Sept. 24, 1963 F. A. STREET 3,104,882

PACKING DEVICE

Filed Aug. 25. 1960 3 Sheets-Sheet 1

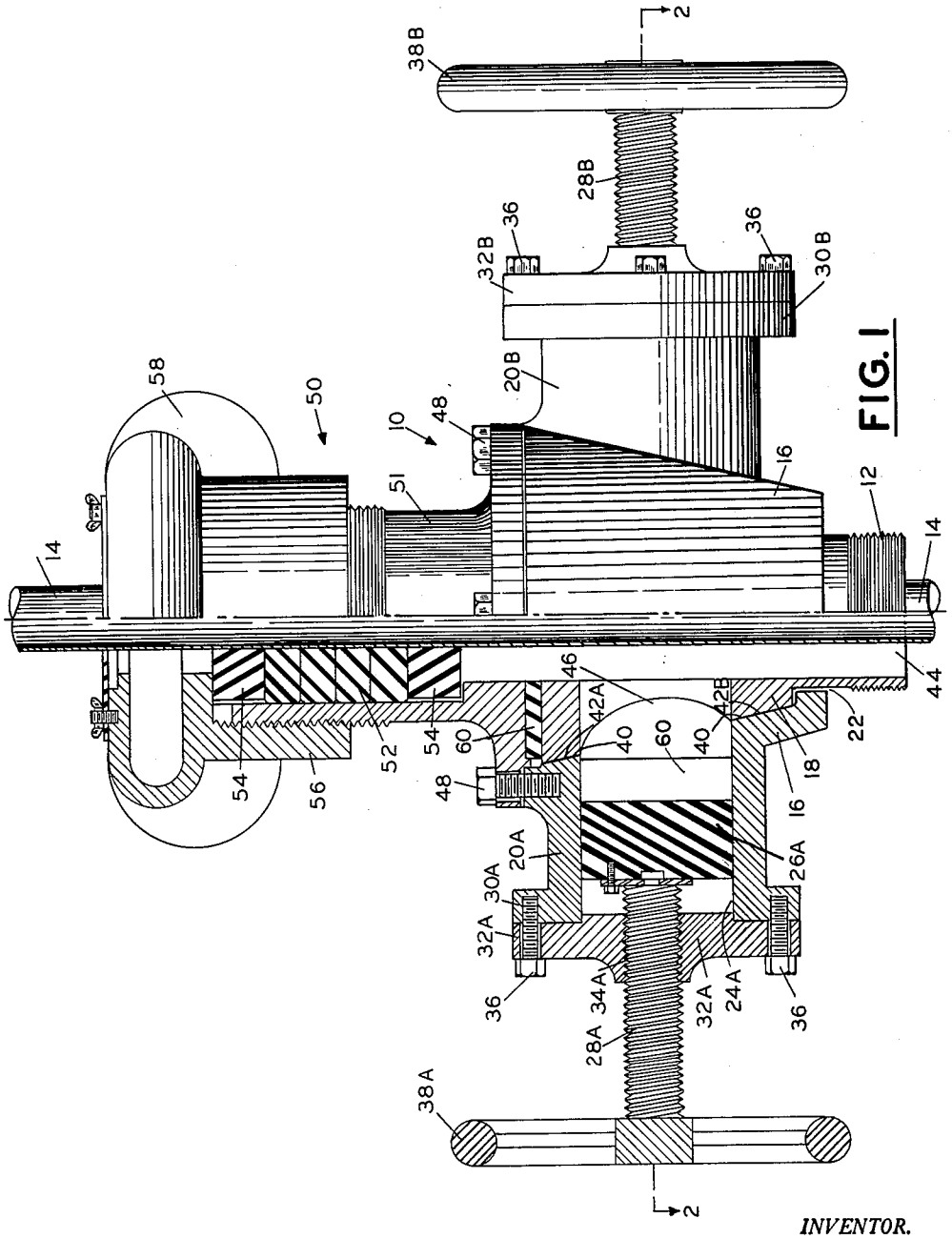


FIG. 1

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PACKING DEVICE

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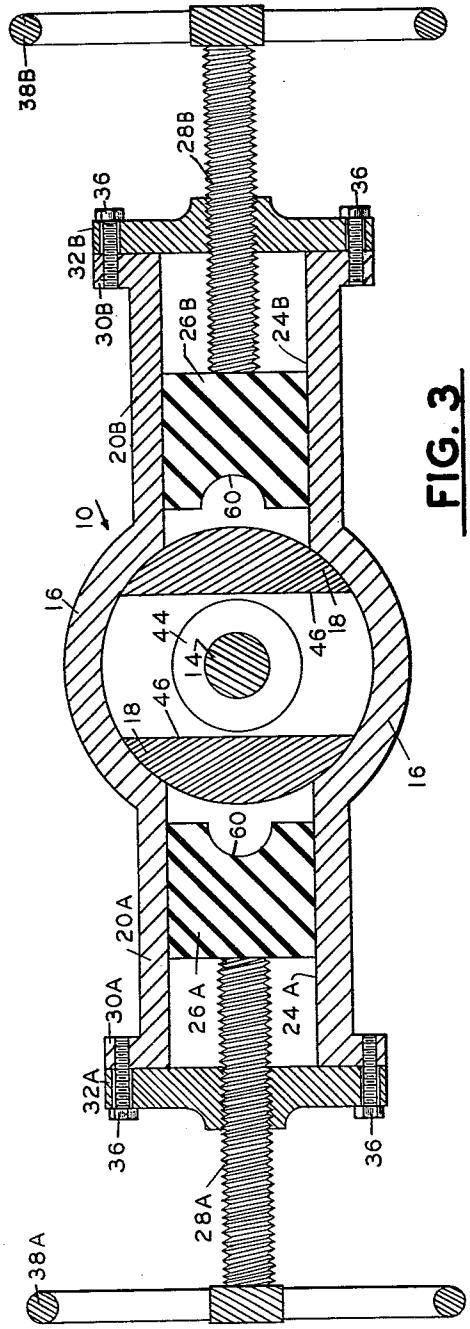


FIG. 3

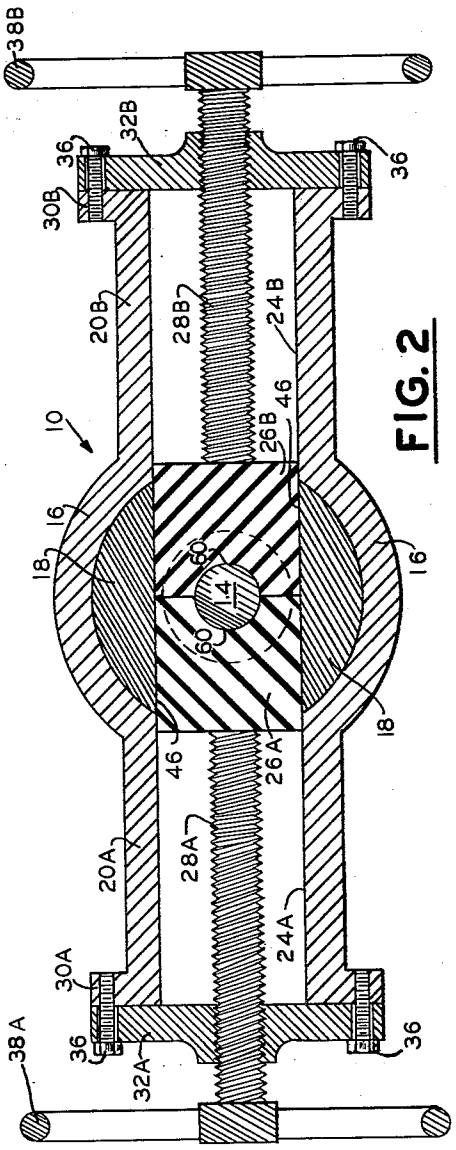


FIG. 2

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PACKING DEVICE

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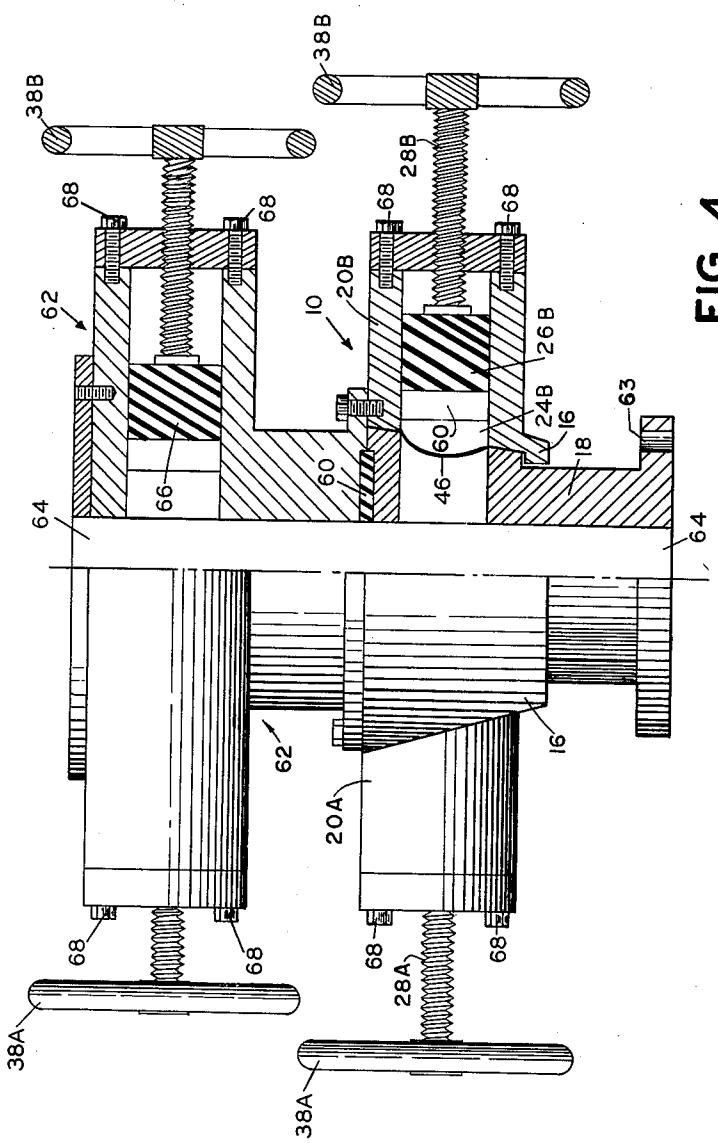


FIG. 4

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3,104,882
PACKING DEVICE

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7 Claims. (Cl. 277—9)

This invention relates to a packing device. More particularly the invention relates to a novel packing device adaptable for use in stuffing boxes, blowout preventers and so forth wherein multiple packing is used and including means whereby all portions of the packing may be changed while the device is under pressure and, in most instances, while the mechanism to which the device is affixed is in operation.

Stuffing boxes are readily available on the market which include double packing arrangements so that reserve packing may be engaged to seal the rod, pipe or shaft, which the stuffing box is designed to pack, while the working packing is being replaced. In this manner others have attempted to provide stuffing boxes enabling the working packing to be repacked while the stuffing boxes are under pressure, or while the mechanism is being used, but these devices do not provide means whereby both the working and the reserve packing may be replaced while the stuffing box is under pressure.

In the petroleum industry, duplex stuffing boxes are often provided having one set of packing below and a second set of packing above in a tandem arrangement around an oil well polished rod. The upper packing is readily accessible and is the packing ordinarily used to seal off the polished rod to prevent the well from leaking. When the upper packing wears the lower packing is engaged to retain the pressure of the well while the upper packing is removed and replaced. This system works satisfactorily except that when eventually the lower packing must be replaced there is no means of closing off the well.

A similar situation exists in the arrangement of blowout preventers as used in oil well drilling. Under the present arrangements, a series of blowout preventers are stacked in tandem, one for each of the various sizes of pipes and drill stems that are used in the drilling operation. As each blowout preventer is stacked above the other, it is possible to close lower blowout preventers to replace the packing of the upper blowout preventers but no method is available whereby the lower blowout preventers may be opened if the well is under pressure for repacking. The device of this invention provides a means of constructing blowout preventers whereby the packing may be readily changed to fit the size pipe desired, even though the well is under pressure.

The packing used around the shafts of boat propellers and submarine propellers introduce a difficult maintenance problem. In order to repack the shafts of boats and submarines they must be placed in dry dock or removed from the pressure of the water outside, otherwise when the packing is removed from the shafts, water would rush from outside of the boat or submarine to fill the inside. Under the principles of this invention it is possible to repack boat and submarine propeller drive shafts while the crafts are still in the water, and in fact, while in the water and in operation.

It is therefore an object of this invention to provide a packing device adaptable for use with a duplex packing arrangement including means whereby both packings may be replaced while the packing device is under pressure.

Another object of this invention is to provide a packing device adaptable for use in conjunction with blowout preventers whereby the packing of said blowout

preventers may be changed while the well to which the blowout preventer is applied is under pressure.

Another object of this invention is to provide a packing device having opposed packing rams arranged whereby the packing rams may be withdrawn and the device rotated whereby pressure on the packing rams is removed.

Another object of this invention is to provide a packing device for use on boats and submarines adaptable for use in conjunction with a multiplicity of other types of packing devices whereby the total packing surrounding a propeller shaft may be removed and replaced while the shaft is in operation and under water pressure.

Another object of this invention is to provide means whereby objects, such as tools, may be passed through a pressure separating wall.

Another object of this invention is to provide a packing device adaptable for use in conjunction with a shaft wherein the packing may be replaced while the shaft is under pressure and wherein the device is simply constructed and economical to manufacture and assemble.

These and other objects and a better understanding of the invention may be had by referring to the following description and claims taken in conjunction with the attached drawings in which:

FIGURE 1 is a side view of the device of this invention, shown partly in cross-section, as the device is used in conjunction with a typical oil well stuffing box applied to serve as a stuffing box for a polished rod to prevent oil from flowing past the polished rod and out of the well.

FIGURE 2 is a cross-sectional view taken along the line 2—2 of FIGURE 1 showing the packing rams of the device closed on the polished rod wherein pressure is relieved from the upper stuffing box packing so that the upper packing may be freely removed without the pressure of the well escaping to the atmosphere.

FIGURE 3 is a cross-sectional view likewise taken along the line 2—2 of FIGURE 1 but wherein the packing rams of the device have been released from engagement with the polished rod and wherein the mechanism has been rotated so that pressure from the well is no longer applied to the rams whereby the packing rams may be replaced without the pressure of the well escaping to the atmosphere.

FIGURE 4 is a side view, shown partly in cross-section, of an arrangement of the device of this invention in conjunction with a blowout preventer, demonstrating the adaptation of the invention for use in blowout preventers.

Referring now to the drawings, and first to FIGURE 1, the packing device of this invention is indicated generally by the numeral **10**. The device of FIGURE 1 is shown as it would be typically applied to an oil well wherein threads **12** would screw into the top of a pumping T (not shown). A polished rod **14** is positioned within the well and is actuated up and down in the usual manner of producing oil from a subterranean structure. With each oil well a stuffing box must be provided so that the oil lifted to the surface by actuation of polished rod **14** will not flow out of the tubing and onto the ground but rather will flow through a lead line (not shown) into a tank battery. Frequently the well is under pressure and the stuffing box must actuate to prevent the escape of gas or oil which would be blown out of the tubing if no restraining means were available.

The packing device **10** consists of two basic structural elements, a body member **16** and a plug member **18**. The body member **16** includes integrally formed ram supports **20A** and **20B**, and has an axial opening **22**. Ram supports **20A** and **20B** are provided with ram openings **24A** and **24B** which have an axis substantially perpendicular to the axis of polished rod **14**. Positioned in ram openings **24A** and **24B** are packing rams **26A** and

26B which are disposed to closely engage the interior surface of ram openings 24A and 24B. Threaded shafts 28A and 28B engage packing rams 26A and 26B respectively. Rotation of threaded shafts 28A and 28B will move packing rams 26A and 26B toward or away from polished rod 14 according to the direction of rotation.

Ram supports 20A and 20B terminate in flanges 30A and 30B to which are affixed flange plates 32A and 32B. Threaded openings 34A and 34B are provided to receive threaded shafts 28A and 28B respectively. Bolts 36 support the flange plates 32A and 32B to flanges 30A and 30B.

Hand wheeels 38A and 38B are affixed to threaded shafts 28A and 28B whereby shafts 28A and 28B may be manually rotated to move packing rams 26A and 26B. Shafts 28A and 28B may be actuated, in addition to the manual means shown, in many other ways such as hydraulically, pneumatically and electrically.

Plug portion 18 comprises a cylindrical tapered body having a portion of its exterior surface conforming to the internal tapered axial opening 40 of body member 16.

Plug portion 18 has approximately the same relationship with body member 16 as does the plug portion of a typical plug valve. Upper and lower seating surfaces 42A and 42B exist between body member 16 and plug member 18 to provide sealing means whereby leakage of gas or liquids exterior of the device is prevented.

Plug portion 18 is tubular in configuration, having an axial opening 44, through which polished rod 14 passes. Axial opening 44 is intersected by packing openings 46. Packing openings 46 extend from opposite peripheries of the plug member 18 and may be termed a single opening extending through the plug member 18, intersecting axial opening 44. Although two packing openings 46 are deemed to be the optimum arrangement, it can be seen that three, four or any other greater number of packing openings 46 could be provided as long as each aligned with a ram opening 24 in body member 16.

The axes of packing openings 46 optimumly engage the axis of axial opening 44 substantially perpendicularly. Packing openings 46 have configurations substantially equivalent to the internal configuration of ram openings 24A and 24B and of the external configuration of packing rams 26A and 26B. The packing device 10 is arranged such that plug member 18 and body member 16 may be rotated with respect to each other. When rotated to the position wherein alignment occurs between packing openings 46 of plug member 18 and ram openings 24A and 24B of body member 16 packing rams 26A and 26B may be moved into plug member 18 to engage polished rod 14. This is shown best in FIGURE 2.

Supported to the top of body 16, by bolts 48, is a typical repackable stuffing box 50. Stuffing box 50 may be of any design (many are available on the market) and the particular design shown in FIGURE 1 is by way of example only. The stuffing box 50, as far as a particular design is concerned, does not form a portion of the invention, but is shown to demonstrate how a typical stuffing box may be used in conjunction with the invention to provide arrangement whereby polished rod 14 may be packed and wherein all of the packing may be removed and replaced without the gas and liquid pressure of the well being subjected to the atmosphere.

Stuffing box 50 is typically formed of a cylindrical body 51 having packing rings 52 supported in position therein by packing glands 54 which are held under compression by the screwed fitting of cap portion 56. Cap portion 56 may be rotated by integrally formed handles 58 whereby additional pressure is applied on packing 52 to compensate for wear and prevent leakage. Packing rings 52 may be replaced by unscrewing cap portion 56 from stuffing box body 51. With cap portion 56 unscrewed packing rings 52, which are typically split rings, may be lifted out of stuffing box body 51, discarded, and replaced with new rings. This is the procedure customarily followed in oil well stuffing boxes however, if the stuffing box 50 is used on a well having a pressure, when cap portion 56 is removed nothing will be available to restrain the pressure of the well and the pressure will be vented to atmosphere. This permits the escape of gas and oil which, of course, is highly undesirable.

The functioning of the packing device 10 of this invention to permit the stuffing box portion 50 to be removed for packing without exposing the well to atmospheric pressure is best seen by referring to FIGURES 2 and 3. FIGURE 2 discloses the attitude of the packing device 10 when ram openings 24A and 24B have been aligned with packing openings 46 in plug member 18. As shown in FIGURE 2, hand wheels 38A and 38B have been manually rotated forcing packing rams 26A and 26B to engage polished rod 14. Packing rams 26A and 26B are provided with curved sealing surfaces 60 to conform to polished rod 14 and when pressed against polished rod 14 restrain the flow of fluid or gases to pass beyond the packing rams 26A and 26B. The close engagement of packing rams 26A and 26B with the interior of packing openings 46 of plug portion 18 prevents the escape of gas or fluid.

With the packing device 10 in position as shown in FIGURE 2, the gas and fluid pressure of the well will be sealed and no pressure will be applied to stuffing box portion 50. Therefore with packing device 10 in this position stuffing box 50 may be repaired regardless of the pressure which exists on the well and may even be repaired while polished rod 14 continues to reciprocate to produce oil from the well.

After stuffing box portion 50 has been repaired and cap portion 56 has been screwed back into position to force packing rings 52 to engage polished rod 14, then packing rams 26A and 26B may be withdrawn from engagement with polished rod 14 so that the stuffing box portion 50 now contains the pressure of the well. Packing rams 26A and 26B fit fairly snug in ram openings 24A and 24B and in packing openings 46 of plug member 18. Packing rams 26A and 26B are of a material soft enough to conform under pressure to the contour of packing openings 46.

Other products are available and other stuffing box arrangements have been made which accomplish the function of the device of this invention as described in its operation up to this point. That is, other arrangements are available whereby the upper packing 52 may be replaced while the pressure of the well is contained with lower packing, but none has shown the further steps of providing means whereby the packing rams 26A and 26B may also be replaced while the well is under pressure and even while the polished rod 14 is continuing to be actuated. This is accomplished in a manner best shown in FIGURE 3. If it is desired to replace packing rams 26A and 26B, they are first withdrawn to the position similar to that shown in FIGURE 1. At this point however, pressure from the well still is exerted on the packing rams 26A and 26B and is prevented from escaping to the atmosphere by the close fit of the packing rams 26A and 26B to the interior surface of the ram openings 24A and 24B. In order to permit their removal without exposing the interior pressure of the well to the atmosphere, body member 16 of packing device 10 is rotated approximately ninety degrees with respect to plug member 18. This may be accomplished by physically gripping hand wheels 38A and 38B and moving the body portion 16 around a quarter of a revolution. In larger installations body portion 16 may be also rotated mechanically, hydraulically, pneumatically or electrically. Since stuffing box portion 50 is attached to body portion 16, it will revolve a quarter of a revolution also, but this in no way affects the functioning of the stuffing box portion 50. With body member 16 rotated ninety degrees relative to plug member 18, the cross-sectional arrangement shown in FIGURE 3 is achieved. In this position it will

be noted that plug member **18** completely seals off ram openings **24A** and **24B** from exposure to the interior pressure of the well. In this position bolts **36** may be removed, disengaging flange plates **32A** and **32B** from flanges **30A** and **30B** so that packing rams **26A** and **26B** can completely be removed from ram supports **20A** and **20B**. With packing rams **26A** and **26B** completely removed, no escape of liquid or gas will occur to the atmosphere because of the sealing engagement between the exterior configuration of plug member **18** and axial opening **22** of body member **16**.

Packing rams **26A** and **26B** can then be replaced with new rams and the packing device **10** reassembled. After it is reassembled with new packing rams **26A** and **26B** the device may be left in its position as shown in FIGURE 3 as long as desired and until time occurs for replacing the packing **52** of stuffing box portion **50**. When in the position of FIGURE 3, no pressure is exerted from within the well on the packing rams **26A** and **26B** and therefore there is no possibility of leakage between packing rams **26A** and **26B** and ram openings **24A** and **24B**.

A gasket **60** may be provided between plug member **18** and stuffing box body **51** to prevent possible leakage of fluid at this juncture and also to provide a resilient force urging contact between internal tapered portion **40** of axial opening **22** and seating surfaces **42A** and **42B** of plug member **18**. As stated previously, the relationship of body member **16** and plug member **18** is that of the plug of a plug valve to its housing and other sealing means, such as gaskets and O rings, may be provided in various arrangements and other resilient means, such as springs, may be used to improve the security against possible leakage of this mechanism and to equip the device for high pressures and other special applications.

