May 23, 1933. J. C. FORTUNE 1,910,890

HYDRAULIC FEED FOR ROTARY DRILLS

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Fig. 1.

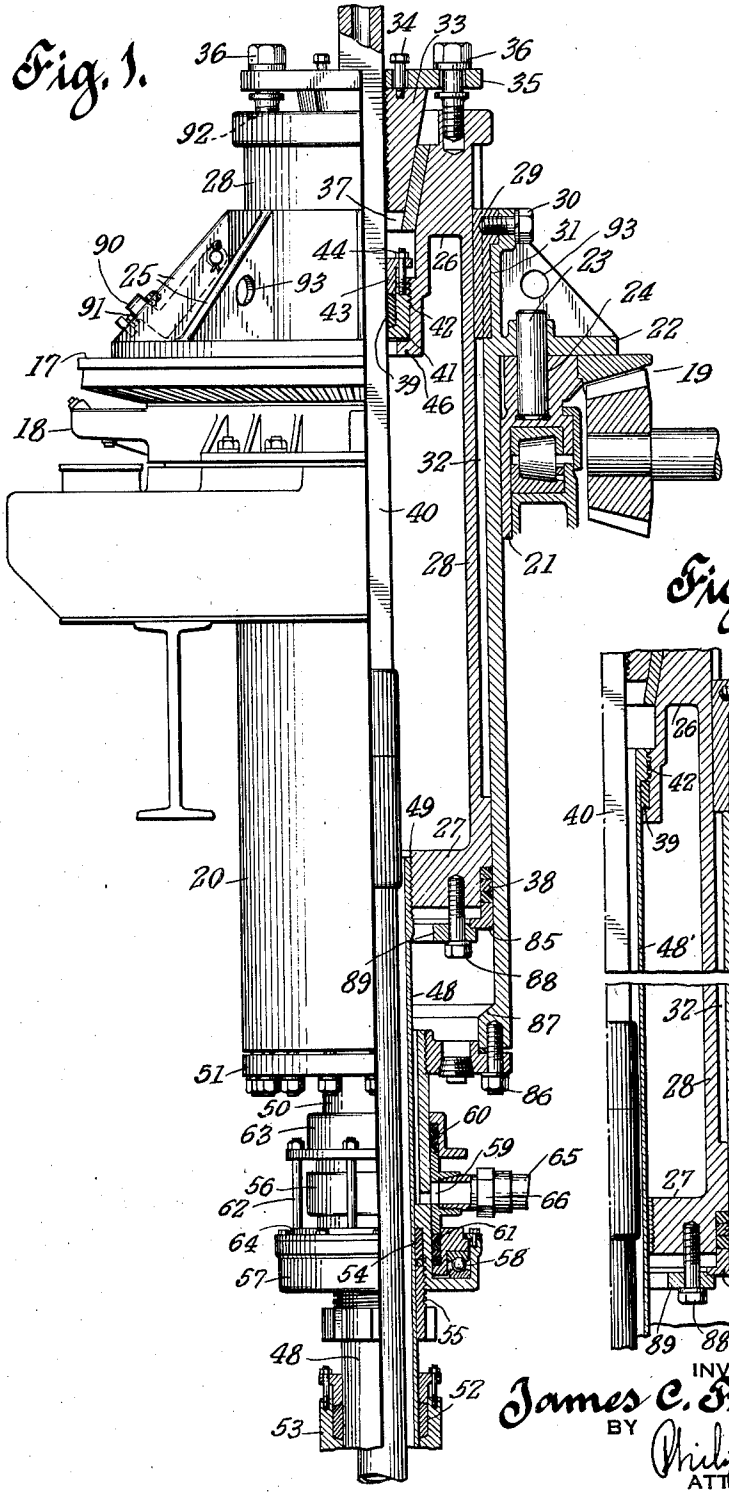


Fig. 2.

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Fig. 3.

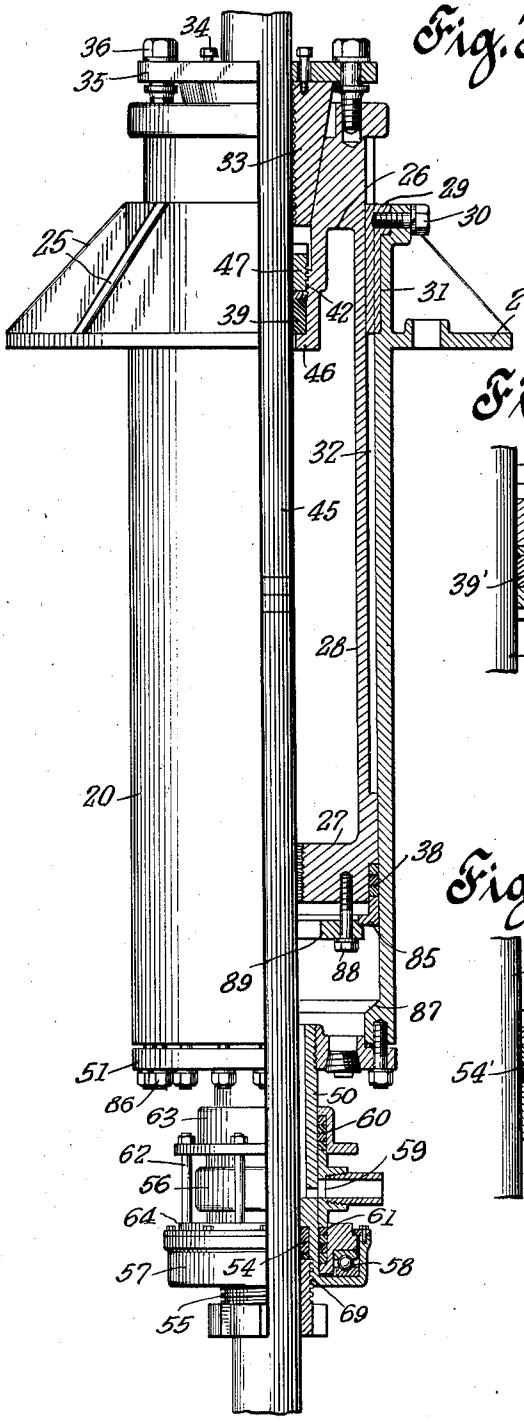


Fig. 6.

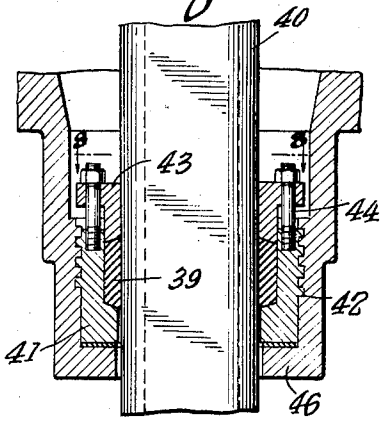


Fig. 4.

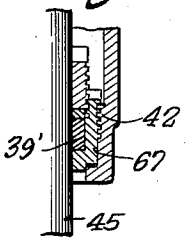


Fig. 7.

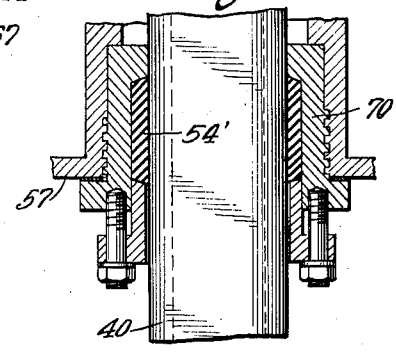


Fig. 5.

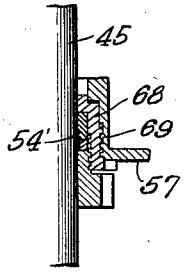
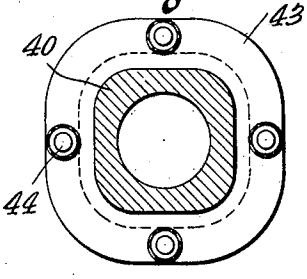


Fig. 8



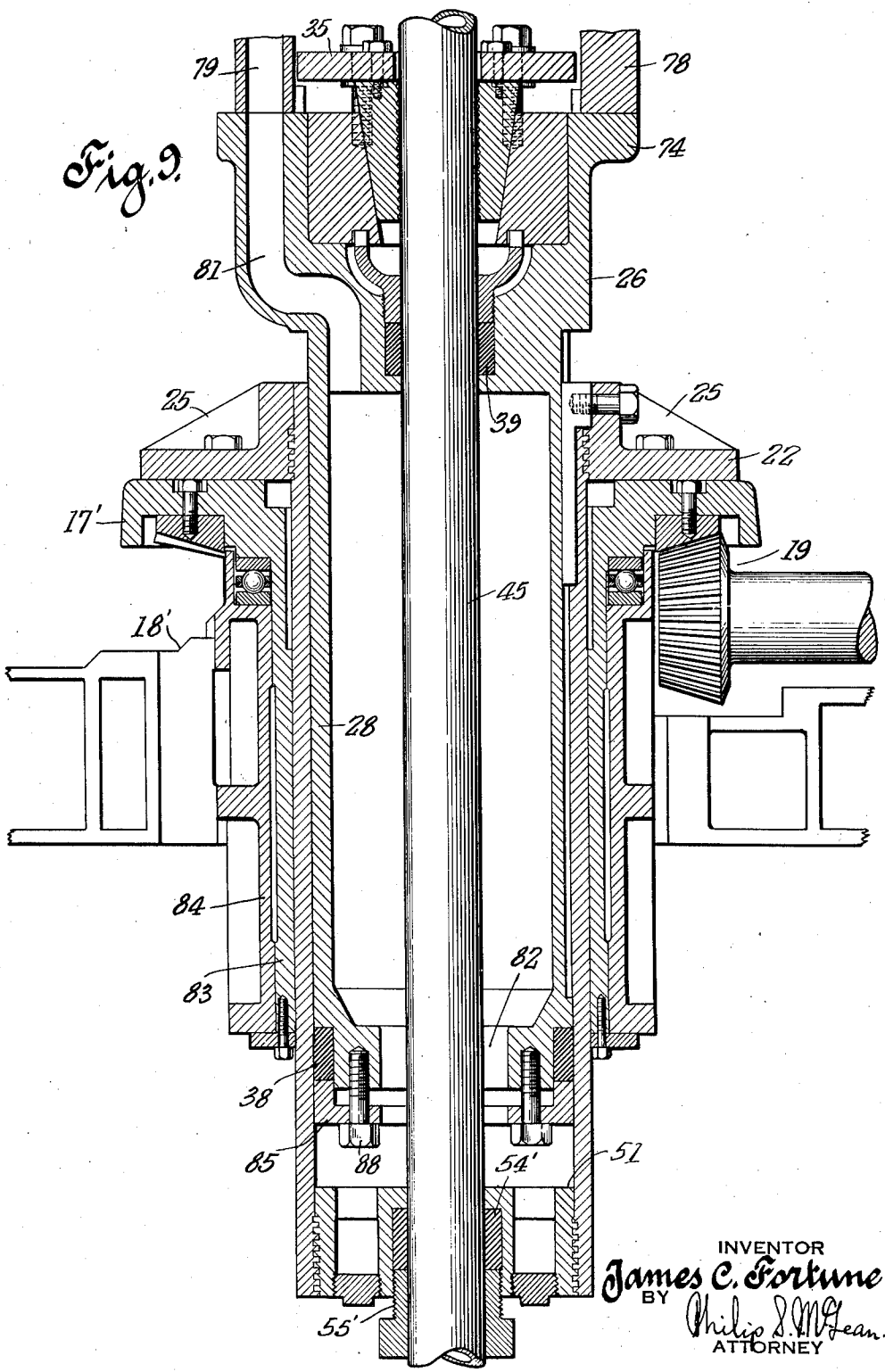
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HYDRAULIC FEED FOR ROTARY DRILLS

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Fig. 9.



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HYDRAULIC FEED FOR ROTARY DRILLS

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Fig. 10.

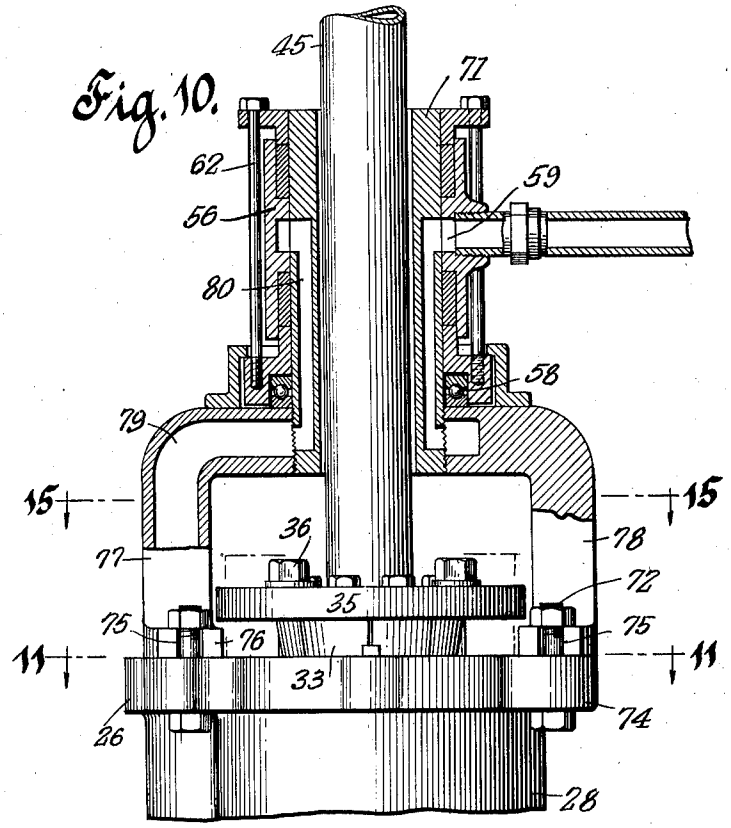
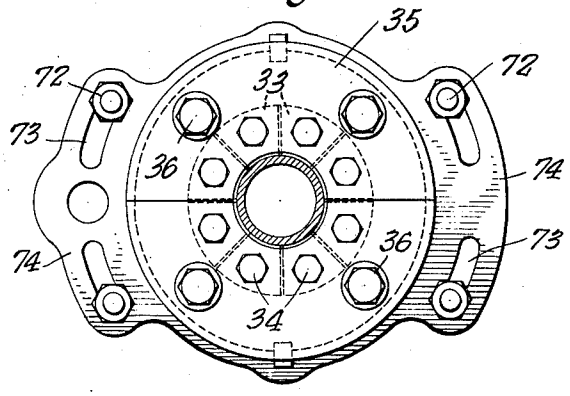


Fig. 11.



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Fig. 12.

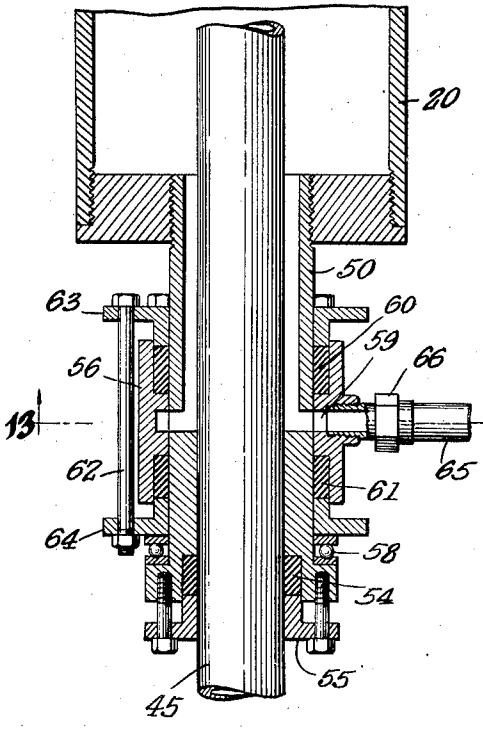


Fig. 14.

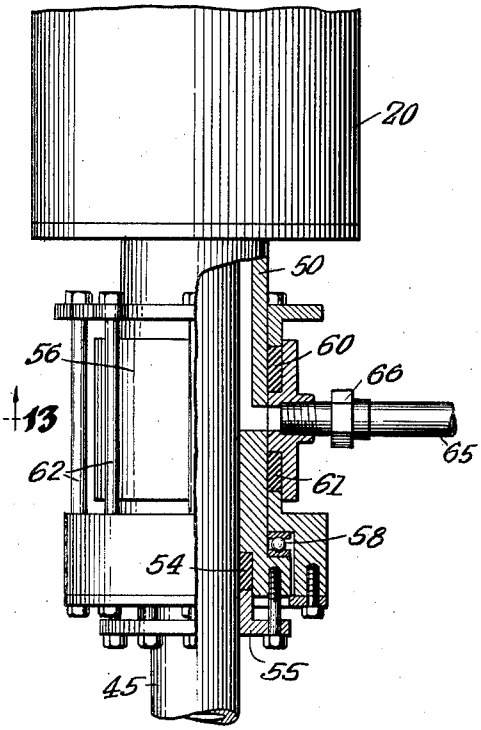


Fig. 13.

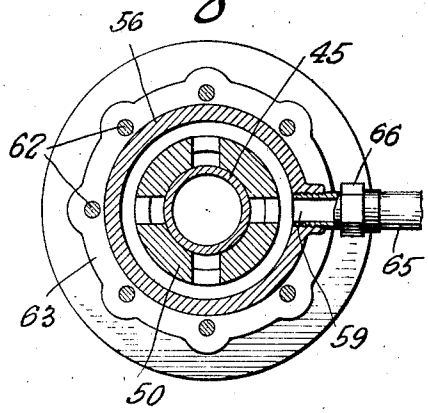
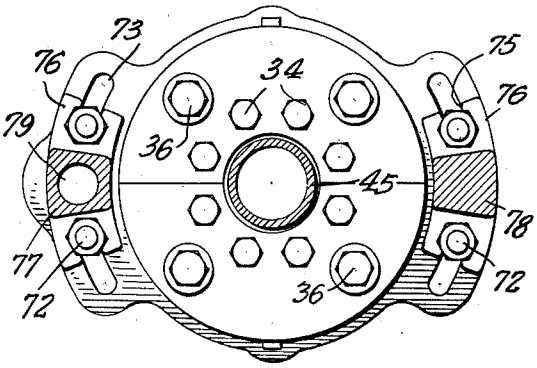


Fig. 15.



