773, issued to Walker, June 6, 1967. It is important to note that the resilient sealing member in each of the blow out preventers can be positioned so as to completely shut off the well hole even in the absence of any drilling string. Thus, when the resilient sealing member in the rotary blow out preventer has become worn, the static blow out preventer may be actuated so that the resilient sealing member **110** will completely close the well hole and the above-described subassembly may then be withdrawn from the rotary blow out preventer so that the resilient sealing member may be replaced. The static blow out thereby prevents the escape of any gas or mud during the replacement operation of the resilient sealing member **42**. It will be seen that the apparatus **15** therefore, provides means to prevent the escape of gas or mud from the well hole in the absence of any drilling string, when such drilling string is stripped, or when the drilling string is rotated. Consequently, it will be appreciated that control of the gas, mud, and well pressures by apparatus **15** is operative during an entire drilling operation. It will further be noted that the apparatus **15** will accommodate a variety of cross-sectional shapes of mandrels which can be effectively sealed off including a square Kelly mandrel or one that is polygonally shaped.

Obviously many modifications and variations of the present invention in the light of the above teachings. It is therefore to be understood, that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. In a rotary blow out preventer construction for use in drilling, stripping and production well operations, the combination of:

stationary housing means comprising an enlarged axially extending chamber having a top opening provided with a top inclined landing surface and a reduced coaxially aligned bottom opening provided with a bottom inclined landing surface;

a blow out preventer unit releasably mounted in said enlarged chamber in coaxial relation therewith and including stationary top and bottom means having faces cooperable with said top and bottom landing surfaces for positioning said unit in said enlarged chamber;

a rotatable assembly antifrictionally mounted between said top and bottom stationary positioning means and including a rotatable housing;

a resilient seal member cooperable with said rotatable housing and having an axial passageway adapted to radially contract to close said passageway; and

means movable axially of said chamber for selectively applying pressure to said resilient seal member to close flow of resilient material of said seal member to selectively close said passageway including gripping a well tool in the passageway for rotation of the seal member therewith.

2. A blow out preventer construction as stated in claim **1** wherein said means for applying pressure to said resilient seal member includes

a rotatable follower means for said resilient seal member; and

a nonrotatable piston means for actuating the follower means.

3. In a rotary blow out preventer construction for use in drilling, stripping and production well operations, the combination of:

stationary housing means comprising an enlarged axially extending chamber having a top opening and a reduced coaxially aligned bottom opening;

a blow out preventer unit releasably mounted in said enlarged chamber in coaxial relation therewith and including stationary top and bottom means for landing and positioning said unit in said enlarged chamber;

a rotatable assembly antifrictionally mounted between said top and bottom stationary landing means and including a rotatable housing;

a resilient seal member cooperable with said housing and having an axial passageway adapted to radially contract to close said passageway;

means movable axially of said chamber for selectively applying pressure to said resilient seal member to cause flow of resilient material of said seal member to selectively close said passageway including gripping a well tool in the passageway for rotation of the seal member therewith;

releasable top and bottom lock pin means carried by said stationary housing cooperable with said top and bottom stationary means of said blow out preventer unit; and

means for releasing said top lock pin means from a remote location whereby said blow out preventer unit is releasable from said stationary housing.

7. In a rotary blow out preventer construction for use in drilling, stripping and production well operations, the combination of:

stationary housing means comprising an enlarged axially extending chamber having a top opening and a reduced coaxially aligned bottom opening;

a blow out preventer unit releasably mounted in said enlarged chamber in coaxial relation therewith and including stationary top and bottom means for landing and positioning said unit in said enlarged chamber,

a rotatable assembly antifrictionally mounted between said top and bottom stationary landing means and including a rotatable housing,

a resilient seal member cooperable with said housing and having an axial passageway adapted to radially contract to close said passageway;

means movable axially of said chamber for selectively applying pressure to said resilient seal member to cause flow of resilient material of said seal member to selectively close said passageway including gripping a well tool in the passageway for rotation of the seal member therewith;

said bottom stationary landing means including an axial sleeve member within said stationary housing cooperable with said means for applying pressure for guiding said pressure applying means during axial movement thereof; and

retainer means on said sleeve member seated on said stationary housing adjacent its bottom opening.

