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COMBINATION STRIPPER AND BLOWOUT PREVENTER

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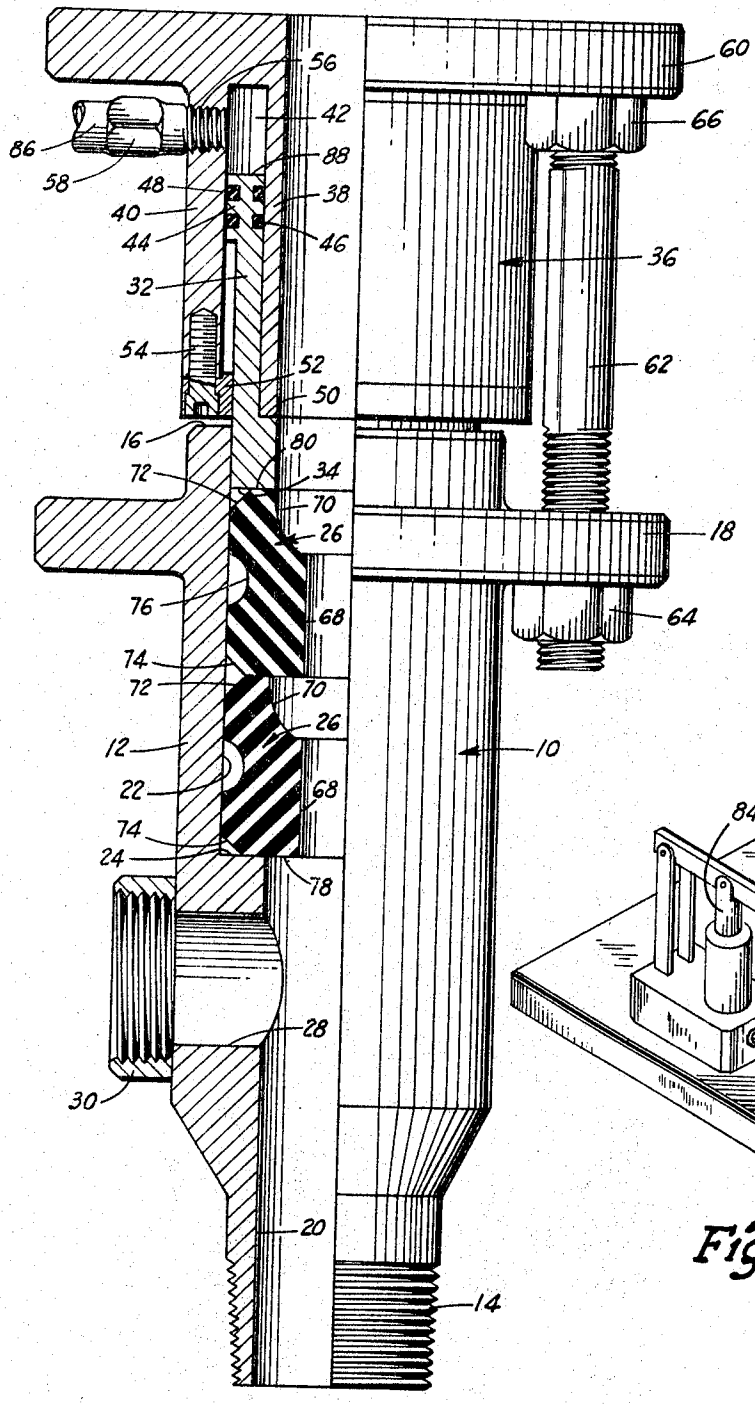