The principles of this invention can be applied to any type of stuffing box arrangement to pack moving shafts. The shafts may be reciprocating, such as polished rod **14**, or rotating, as is encountered in centrifugal pumps, boat and submarine propellers, steam turbines, and so forth. The description displayed in FIGURES 1, 2 and 3 wherein the mechanism of the invention is applied to stuffing box of a typical oil well is by way of example only and is not intended to constitute a limitation of the application of the principles of the invention to this restricted field. A different application incorporating the same principles of the invention is shown in FIGURE 4.

In this case a blowout preventer, indicated generally by the numeral **62**, replaces the stuffing box **50** of FIGURE 1. Plug portion **16** in FIGURE 4 is shown having a flange **63** integrally formed therewith instead of the threads **12** as shown in FIGURE 1, adapting the device as it typically would be applied to the surface pipe (not shown) during oil well drilling. Cylindrical opening **64** extending through the packing device **10** is adaptable to receive drill pipe, casing, tubing and the other material which must be run into a well in the drilling and completion of an oil well. In the present use of blowout preventers, when a high pressure sand has been encountered in the drilling of a well, the well must always afterwards be maintained in a manner whereby any sudden increase in pressure may be enclosed so that a blowout of the well does not occur. Each time a new size of pipe is run into the well an additional blowout preventer **62** must be added to the stack of blowout preventers to close on the new size pipe in case of a sudden increase in gas pressure within the well. For this reason, the blowout structures on deep wells sometimes become twenty or thirty feet in height due to the large number of different preventers which must be added each having rams **66** of a different configuration to close on a different size of pipe.

By utilizing the principles of this invention, it is possible to provide blowout preventers wherein the ram **66** may be changed when a different pipe size is used without the possibility of the well ever blowing out because of improper blowout prevention protection. This is accomplished by providing packing rams **26A** and **26B** of the pipe size in the well at the time the change is desired to be made in the size of rams **66** of the blowout preventer **62**. Packing rams **26A** and **26B** may be changed without exposing the interior pressure of the well to atmospheric conditions merely by rotating the body member **16** ninety degrees relative to plug member **18** sealing the ram openings **24A** and **24B**, removing the existing packing rams **26A** and **26B** and replacing with packing rams **26A** and **26B** having a packing surface **60** of the proper configuration. Body portion **16** may then be rotated to position wherein alignment occurs between ram openings **24A** and **24B** and packing openings **46** of plug portion **18**. Threaded shafts **28A** and **28B** may be rotated, moving packing rams **26A** and **26B** inwardly so that the pipe, tubing, or drill stem within the opening **64** is packed off. When this sealing operation takes place, then rams **66** may be removed from blowout preventer **62** by removing bolts **68** and new rams **66** placed into service which will conform to the new pipe sizes to be used in the drilling operation.

The use of the packing device **10** of this invention in conjunction with blowout preventer **62** will enable a substantial reduction in the number of different blowout preventers required on a deep well. Many arrangements will suggest themselves to those experienced in the blowout preventer field whereby packing devices **10** may be alternated between various blowout preventers **62** to achieve flexibility of operation and complete protection against well blowouts.

The invention has been described wherein the exterior surface of plug member **18** has a tapered surface conforming to a portion of the axial opening **22** of body member **16**. This is by way of example rather than limitation. Any configuration providing a substantially leak proof and rotatable seal between body member **16** and plug member **18** will meet the requirements of the invention. For instance, a cylindrical rather than a tapered configuration would function in the same manner as shown, or a design wherein the plug member **18** is of a spherical configuration (as encountered in ball valves) would be within the scope of this invention. The primary advantage of the tapered configuration shown is that any wear is automatically compensated for by the resilient force of packing **60**.

The application of the principles of this invention for packing propeller shafts of ships and submarines, and the use of the invention as a device for packing the shafts of turbines, pumps, valves and other devices, permitting complete repacking of the stuffing box devices, will be apparent from the specific description of the application to oil wells and blowout preventers.