5. A construction as stated in claim **4** wherein said means for selectively applying pressure includes:

piston means in an annular space defined by said sleeve member and said stationary housing and axially slidably movable along said sleeve member and said housing.

6. A construction as stated in claim **5** wherein said means for selectively applying pressure includes:

follower means providing a seat for said resilient seal member and slidably sealingly engaging said sleeve member and said rotatable housing.

7. A construction as stated in claim **4** including bearing means positioned between said piston means and said follower means.

8. In a rotary blow out preventer construction for use in well operations, the combination of:

stationary housing means comprising an enlarged axially extending chamber having a top opening provided with a top inclined landing surface and a coaxially aligned bottom opening provided with a bottom inclined landing surface;

a blow out preventer unit mounted in said enlarged chamber in coaxial relation therewith and having landing faces cooperable with said top and bottom landing surfaces;

said blow out preventer unit including a rotatable assembly mounted for rotation in said chamber;

said rotatable assembly including a rotatable housing;

a resilient seal member rotatable with said housing and having an axial passageway adapted to radially contract to close said passageway; and

means movable axially of said chamber for radially contracting said resilient seal member to cause flow of said resilient material against a well tool in said passageway for frictionally gripping said tool, whereby gripping of said tool prior to and during rotation thereof and imparting rotation to the resilient seal member upon rotation of the well tool avoids slippage therebetween and reduces wear of the resilient member.

9. In a rotary blow out preventer construction for use in well operations, the combination of:

a stationary housing means provided with a top landing surface and a bottom landing surface and having an axially extending chamber between said surfaces;

a rotatable blow out preventer unit within said chamber;

retaining means landed on said top landing surface;

a stationary bearing means between one end of said rotatable unit and said retaining means;

axially movable means at the other end of said rotatable unit;

a bearing means carried by said axially movable means and rotatably supporting the other end of said rotatable unit;

guide means carried on said bottom landing surface and cooperable with said axially movable means;

said blow out preventer unit including a resilient seal member flowable radially inwardly upon axial movement of said movable means in one direction.

10. In a blow out preventer construction as stated in claim **9** wherein said axially movable means includes

a nonrotatable piston means supporting said last mentioned bearing means; and

a rotatable follower means for said resilient seal member supported on said last mentioned bearing means.

11. In a blow out preventer construction for use in drilling, stripping and production well operations and retaining control of well fluids under repair conditions comprising the combination of:

a external stationary housing means including an enlarged upper blowout preventer chamber and a lower blow out preventer chamber;

means between said chambers for passage of well fluid from said housing means;

a rotatable blow out preventer unit landed on and carried by said stationary housing means in said upper chamber;

a nonrotatable blow out preventer unit carried by said stationary housing means in said lower chamber;

said blow out preventer units and said housing being provided with an axial through passageway for a pipe string.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,561,723 Dated February 9, 1971

Inventor EDWARD T. CUGINI

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

column 6, line 48, delete [said].

Column 7, line 23, hyphenate "non sealing".

Column 8, line 4, after "may", insert --be--; same column 8, line 59, delete [close] and insert --cause--.

Column 9, line 23, delete [7] and insert --4--; same column 9, line 61, delete [4] and insert --6--.

Column 10, line 53 [a] and insert --an--; same column 10, line 63, delete [.] and insert --;-- and add

--each of said blow-out preventer units including a resilient seal member and axially movable means actuatable independently of the other unit for radially contracting said seal member to close said passageway;

said rotatable blow-out preventer unit being actuatable to seal said passageway about a pipe string and to rotate with said string;

means for releasably locking said rotatable blow-out preventer unit in said upper chamber of said stationary housing means whereby said rotatable unit may be withdrawn from said stationary housing means while said non-rotatable blow-out preventer unit is actuatable to close said passageway;

said rotatable blow-out preventer unit including

a top stationary means landed on said stationary housing means;

said means for radially contracting said seal mea including

a rotatable follower means for said resilient sea member of said rotatable blow-out preventer unit;

and a non-rotatable piston means for actuating sa follower means.--

Signed and sealed this 14th day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents