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LINER PACKAGE FOR HOOKS

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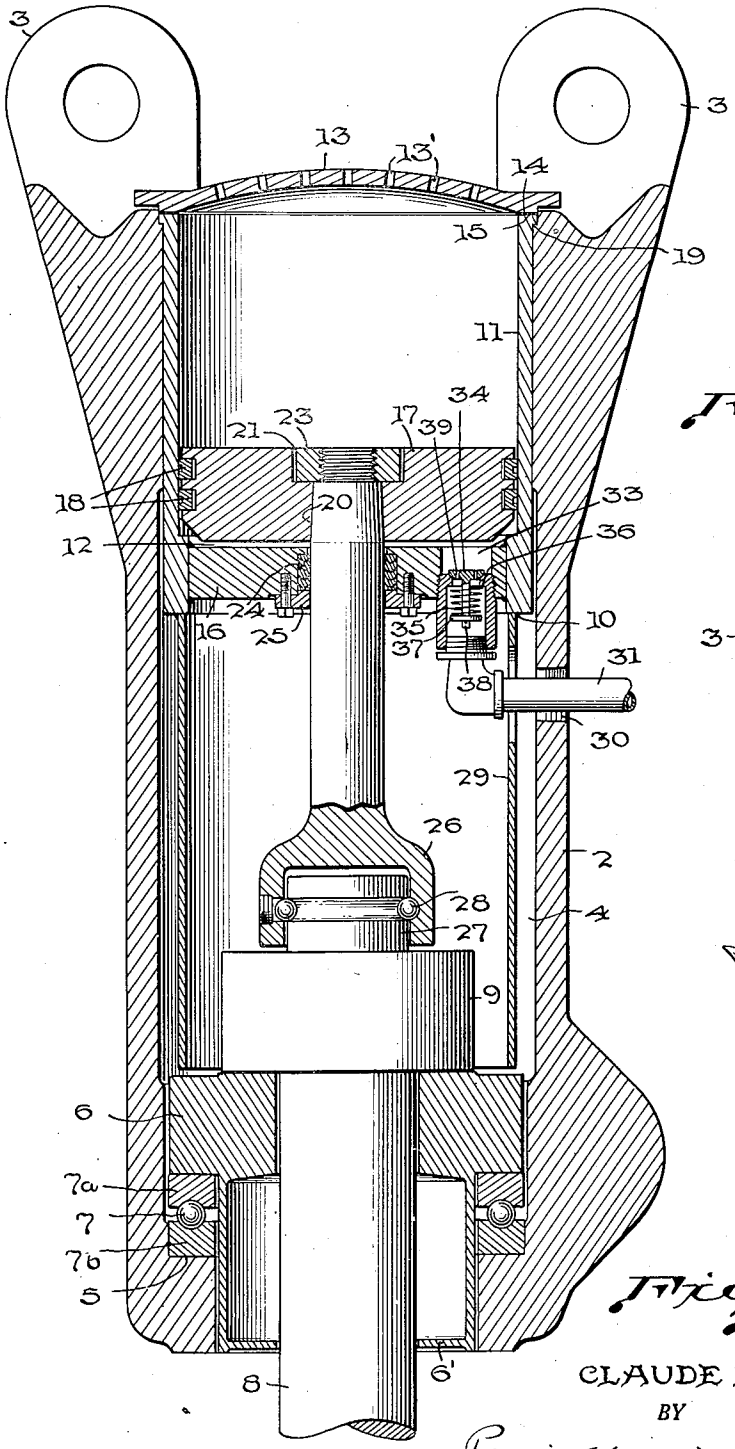

Fig. 1.

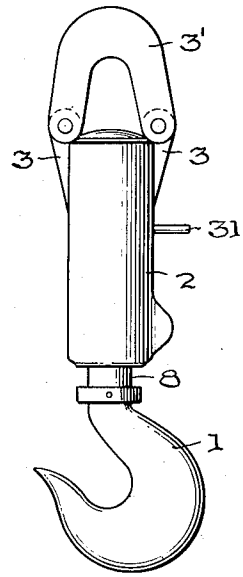

Fig. 2.

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LINER PACKAGE FOR HOOKS

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2 Claims. (Cl. 294—88)

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This invention relates to hooks of the type used in oil well drilling, and particularly to a hook liner package or self-contained unit which may be inserted into hooks of the type now in use to provide with such hooks the desirable features of hooks of the type disclosed and claimed in my Patent No. 2,519,288.

Hooks of the type presently used in oil well drilling operations are large and expensive. They must be capable of supporting a rotary swivel and a drill stem, which may weigh as much as 600,000 pounds, or more. To replace the old type hook with one of the type disclosed in my above patent is an expensive operation. Consequently, it is proposed to insert into an opening in such hooks an operating unit which will permit sensitive control being obtained over the lifting force exerted on the hook, allow rotation of the hook shank relative to the operating mechanism, and permit control of the operating mechanism from a remote position, all at a substantially smaller cost than that required for replacement of the existing hook with my improved type of hook.

As well as being used to support the rotary swivel, the kelly and the drill stem during the actual drilling operation, the hooks of rotary rigs are also used to support and position stands of pipe which are to be added to the drill stem as the drill bit penetrates deeper into the earth. A still further use of such hooks is to hold stands of pipe as they are detached from the drill stem during replacement of the bit and to provide the necessary lifting force to the stand as the joint between the lowermost section of pipe of the stand to be removed and the uppermost section of pipe of the drill stem left in the well is disengaged. Particularly during this latter operation, the pulling force exerted on the pipe stand by the hook must be held under close control so that the threads of the tool joints which connect the sections of the pipe together will not be damaged during disconnection.

The hooks now generally in use do not satisfactorily provide this necessary close control. An oil well hook has been marketed which was intended to supply this close control by the provision of hydraulic control means for the well-known spring hook. With this hook, the force of the spring was released when the pipe stand was to be raised from the drill stem, and the choke of the hydraulic means gave some control over the speed of application of the upward spring thrust to the hook. However, if the speed of the disengaging action on the threaded

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pipe joints was greater or less than the choke action, there was either no upward thrust at all, or the full force was instantaneously applied as the hydraulic cushion was released. The sudden release or exertion of force often caused damage to the tool joints and other equipment, as well as being dangerous to workmen, when such large apparatus as that used in drilling operations was involved.

During the attachment of additional pipe stands to the drill stem and detachment of sections of pipe from the stem, the stands and sections must be rotated to engage and disengage the threaded connections. The hook is directly supported by a travelling block through which cable, called the drilling line, is passed, the travelling block being suspended from a stationary crown block by the drilling line. If the hook body and travelling block are rotated with the hook, the drilling line will be twisted, causing snarling and possible damage to the line. Consequently, it is desirable that the hook be freely rotatable with the stand or section, but that the hook body, which is directly attached to the travelling block, be stationary relative thereto.

The hook liner package or unit of the present invention is so designed that close control over the force exerted by the hook on the pipe stand is possible and free rotation of the hook relative to the hook body may occur.

The liner package or unit of the present invention is inserted into a substantially cylindrical space in an existing hook. The unit has a cylinder liner, the outer wall of which is positioned adjacent the inner wall of the cylindrical space of the hook. Within the upper portion of the liner a partition extends across the liner and a piston is positioned above the partition. The partition and the piston form the ends of an expansible fluid chamber, the upper portion of the cylinder liner forming the wall thereof. Fluid under pressure is admitted to the lower end of this expansible chamber through the partition to cause longitudinal movement of the piston within the cylinder liner. The piston carries a piston rod which extends downwardly within the hook body, through the radial partition. At its lower end, the piston rod is connected to the shank of the hook through a connection which allows rotation of the hook shank with respect to the piston. The upper portion of the hook shank, the piston rod and the connection between the two are enclosed by a cylindrical skirt extending downwardly from the liner cylinder. The hook shank has an enlarged por-

tion which rests against and is supported by a bearing member rotatably supported on an inwardly-extending shoulder formed on the lower end of the hook body, the cylindrical skirt extending downwardly to just above the bearing member, and preventing upward movement of the bearing member in the cylindrical space.