Fig. 1

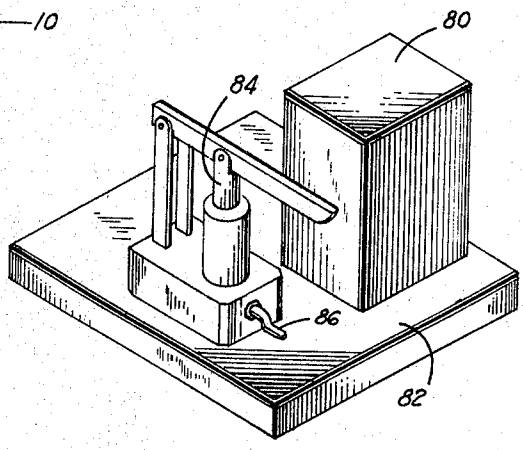


Fig. 2

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COMBINATION STRIPPER AND BLOWOUT PREVENTER

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This invention relates to improvements in oil and gas well apparatus and more particularly, but not by way of limitation, to a combination stripper and blowout preventer for utilization during the completion of a well or during servicing or workover operations on a producing well.

Subsequent to the drilling of an oil or gas well bore, the well is prepared for production of fluid in the manner best suited to the subsurface conditions. Perhaps the most common completion method comprises the setting of a final string of casing, known as the oil string, which usually extends from the surface of the ground to the top of or through the subsurface producing zone or oil sand. The oil string is usually then cemented in place and perforated in the vicinity of the producing zone in order that the well fluid may enter the casing. Since the casing normally remains in the well bore for an extended period of time and repair or replacement thereof is expensive, it is the usual practice to insert a tubing string through the casing and suspend the tubing therein in order that the well fluid may flow therethrough to the surface of the well bore. When the normal pressures within the well bore are insufficient for elevating the fluid through this central tubing, commonly called the flow string, a pump or other means may be supported by the tubing for providing an artificial lift of the fluid through the tubing. This flow string may be more easily removed from the well bore for repair work than the cemented casing.

In order to conserve steel materials, many well completion operations today utilize relatively small diameter casing for the oil string as compared to the larger casing, and this smaller casing is often referred to as tubing. Of course, in these installations, the flow string is also of a smaller diameter. Since there is frequently excessive pressure within the well bore, it is desirable to provide a packing device, known as a blowout preventer, around the inner tubing or flow string during the installation thereof within the set casing. This substantially precludes the accidental escape of high pressure from the surface of the well. In addition, it is usually desirable to provide a stripper around the flow string for bearing against the outer periphery thereof as the tubing is lowered within the casing.

The flow string and any pumping equipment, or other artificial lift apparatus carried thereby, is subject to deterioration during the production of the well fluid and it often becomes necessary to pull the flow string as well as the pumping equipment from the bore in order to repair or replace portions thereof. During this operation, usually referred to as stripping, it is considered necessary to install a blowout preventer at the surface of the well to preclude loss of fluid due to excessive pressures in the bore. In addition, it is usually necessary to provide a stripper device around the flow string, or sucker rods, or any other tubing being removed from the well bore during the remedial work or servicing of the well. As a result, it is usually necessary to install at least two tools or devices in connection with this portion of the servicing operation or in the well completion operations, and in many instances, three or four separate tools are required.

The present invention contemplates a novel combination stripper and blowout preventer which may be utilized in both well completion work and remedial or workover

operations. The novel tool may be used in lieu of the three or four tools usually required in these circumstances. The tool comprises a housing which may be secured directly to the well head or other suitable surface connection member and is provided with a plurality of packer members of a particular inner and outer configuration for packing off the annular space between the flow string and the housing. Means is carried by the housing which may be either mechanically or fluid operated for longitudinally compressing the packing members to assure an efficient sealing around the flow string, sucker rods, or the like, as well as the inner periphery of the housing. The particular configuration of the sealing or packing member is such that the inner periphery thereof will close completely if there is no tubing inserted therethrough, thus providing a sealing off of an open hole, if desired. The inner periphery of the packing members functions to strip the tubing when either putting the tubing in the hole or pulling it out of the hole. Thus, this one novel tool may be utilized for at least three separate and independent functions, namely as a blowout preventer, a stripper, or as a complete shut-off blowout preventer. The novel combination blowout preventer and stripper is simple and efficient in operation and economical and durable in construction.

It is an important object of this invention to provide a single tool for an oil well installation which may be utilized in lieu of a plurality of conventional tools presently required in certain well bore operations.

It is another object of this invention to provide a combination stripper and blowout preventer having packing members of a particular configuration for efficiently sealing the annular space between an outer housing and the flow string, or the like, of a producing well.

Another object of this invention is to provide a novel combination stripper and blowout preventer for oil or gas wells which may be operated either by fluid power or manually.

Still another object of this invention is to provide a novel tool for utilization with an oil or gas well to perform a plurality of functions in a single unit.

Other and further objects and advantageous features of the present invention will hereinafter more fully appear in connection with a detailed description of the drawings in which:

FIGURE 1 is an elevational view partly in section depicting a combination stripper and blowout preventer embodying the invention.

FIGURE 2 is a perspective view depicting a general arrangement for fluid operation of the device depicted in FIGURE 1.

Referring to the drawings in detail, reference character **10** generally indicates a combination stripper and blowout preventer device comprising a substantially cylindrical housing or body **12** having a threaded stem portion **14** provided at one end thereof for connection with a well head (not shown) or the like, normally found at an oil or gas well site. The opposite end **16** of the housing **12** is open for a purpose as will be hereinafter set forth and an outwardly extending circumferential flange **18** is provided on the outer periphery of the housing **12** spaced from the open end **16**. A central bore **20** extends longitudinally through the housing **12** and is enlarged at **22** to provide an inwardly directed annular shoulder **24** for supporting a plurality of stacked resilient members generally indicated at **26**. A radially extending port **28** is provided in the housing **12** to provide communication between the interior of the bore **20** and the exterior of the housing **12**. A suitable threaded connection member or collar **30** may be secured on the outer periphery of the housing **12** in any suitable manner (not shown) and in alignment with the bore **28** for receiving a suitable fitting

(not shown) to permit discharge of well fluid from the bore **20** as is well known.

A cylindrical piston **32** is slidably disposed in the open end **16** of the housing **12** and the lower end **34** thereof bears against the uppermost resilient member **26** as clearly shown in FIGURE 1. A follower cap member generally indicated at **36** is slidably disposed around the piston **32** and comprises an inner sleeve **38** concentrically arranged with an outer sleeve **40** for receiving the piston **32** within the annular space **42** therebetween. The upper end of the piston **32**, as shown in FIGURE 1, is provided with an outwardly extending circumferential shoulder **44** whereby the inner periphery of the piston **32** and outer periphery of the flange **44** engages the sidewalls of the annular chamber **42** for guiding any reciprocal movement of the piston **32** with respect to the follower **36** as will be hereinafter set forth in detail. It is preferable to provide a plurality of longitudinally spaced annular sealing ring members **46** on the inner periphery of the piston **32** to provide a sealing engagement with the outer periphery of the inner sleeve **38** and a plurality of spaced sealing rings **48** on the outer periphery of the flange **44** for sealing engagement with the inner periphery of the outer sleeve **40**. An inwardly directed annular shoulder **50** is provided on the inner periphery of the piston **32** for engaging one end of the inner sleeve **38** in one relative position therebetween. An annular ring **52** is removably secured to the lower end of the outer sleeve **40** in any well known manner such as by a plurality of threaded stud members **54**. The ring **52** is preferably of an outer diameter substantially equal to the outer diameter of the sleeve **40** and an inner diameter of a size for slidable engagement with the outer periphery of the piston **32**. The ring **52** provides a stop to engage the flange **44** for limiting the movement of the piston **32** in one direction within the annular chamber **42**.

A threaded aperture **56** is provided in the outer sleeve **40** for receiving a suitable fitting member **58** whereby fluid pressure may be injected into the annular chamber **42** as will be hereinafter set forth. In addition, an outwardly extending circumferential flange **60** is provided at the upper end of the follower member **36** and is provided with a plurality of circumferentially spaced apertures (not shown) disposed in substantial alignment with similarly spaced apertures (not shown) provided in the flange **18** of the housing **12**. The flanges **18** and **60** may be interconnected by means of a plurality of spaced stud members **62** extending through the aligned apertures and secured therein by suitable locking nuts **64** and **66** as is well known.