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Patented May 23, 1933

1,910,890

UNITED STATES PATENT OFFICE

JAMES CLEPHANE FORTUNE, OF MONTEREY, CALIFORNIA, ASSIGNOR TO SHELDON MACHINERY CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

HYDRAULIC FEED FOR ROTARY DRILLS

Application filed June 6, 1930. Serial No. 459,486.

This invention relates to well drilling equipment of the rotary type and special objects of the invention are to provide practical and efficient hydraulic feed mechanism applicable to existing forms of rotary tables, which equipment can be readily combined with or removed from the rotary table and which may be used to meet the varying conditions and requirements ordinarily encountered in well drilling.

The invention may be considered as related to the Sheldon Patent 1,612,226 of December 12, 1926 in that the hydraulic feed cylinder is of annular form and is supported by the table, so as to rotate therewith.

The present invention involves a material departure from the former however, in that the entire hydraulic equipment is adapted to be mounted in an ordinary rotary table, instead of being built into a rotary table especially designed for the purpose.

The foregoing and other novel distinctions, features and combinations of the invention are set forth in the following specification and broadly covered in the claims.

The drawings accompanying and forming part of the specification illustrate several of the various forms the invention may take, but as such illustrations are primarily for purposes of disclosure, it should be understood that the structure may be modified and changed all within the broad scope of the invention.

Fig. 1 is a vertical, sectional and partly broken side elevation view showing the invention as applied to and in use with an ordinary rotary table; Fig. 2 is a broken vertical sectional detail illustrating another use of the form of the invention shown in Fig. 1; Fig. 3 is a part sectional view similar to Fig. 1 showing the invention used for handling larger size "flush joint" pipe instead of the "square kelly" and collar joint pipe first shown; Figs. 4 and 5 are broken sectional details illustrating the employment of packing adapters in the structure of Fig. 3 for handling smaller size flush joint pipe; Figs. 6 and 7 are broken partly sectional details showing the upper and lower packings employed in a structure like that shown in Fig. 3 for handling so-called "square grief stem"; Fig. 8 is a detail as on the plane of line 8—8 of Fig. 6; Figs. 9 and 10 are broken sectional views, the latter being in effect a vertical continuation of the former, illustrating a modification in which the control of fluid is effected at the top instead of at the bottom of the apparatus as in the preceding views; Fig. 11 is a detail section as on substantially the plane of line 11—11 of Fig. 10; Fig. 12 is a broken sectional view of another form of water swivel for the lower end of the power cylinder; Fig. 13 is a view as on line 13—13 of Fig. 12; Fig. 14 is a view generally similar to Fig. 12 to another form of water swivel; Fig. 15 is a sectional view as on line 15—15 of Fig. 10.

In Fig. 1, an embodiment of the invention is illustrated as combined with a "rotary" of conventional design, consisting of a table 17 journalled in a base structure 18 and driven by bevel pinion gearing 19.

The hydraulic feed equipment is in the nature of an attachment or an auxiliary which may be combined with the rotary by seating it in and on the table. Thus, in the illustration the power cylinder 20 of the hydraulic feed is shown as lowered down in the bore 21 of the rotary and as having a wide outstanding flange 22 resting on top of the table and suitably anchored to the table as by means of pins 23 entered through this base flange into the back-up post sockets 24 in the top of the table. That part of the cylinder which extends above the table is shown as braced to the outstanding flange by radially disposed inclined braces 25.

Operating within the power cylinder is a piston of annular form and shown as consisting of upper and lower heads 26, 27 connected by a cylindrical portion 28 slidingly keyed in the cylinder by means of a key 29 removably secured by bolt 30 in a key seat 31 of the upper cylinder extension and received in a keyway 32 in the side of the piston shell.

The upper piston head serves as a mount for the pipe gripping devices, which latter are shown as consisting of pipe gripping segments 33 loosely connected by bolts 34 with

a clamp plate 35, which is acted on by bolts 36 to thrust the gripping segments down into a tapered seat or socket 37.

The hollow barrel piston is suitably packed in the cylinder and may be packed off at either or both ends depending on special requirements. The "piston-to-cylinder" packing is designated 38. The upper piston packing, that is the packing between the piston and the drill pipe is designated 39. This may vary in accordance with the size and form of pipe. Thus in Fig. 1, where the drive is effected through a length of so-called "square" grief stem 40, the packing is shaped accordingly and is carried by a special adapter 41 turned down into a screw seat 42 in the upper piston head, said adapter having an appropriate seat for the square packing, which latter is shown as set up by a correspondingly shaped gland 43 held by bolts 44.

In handling larger size flush joint pipe, such as shown at 45 in Fig. 3, the adapter becomes unnecessary, the packing being shown set down in the screw seat 42 resting on the flange 46 and adjusted by a gland nut 47 entered directly in the screw seat.

At the bottom, the piston may be packed off in different ways. Thus in Fig. 1 packing between piston and pipe is shown as effected by means of a packing sleeve 48 screwed at 49 up into the lower piston head 27 and operating down through a tubular extension 50 of the lower cylinder head 51 through a stuffing box 52 in the well head 53, said sleeve being packed off where it emerges from the cylinder extension by packing 54 held by a gland nut 55.

The water or other fluid is admitted to and exhausted from the cylinder in the form of the invention shown in Figs. 1 to 3, 12 and 14, through the medium of a box or gland 56 surrounding the neck 50 on the lower end of the cylinder and suitably packed in relatively rotatable relation thereon. In these several views the cylinder extension is shown as carrying a seat or flange 57 supporting a ball bearing 58 on which the water swivel rides and this swivel is shown as packed at its upper and lower ends, above and below the ports 59 therein by packings 60, 61, adjustment of the latter being effected by stay bolts 62 connecting the flanges of the upper and lower gland rings 63, 64.

Suitable piping, such as indicated at 65 is connected with the swivel collar 56 and a union or joint 66 may be provided in this piping at a point relatively close to the collar, so that the pipe connections may be readily broken at a point within the circumference of the cylinder, so that such piping will not interfere with the withdrawal of the hydraulic feed mechanism from the table.

The packing 54 at the lower end of the swivel neck is made to cooperate with a packing sleeve, when that is employed, as in Fig. 1 or directly with the pipe as in Figs. 3 and 12.

As another alternative, the packing sleeve may be connected with the upper piston head instead of with the lower piston head. This change is indicated in Fig. 2 where the packing sleeve is denoted 48′ and is shown as having a screw flange at its upper end directly engaging in the screw seat 42 in the upper piston head. The packing sleeve in this case is clear of the lower piston head and cooperates with the lower cylinder packing 54 the same as in Fig. 1.

The pressure of the fluid is effective against the lower piston head 27 in Fig. 1, it being noted that the packing sleeve 48 provides a seal from the water swivel at the bottom up through the neck of the cylinder into the space beneath the lower piston head. In Fig. 2 on the other hand, the pressure is effective against the upper piston head 26, the entire piston being filled with water in this instance up through the open screw seat 49 in the lower piston head, the packing sleeve 48′ serving as a seal down to the lower packing 54 of the water swivel. In the construction of Fig. 3, the pressure is also effective against the upper piston head 26, the packing sleeve being omitted in this instance and the piston being packed directly to the pipe at the top and the cylinder being packed to the pipe at the bottom. The top packing is accessible upon loosening and lifting the pipe clamps and the lower packing is accessible to adjustment at all times.

The same apparatus may be used for operating on smaller size pipe by using adapters such as shown in Figs. 4 and 5, where the top and bottom packings 39′ and 54′ are shown seated in reducing rings or adapters 67, 68, entered in the screw seat 42 of the upper piston head and in the screw seat 69 in the lower end of the neck extension of the cylinder.

Fig. 6 illustrates more in detail the upper piston packing for a square kelly or grief stem and Fig. 7 shows how with a special adapter 70 screwed into the lower end of the cylinder extension this square grief stem can be packed at 54′ so as to pass all the way down through the feed cylinder. Thus a length of square grief stem may be run entirely through the feed cylinder.

The structures of Figs. 9 and 10 differ from the foregoing principally in that the water swivel is provided at the top and connected with the piston instead of with the cylinder. This swivel is generally similar to the lower water swivel and for that reason corresponding reference characters have been applied thereto, it being noted however, that in this instance, the swivel collar 56 is rotatably engaged on a neck portion 71, which is carried by the upper head 26 of the piston.

In the particular construction shown, this top swivel is mounted on the piston in quickly detachable fashion by by means of bolts 72 extending through arcuate slots 73 in the flange extension 74 of the upper piston head and engaging in the open slots 75 in the feet 76 of the posts 77, 78, which carry the swivel neck. The first of these posts is shown as hollow to provide a passage 79 opening from the neck passage 80 down into a passage 81, which extends down through the upper piston head to the space within the hollow piston. The lower piston head is left with a passage 82 surrounding the drill pipe, so that the pressure of the fluid is always effective against the lower cylinder head 51. In this case, the pipe is packed off at the top by the packing 39 carried by the upper piston head and at the bottom by the packing 54' generally similar to the packing 54 in Fig. 3, but carried directly by the lower cylinder head.