The principles set out herein have been particularly described specifically applying the principles of the invention to only two of a multiplicity of possible arrangements. The specific embodiments are presented only by way of example of the application of the invention and not by way of limitation.

I claim:

1. A packing device adaptable for packing a shaft comprising, in combination, a body portion having an axial opening therein, said body portion having at least two ram openings therein intersecting said axial opening; packing rams slideably positioned in said ram openings; a plug member having a portion of its external configuration adaptable for rotatably engaging said axial opening of said body member, said plug member having an axial opening adaptable for receiving said shaft and said plug member having at least two packing openings intersecting said axial opening and wherein said plug member may be rotated within said body member to substantially align said ram openings in said body member with said packing opening of said plug member whereby said packing rams

may enter said packing openings of said plug member to engage said shaft.

2. A device according to claim 1 including resilient means of maintaining said axial opening in said body member and said portion of the exterior surface of said plug member in rotatable but pressure sealing contact.

3. A packing device adaptable for packing a shaft comprising, in combination, a body member having an axial opening therein, and said body member having at least two ram openings therein intersecting said axial opening; packing rams slideably positioned in said ram openings; a plug member having a portion of its external configuration adaptable for rotatably engaging said axial opening of said body member, said plug member having an axial opening adaptable for receiving said shaft and said plug member having at least two packing openings intersecting said axial opening adaptable for alignment with said ram openings of said body member whereby said packing rams may enter said packing openings of said plug member to engage said shaft; and a stuffing box means affixed to said body portion adaptable for engaging said shaft, said stuffing box means displaced axially from said plug member along said shaft whereby said stuffing box means and said packing rams may jointly and individually pack said shaft.

4. A packing device adaptable for use as a blowout preventer on a well adaptable for packing pipe positioned into said well comprising, in combination, a plug member having an axial opening therethrough adaptable for loosely receiving said pipe positioned into said well, said plug member having at least two packing openings therein intersecting said axial opening; means of affixing said plug member to said well; a body member having an axial opening therein adaptable for rotatably engaging a portion of the exterior surface of said plug member, said body member having at least two ram openings therein intersecting said axial opening and adaptable for alignment with said packing openings of said plug member; packing rams slideably positioned in said ram opening of said body member adaptable for entering aligned packing openings of said plug member to engage said pipe; and blowout preventer means supported to said body member having an axial opening aligning with axial opening of said plug member whereby said blowout preventer and said packing rams may jointly and individually pack said pipe.

5. A device according to claim 4 including resilient means of maintaining said axial opening in said body member and said portion of the exterior surface of said plug member in rotatable but pressure sealing contact.

6. A packing device adaptable for packing a shaft comprising, in combination, a body member having an axial opening therein, and said body member having at least two ram openings therein intersecting said axial opening; packing rams slideably positioned in said ram openings; a plug member having a portion of its external configuration adaptable for rotatably engaging said axial opening of said body member, said plug member having an axial opening adaptable for receiving said shaft and said plug member having at least two packing openings intersecting said axial opening adaptable for alignment with said ram openings of said body member whereby said packing rams may enter said packing openings of said plug member to engage said shaft; and a stuffing box means affixed to said body member adaptable for engaging said shaft, said stuffing box means displaced axially from said plug member along said shaft whereby said stuffing box means and said packing rams may jointly and individually pack said shaft.

7. A packing device adaptable for use as a blowout preventer on a well adaptable for packing pipe positioned into said well comprising, in combination, a plug member having an axial opening therethrough adaptable for loosely receiving said pipe positioned into said well, said plug member having at least two packing openings therein intersecting said axial opening; means of affixing said plug member to said well; a body member having an axial opening therein adaptable for rotatably engaging a portion of the exterior surface of said plug member, said body member having at least two ram openings therein intersecting said axial opening and adaptable for alignment with said packing openings of said plug member; packing rams slideably positioned in said ram openings of said body member adaptable for entering aligned packing openings of said plug member to engage said pipe; and blowout preventer means supported to said body member having an axial opening aligning with axial opening of said plug member whereby said blowout preventer and said packing rams may jointly and individually pack said pipe.

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