The packing members **26** may be constructed from any suitable resilient material such as rubber, neoprene, or the like, and is provided with a central bore **68** extending therethrough adapted to engage the outer periphery of the tubing string or flow string (not shown) with which the apparatus **10** is being utilized. The bore **68** is enlarged at **70** and the cross-sectional configuration of the enlarged portion **70** is preferably arcuate as clearly shown in the drawings. The outer periphery of the resilient member **26** may be chamfered at both ends as shown in **72** and **74** and an annular recess **76** is provided around the outer periphery of the resilient member **26** preferably substantially centrally disposed between the chamfered portions **72** and **74**. The cross-sectional configuration of the recess **76** is preferably arcuate as shown in FIGURE 1 and the outer periphery of the resilient member **26** disposed between the recess **76** and the opposite chamfered **72** and **74** is preferably substantially straight for engaging the inner periphery of the housing **12**. The relatively long internal bore **68** provides an efficient sealing around the flow string (not shown), sucker rods (not shown), or the like, extending throughout the device **10**. The outer periphery of the resilient members **26** provides an efficient sealing with the housing **12**. The bottom and top surfaces **78** and **80**, respectively, of the resilient members

26 as shown in FIGURE 1 are preferably substantially flat whereby a plurality of the packing members **26** may be superimposed within the housing **12**. Of course, the lowermost packing member **26** is supported by the shoulder **24** and the uppermost packing **26** is engaged by the piston **32** whereby longitudinal force or pressure may be exerted on the plurality of packing members **26** disposed within the housing **12**.

Referring now to FIGURE 2, fluid may be supplied to the annular chamber **42** of the follower member **36** by means of suitable surface equipment as shown diagrammatically herein. A fluid reservoir **80** may be mounted on a suitable base **82** which in turn is installed in the proximity of the apparatus **10** in any well known manner (not shown). Of course, the reservoir **80** and base structure **82** may be separated from the apparatus **10** by as much as fifty feet, if desired, and is not limited to any particular spacing or position with respect to the device **10**. A suitable pump **84** may be mounted on the base structure **82** and connected with the reservoir **80** in any well known manner (not shown) for moving the fluid from the reservoir **80** through an outlet conduit **86** which extends from the pump **84** to the fitting **58**. The actuation of the pump **84** draws the fluid from the reservoir **80** through the conduit **86** and into the annular chamber **42** of the follower cap **36**. The fluid in the chamber **42** acts upon the outer surface **88** on the piston **32** for urging the piston **32** in a direction toward the packing members **26**. The downward movement of the piston **32** compresses the packings **26** and the particular configuration of the packings **26** causes the deformation thereof to greatly enhance the sealing between the flow string (not shown) and the inner periphery of the housing **12** as will be hereinafter set forth in detail.

Operation

The combination stripper and blowout preventer may be installed around the flow string, sucker rods, or other tubular members in a well bore (not shown) by threaded connection at **14** with the well head (not shown) or the like. With the novel tool **10**, utilized in position around the tubing or flow string, particularly tubing of a relatively small outer diameter, the packing members **26** will engage the outer periphery of the flow string and function as a blowout preventer.

Referring now to FIGURE 1, the plunger or piston **32** is depicted in the uppermost position with respect to the follower cap **36**. A suitable fluid, such as oil, water, or the like, may be introduced into the annular chamber **42** above the piston **32** by means of the pump **84**. As fluid is introduced into the chamber **42**, an equal force will be exerted in all directions against the sides of the chamber **42** and the outer end **88** of the piston **32**. Since the follower **36** cannot move in an upward direction because of the connection with the flange **18**, the force exerted on the piston **32** will urge the piston downwardly against the resilient members **26** to exert a longitudinal pressure thereon. This force exerted on the packings causes the packings to deform in such a manner that the internal bore **68** thereof is urged radially inward into a tight sealing engagement with the outer periphery of the tubing extending therethrough. In addition, the outer periphery of the packings **26** are simultaneously urged radially outwardly to form an efficient sealing engagement with the inner periphery of the housing **12**. This is action enhanced by the annular groove **76** provided on the outer periphery of the packing members **26**. Even though considerable wear may occur to the packing rings **26**, particularly on the inner periphery thereof, an increased longitudinal pressure by the piston **32** will maintain an efficient seal between the housing **12** and flow string to provide a prolonged and efficient life for the packing **26**.