The form of the invention last described with the hydraulic swivel at the top instead of at the bottom of the structure has the advantage of greater accessibility for the swivel and in the fact that no extra space has to be provided for the swivel in the "cellar" of the rig. The stand or bracket structure 78 is open at the sides as appears most clearly from Figs. 10 and 15, so as to leave plenty of room for operating the slips or pipe clamps and as probably best shown in Figs. 10, 12 and 14, the swivel collars may be made as identical or substantially identical structures, so as to be interchangeably usable for either top or bottom swivels, that is in conjunction with a neck on the lower end of the cylinder, as in Figs. 12 and 14, or on a neck carried by the upper end of the piston as in Fig. 10. The ball bearings 58 which carry the weight of the swivel collars and pipe connections may be of interchangeable design, so that the parts may be made up in stock and assembled in either of the relations described, as required.

In all forms of the invention disclosed, the exterior of the cylinder is of flush construction, so that the same may be readily drawn from the rotary table. This is particularly clear in Fig. 3, where the pressure feed mechanism is illustrated as a complete unit apart from the table. In this view, the clamps are shown set up on the pipe and this clamping of the device on the pipe enables the apparatus being conveniently removed from the table by simply hoisting out a length of pipe or grief stem with the device secured in clamped relation thereon. The device may then be stored in this relation ready to be returned to operative relation in the table, using the pipe in effect as a means for handling the same.

It will be noted particularly that the apparatus may be used with different forms of rotary tables now on the market, or it may be combined with a special form of deep bearing rotary table, such as the one shown at 17' in Fig. 9 and having an extra long bearing 83 journalled in a long bearing sleeve 84 carried by the table base 18'.

The various parts are all readily accessible. This is particularly true of the pipe clamps and the various packings, it being noted with respect to the upper packing that this can be readily gotten at upon loosening and lifting the pipe clamp. The same feature of accessibility is true of the piston-to-cylinder packing. In the form of this packing shown in Fig. 9, the packing adjusting ring 85 is of angular cross-section and can be pulled out at the bottom of the cylinder when the lower cylinder head 51 is unscrewed from within the cylinder shell. In the construction illustrated in Figs. 1 and 3, the cylinder head 51 is secured by a ring of stay bolts 86, which are set into the upset and internally offset thickened lower end portion 87 of the cylinder. This internal offset prevents removal of the packing clamp ring 85 when the lower cylinder head is removed, but in this particular case this clamping ring is relatively narrow and the bolts 88 which secure in place and are used for tightening up the packing engage with a special ring 89, which has a bearing on the packing clamp ring, but is of less diameter than the internal shoulder 87 and so can be dropped out of the cylinder when the cylinder head is removed. The clamp ring 85 can then be lowered onto shoulder 87, leaving above it ample space for replacing or working on the packing.

The use or non-use of the packing sleeves 48 or 48', in conjunction with the lower or upper end of the piston as in Figs. 1 and 2 and the various packing adapters enables the invention being used to meet the various conditions ordinarily encountered in well drilling. The device may be furnished either with the rotary table or simply as a separate unit attachable to existing rotary tables. The outstanding, radially braced flange 22 at the upper end of the cylinder forms a relatively wide base for supporting and bracing the hydraulic feed in the table and this rigid structure of the cylinder also reinforces and braces the table, enabling a standard rotary table to carry the extra load imposed by this hydraulic feed mechanism.

The projecting of the cylinder up above the top of the table helps to balance the load of the cylinder on the table and also reduces to that extent the projection of the cylinder below the table. The pumps, piping and valve gear by which the water or other power fluid is admitted to and exhausted from the power cylinder are not illustrated, it being understood that these may be of any suitable construction. Preferably however, there will be provided a control valve within convenient

reach of the "driller" by which he can immediately control the escape of fluid from the cylinder. This so-called "bleed" valve keeps the driller in full control of the feed at all times, enabling him to accelerate or decrease or to entirely stop the feed at any time. This "bleed" valve also may be used in conjunction with a fluid pressure supply valve to enable admission of fluid at any time to lift the drill off the bottom.

The provision of the fluid connections by means of a swivel neck carried either by the cylinder or by the piston is especially important. The peripheral speed of this reduced neck part is considerably less than that of the larger diameter cylinder. The wear on the packings therefore is lessened to this extent. Also, the packings and the parts associated therewith are considerably smaller and less bulky than in a construction where the supply connections are made directly into the cylinder. The swivel part of the device, by this invention, is but little larger than the kelly or grief stem and because of this, and the fact that the device may remain attached to the grief stem, the device, may rightly be considered a "hydraulic kelly". The terms used herein, such as "drill pipe", "drill stem" and the like, have been used in a descriptive rather than in a limiting sense, and the specification and claims should be read accordingly, except possibly for such limitations as may be imposed by the prior art.