Supply of fluid under pressure to the expansible chamber formed within the cylinder liner causes an upward force to be exerted on the piston tending to move it upwardly. Since the piston is connected through its piston rod to the hook shank, an upward force will also be exerted on the hook at this time tending to move it in an upward direction. An upward force will then be imparted to the pipe stand supported by the hook at the appropriate time during the disengaging action of the pipe joint.

The pressure at which fluid is supplied to the cylinder may be closely controlled by an operator and may be set at any desired value, the value being selected in accordance with the weight of pipe which the hook is supporting. Consequently, the insertion of the liner package or unit into an already-existing hook permits close control over the force or upward thrust exerted on the pipe stand by the hook when a pipe stand is to be disconnected or connected to the drill stem and allows rotary movement of the hook with respect to the piston and the piston rod. Furthermore, to provide for these desirable features, it is not necessary to replace the entire existing hook with a new one. The existing hook may be used, the liner unit merely being inserted into the existing hook body.

The invention will be more fully described in connection with the accompanying drawings which illustrate a preferred embodiment of the invention.

In the drawings:

Fig. 1 is an elevational view of a hook embodying my invention, and

Fig. 2 is a vertical sectional view through the hook body of Fig. 1 with my liner unit positioned therein, with the hook bail removed.

Hook assemblies for use in rotary drilling rigs comprise generally a hook 1 and a hook body 2. The hook body has a pair of bail ears 3 at its upper end to which is attached a bail 3' to be supported from the travelling block (not shown).

The hook body 2 has a substantially cylindrically-shaped chamber 4 extending longitudinally therethrough. At the lower end of the chamber, the wall of the hook body extends inwardly to form a shoulder 5 upon which a bearing member 6 is supported. Ball bearings 7 are interposed between upper and lower bearing rings 7*a* and 7*b* positioned between the lower surface of the bearing member 6 and the shoulder 5 at the lower end of the hook body to allow rotation of the bearing member 6 relative to the hook body 2.

The hook has a vertically-extending hook shank 8 threadedly or in other suitable manner connected thereto and extending upwardly therefrom through the lower entrance into the hook body 2. The bearing member has an inwardly-extending flange 6' at its lower end which forms an annular bearing enclosing the hook shank. This annular bearing acts to prevent lateral movement of the hook shank when the hook is rotated.

The hook shank 8 has an enlarged radially-extending bearing portion 9 located within the lower section of the cylindrical chamber 4, the lower surface of which rests upon the bearing member 6 when the hook shank is in its lowermost position, as hereinafter more fully described.

The hook liner package or unit comprises a cylindrically-shaped liner 10, the upper portion 11 of which forms the wall of an expansible fluid chamber 12. The upper end of the chamber 4 is closed by a cap member 13, which has a plurality of vent holes 13' through it to permit escape of air when the piston is moved upwardly. The cap member has an annular flange 14 adjacent the radial extremity of its under side which bears against the upper outwardly flanged end 15 of the cylinder liner. The lower end of the expansible chamber 12 is defined by a radially-extending partition 16 which is welded, or in other suitable manner attached, to the lower end of the upper portion 11 of the cylindrical liner. A cylindrical piston 17 is mounted in the fluid chamber 12 for reciprocation by fluid pressure supplied to the expansible chamber, as will be later explained. The piston 17 has sealing rings 18 inserted in slots in its peripheral edge portion which bear against the inner wall of the upper portion 11 of the cylindrical liner to prevent fluid escape from one side of the piston to the other.

The lower surface of the outwardly extending flange 15 formed at the upper end of the upper portion 11 of the cylindrical liner lies against a corresponding inwardly extending shoulder 19 formed at the upper end of the hook body.

The piston 17 has an upwardly converging tapered bore 20 extending from its lower side to a recess 21 formed in its upper side. The upper end of the piston rod 22 has a correspondingly tapered portion which extends through the tapered bore 20 and has a threaded surface into which a threaded nut or cap 23 is threaded to rigidly secure the piston to the piston rod. The piston rod 22 is thereby arranged to move vertically with the piston 17.

The piston rod 22 also extends through a central bore in the partition 16, and appropriate packing 24 is inserted between the piston rod 22 and the bore wall of the partition, the packing being held in position by a plate 25 surrounding the piston rod 22 and bolted to the under side of the partition.

The lower end of the piston rod 22 terminates in a cap-portion 26 which fits over the upper end 27 of the hook shank, above the radially-extending bearing portion 9.

The hook shank 8 is rotatably connected to the piston rod 22 by ball bearings 28 positioned within opposed complementary slots formed in the inner surface of the cap portion 26 and the outer vertical surface of the upper end 27 of the hook shank.

A vertically extending cylindrical skirt 29 is attached to the lower end of the upper portion 11 of the cylindrical liner. The skirt 29 is spaced slightly from the wall of the hook body 2 and surrounds the piston rod 22, the connection between the piston rod and the hook shank 8, and the radially-extending bearing portion 9 of the hook shank. The lower end of the cylindrical skirt 29 is spaced a short distance above the bearing member 6 to avoid abrasion between the skirt and the bearing member when the bearing member rotates relative to the hook body, but yet to prevent upward movement of the bearing member when the hook shank moves upwardly.

The wall of the hook body 2 has a passage 30

through the side thereof for a fluid supply pipe 31 which conducts fluid from an external source (not shown) to the expansible chamber 12. The supply pipe 31 extends through the passage 30 and has its inner end extending upwardly substantially at right angles and terminating within a valve body 32 which is fixed within a bore 33 through the partition 16. A valve 34 is positioned adjacent the outlet of the valve body 32 and urged by a spring 35 to closed position against its seat upon the upper surface of the valve body. The spring 35 is interposed between an inwardly-extending flange 36 of the valve body and a plate 37 fixed to the lower end of a valve rod 38 connected to the lower surface of the valve 34. Fluid under pressure entering through the supply pipe 31 to the valve body 32 will press valve 34 off its seat, against the action of spring 35, and allow the fluid to pass through the bore 33 in the partition 16 into the expansible chamber 12.

The valve 34 has orifices 39 therethrough which allow fluid within the expansible chamber 12 to escape slowly through the orifices into the fluid supply pipe 31 when the fluid pressure is removed from the fluid supply pipe, or when a heavy load is put on the hook. The slowness of this escape of fluid allows time for the heavy machines which move the travelling block to get up to full speed before they take the load of the pipe supported by the hook. The orifices also provide a dashpot action which prevents sudden thrust forces from being exerted on the bearing member.

In the operation of the hook, whenever it is desired to impart a lifting force to the hook, air or other fluid under pressure is admitted through the fluid supply pipe 31 and the valve body 32 to the expansible chamber 12. The fluid thus admitted will exert pressure upon the piston 17 tending to force it upwardly within the cylinder liner. Since the piston is connected to the hook shank 8 by its piston rod 22, an upward force will also be exerted on the hook, tending to move it upwardly. The force exerted on the hook will be proportional to the pressure of the fluid within the expansible chamber 12. That pressure may be set to the proper value, the value being determined by the weight which the hook must lift and the acceleration with which it is desired to move that weight upwardly when a stand of the pipe is to be disconnected from the drill stem. Appropriate valve means (not shown) is provided to allow close control over the fluid pressure, and the force exerted on the hook may be kept within limits selected to insure that the threads of the tool joints are not damaged during the disconnection. The valve is located at a convenient position remote from the hook, so that the operator need not move with the hook.

When the threaded joint has been disengaged, the fluid pressure may be turned off and the piston permitted to return to its lower position, the fluid escaping from the expansible chamber through the orifices 39 in the valve 34 into the fluid supply pipe 31. However, since the weight supported by the hook is very large, it is desirable that the weight be supported by the hook body itself, rather than by the radial partition 16. Accordingly, the piston rod 22 is of sufficient length that, during downward travel, the radially-extending bearing portion 9 of the hook shank will reach the upper surface of bearing member 6 while the lower surface of the piston

17 is still spaced a short distance from the partition 16. Since the piston 17 never rests upon the partition 16, the partition is not required to support the weight of the hook and the apparatus which the hook carries.

During engagement and disengagement of one section of pipe from another, the hook, which supports the pipe, must be rotated because the pipe joints are threaded. If the piston rod rotated with the hook, the torsional force exerted on the packing 24 would be transmitted to the partition 16 tending to cause the cylinder liner and the hook body to rotate with the hook. However, neither the piston rod nor the piston will be rotated because of the rotatable connection between the upper end of the hook shank and the cap portion at the lower end of the piston rod.

Consequently, no torsional force is exerted on the upper portion of the cylinder liner tending to rotate the liner and the hook body. Twisting of the drilling line is thereby avoided. Furthermore, no unnecessary wear is put on the piston and the apparatus cooperating with it due to relative rotation between them.

Moreover, the bearing member 6, which rotates with the hook shank 8, is rotatable with respect to the hook body 2, so that the hook body remains stationary while the hook rotates.

It is apparent that many minor changes can be made in the structure herein disclosed without sacrificing the advantages thereof or departing from the scope of the appended claims.

I claim:

1. An oil well hook assembly comprising a hook body whose walls form a cylinder therein, a cylinder liner positioned within said cylinder having an outer portion in frictional engagement with the cylinder wall and constrained against inward movement within the cylinder, a piston in said outer portion, a partition extending across the outer portion inwardly of the piston, a piston rod secured to said piston and extending therefrom through the partition, sealing means between the piston rod and the partition, the piston rod, the partition, and the sealing means defining one end, and the piston defining the opposite end, of an expansible fluid chamber in the outer portion of the cylinder liner, means for admitting fluid under pressure to said expansible chamber, a hook having a shank connected thereto with its distal portion extending into the cylinder, said shank having an enlarged portion within the cylinder, a bearing member rotatably supported on the wall of the cylinder for supporting said enlarged portion of the shank, the end of the shank inwardly of the enlarged portion having a peripheral slot formed thereon, the free end of the piston rod having a cap portion fitting over the inner end of the hook shank, said cap portion having a peripheral slot in its inner face complementary with the slot on said end of the hook shank and bearings positioned in said complementary slots to allow rotatable movement of the hook shank relative to the piston rod, said cylinder liner also having a cylindrical skirt depending from said outer portion thereof having its distal end positioned adjacent said bearing member inwardly thereof to prevent inward movement of said bearing member, whereby admission of fluid under pressure to said expansible chamber causes an upward force to be exerted on the hook.

2. In an oil well hook assembly comprising a hook and a hook body having a bore therein, said hook having a shank connected thereto with its distal portion positioned within said bore in the

hook body, a piston rod secured to said piston and extending outwardly therefrom, said piston rod having a cap portion fitting over the distal portion of the hook shank, means for rotatably connecting the piston rod to the hook including bearings positioned in complementary slots formed on the distal portion of the hook shank and the inner wall of the cap portion of the piston rod, means extending across said chamber and forming with said piston an expansible fluid chamber within said bore in the hook body, and means for supplying fluid under pressure to said expansible chamber to exert a lifting force on the hook.

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