Of course, well fluid may enter the casing **12** through the bore **20** and since it cannot move upwardly around the resilient members **26**, the well fluid will be directed

outwardly through the bore 28 and collar 30 for discharge or accumulation in auxiliary equipment as is well known. When the well tubing or flow string is being pulled from the well bore (not shown), the inner bore 68 of the packing members 26, being relatively long, provide an efficient stripping of the outer periphery of the tubing. In addition, when the tubing or flow string has been completely removed from the well, the inner bore 68 of the packing members 26 will contract radially inward to completely close the bore upon the application of sufficient fluid pressure in the chamber 42, thus sealing off the open hole.

In the event that it is desired to provide manual operation of the device 10, the piston 32 may be moved downwardly by rotation of the studs 62 extended between the flanges 18 and 60. In this instance, a hydraulic fluid will be injected into the chamber 42 and sealed therein by either plugging of the aperture 56 or through the use of the fitting 58 which may be of any suitable type for checking any back flow of the fluid or precluding passage of the fluid in reverse direction from the chamber 42. The hydraulic fluid trapped within the annular space 42 will provide a lock between the end 88 of the piston and the closed upper end of the chamber 42 and thus, the downward movement of the cap 36 upon rotation of the studs 62 in the proper direction will be transferred to the piston 32 regardless of position thereof with respect to the inner sleeve 38. It is to be noted that the engagement between the flange 44 and the ring 52 limits the movement of the piston 32 in one direction and engagement of the shoulder 50 with the inner sleeve 38 limits the movement of the piston 32 in an opposite direction.

It has been found that the resilient members 26 provide an efficient seal at pressures up to 6,000 pounds per square inch when utilized as a blowout preventer. It has also been found that the packing members will withstand pressures up to 3,000 pounds per square inch while rotating the flow string through a time period of 24 hours and using only one set of the packers. In addition, the apparatus has been tested and found to withstand pressures up to 3,000 pounds per square inch when the flow string has been removed from the well and the device 10 is being utilized as a complete shut-off blowout preventer.

From the foregoing, it will be apparent that the present invention provides a novel combination stripper and blowout preventer which may be used for efficient stripping of wire lines, sucker rods, relatively small diameter tubing, or the like, when these rods or tubing members are either coming in or going out of a well bore under pressure. Furthermore, the overall structure of the device is such that the upper surface thereof can support the spider or slips when these devices are in use in connection with the well operation. The resilient members function efficiently to perform multiple operations and are particularly designed and contracted to provide a prolonged useful life therefor. The device may be either manually operated or hydraulically operated by remote control, if desired. The novel combination stripper and blowout preventer provides a plurality of functions in a well servicing or well completion operation through the use of a single unit. The novel tool is simple and efficient in operation and economical and durable in construction.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings, it being understood that any modification in the precise embodiment of the invention may be made within the scope of the following claims, without departing from the spirit of the invention.

What is claimed is:

1. In a tool of the character described, a housing, resilient means disposed within and supported by the housing, cylindrical piston means slidably disposed within the housing and in engagement with one of said resilient means, and follower means cooperating with the slidable means for urging the slidable means in a direction toward the resilient means to apply pressure thereagainst, said follower means including a pair of spaced cylindrical sleeves for receiving the piston means therebetween, said resilient means being of a configuration whereby the inner and outer peripheries thereof expand in opposite radial directions upon the application of said pressure thereagainst.

2. A combination stripper and blowout preventer comprising a housing, a plurality of resilient members supported within the housing, cylindrical plunger means slidably disposed within the housing and in engagement with one of said resilient members, follower means secured to the housing and engageable with the plunger means for urging the plunger in a direction toward the resilient members to apply pressure thereto, said follower member including a pair of spaced cylindrical sleeves for receiving the plunger therebetween, and said resilient members being deformable upon the application of said pressure whereby the inner periphery thereof is urge radially inwardly and the outer periphery thereof simultaneously is urged radially outwardly.

3. A combination stripper and blowout preventer comprising a substantially cylindrical body, an inwardly directed annular shoulder provided on the inner periphery of the body, a plurality of substantially annular resilient members disposed within the body and supported by the shoulder, a substantially cylindrical piston member slidably disposed within the body and in engagement with one of the resilient members, a follower member having a pair of spaced concentric sleeves for receiving the piston therebetween and engageable with the piston member, and means cooperating between the body and the follower member for urging the piston member in a direction toward the resilient members for compression thereof.

4. A combination stripper and blowout preventer as set forth in claim 3 wherein each resilient member comprises a resilient body portion having a substantially straight walled central bore extending therethrough, an enlarged portion provided at one end of the central bore, the outer periphery of the body portion being provided with a substantially centrally disposed annular recess to facilitate deformation of the packing member whereby the inner periphery thereof is urged radially outwardly under compression.

5. A combination stripper and blowout preventer comprising a substantially cylindrical body, an inwardly directed annular shoulder provided on the inner periphery of the body, a plurality of substantially annular packing members disposed within the body and supported by the shoulder, a substantially cylindrical piston member slidably disposed within the body and in engagement with one of the packing members, a follower member engageable with the piston member and comprising a pair of concentrically arranged sleeves having an annular space therebetween for slidably receiving the piston, means for limiting the movement of the piston in opposite longitudinal directions within the annular space, means for inserting a fluid within the annular chamber for acting on one end of the piston, and means cooperating between the body and the follower member whereby the piston may be urged in a direction toward the packing members by either fluid or manual power for compression thereof.

6. A combination stripper and blowout preventer as set forth in claim 5 wherein each packing member comprises a resilient body portion having a substantially straight walled central bore extending therethrough, an enlarged recess portion provided at one end of the central bore, the outer periphery of the body portion being provided with a substantially centrally disposed annular recess to facilitate deformation of the packing member whereby the inner periphery thereof is urged radially inwardly and the outer periphery thereof is urged radially outwardly under compression.

7. A combination stripper and blowout preventer comprising a substantially cylindrical housing, an inwardly directed shoulder provided on the inner periphery of the housing, a plurality of superimposed resilient annular

packing members disposed in the housing and supported by the shoulder, a substantially cylindrical piston slidably disposed in the housing and in engagement with the uppermost packing member, a follower member comprising a pair of conentrically arranged sleeve members having an annular space therebetween for slidably receiving one end of the piston member therein, stop means cooperating between the follower member and piston member for limiting the longitudinal movement of the piston with respect to the follower member, sealing means carried by the piston member for sealing against the sidewalls of the annular space, means for injecting a fluid into the annular space for action on the end of the piston disposed therein, an outwardly extending circumferential flange provided on the outer periphery of the housing, a complementary outwardly extending flange provided on the outer periphery of the follower member, and threaded stud means extending between the flanges for securing the follower to the housing whereby the follower will urge the piston in a direction toward the packing member by either fluid or manual power for longitudinal compression of the packing members.

8. A combination stripper and blowout preventer as set forth in claim 7 wherein each packing member comprises a resilient body portion having a substantially straight walled central bore extending therethrough, an enlarged portion provided at one end of the central bore, the outer periphery of the body portion being provided with a substantially centrally disposed annnular recess to facilitate deformation of the packing member whereby the inner periphery thereof is urged radially inwardly and the outer periphery thereof is urged radially outwardly under compression.

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