It will be noted that by packing to the pipe or to the smaller sleeve 48 or 48′ surrounding the pipe, greater effective area is obtained within the cylinder, enabling operation of the device at relatively low pressure. The upper packing is located within the piston or "ram" and so adds nothing to the overall height of the device. The swivel at the lower end of the cylinder being of less diameter than the bore in the table does not in any way interfere with the removal of the complete device from the table. Similarly, the device may be applied to any ordinary rotary table in a few minutes time. The construction also permits of the use of the largest size bit, which will pass down through the bore of the table.

The invention enables the quick conversion of an ordinary rotary to hydraulic feed control with the attendant advantages of absolute control, faster work and "straight hole" drilling. Because of the lower peripheral speed, the wear on the packings at the hydraulic swivel is comparatively low and because of the fact that there is no relative rotation between the pipe and the packings associated therewith, the wear on these packings is comparatively slight.

To prevent the piston from pulling out to the end of the stroke in the cylinder when the unit is lifted out of the table by leaving it attached to the drill pipe and hoisting on the pipe, suitable holding means may be employed for temporarily securing the piston down in the cylinder. Such means are shown in the illustration in the form of one or more hooks 90 pivoted on the bracing flanges 25 and adapted to be swung up over the top of the piston in its lowered position, said hooks being retained in this holding relation as by means of bolts 91 in the ends of the hooks adapted to be turned down into sockets 92 in the top of the piston.

If it is desired to lift the unit independently of the pipe, hoisting connections may be engaged with the top of the piston, for example, directly with the slip holding clamp plate 35, or a bridle, or the like, may be hooked into hoisting holes 93 provided in the radially extending brace flanges 25.

In addition to the space gained by packing the cylinder and piston to the drill pipe passing therethrough, it will be noted that an extra element is saved in construction because of the fact that the drill pipe is then made to form in fact one of the walls of the hydraulic couple.

What is claimed is:

1. In well drilling apparatus, the combination with a rotary table, of a concentric annular cylinder carried by said table, an annular piston slidingly keyed in said cylinder and forming therewith a rotary structure turning with the table, means carried by said annular piston for driving engagement with a drill pipe extending therethrough and fluid pressure connections for the cylinder supported by the rotating structure aforesaid in non-rotating relation.

2. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said members for gripping engagement with a drill pipe extending through the two members and fluid pressure connections for the cylinder supported by one of said rotating members.

3. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said members for gripping engagement with a drill pipe extending through the two members, fluid pressure connections for the cylinder supported by one of said rotating members and including a neck extension on said rotating member and a collar swivelled on said neck.

4. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said mem-

bers for gripping engagement with a drill pipe extending through the two members, fluid pressure connections for the cylinder supported by one of said rotating members and including a neck extension on said rotating member and a collar swivelled on said neck, said neck having a port in the side of the same in communication with the interior of the cylinder and packing means carried by the swivel collar above and below said port.

5. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said members for gripping engagement with a drill pipe extending through the two members, fluid pressure connections for the cylinder supported by one of said rotating members and including a neck extension on said rotating member and a collar swivelled on said neck, said neck having a bearing forming a rotary support for the swivel collar and said collar having adjustable means for packing the same on the neck.

6. In well drilling apparatus, an annular hydraulic cylinder adapted for mounting in a rotary table so as to turn bodily therewith, an annular piston operating in said cylinder and forming with the cylinder members of a hydraulic feed couple, drill stem gripping means carried by one of said members, a swivel neck of reduced diameter carried by one of said rotating members and provided with a fluid passage open to the interior of the cylinder, a hydraulic supply collar swivelly supported on said neck and adjustable means for hydraulically packing said collar on the neck.

7. In combination with a rotary table, an annular cylinder seated in said table and extending above the top of the table, an annular piston operating in said cylinder, drill stem gripping means carried by said piston, said cylinder and piston both rotating with the table to constitue members of a drill feed couple, one of said members having a swivel neck of reduced diameter in communication with the interior of the cylinder and a hydraulic supply collar swivelly supported on said neck.

8. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said members for gripping engagement with a drill pipe extending through the two members and fluid pressure connections for the cylinder supported by one of said rotating members, a packing sleeve attached to the piston and operating through the cylinder and packing means between the cylinder and sleeve.

9. In well drilling apparatus, the combination of a rotary table, an annular cylinder, an annular piston in said cylinder, said piston and cylinder constituting members of a pressure feed couple and both rotating with the table, means carried by one of said members for gripping engagement with a drill pipe extending through the two members, fluid pressure connections for the cylinder supported by one of said rotating members and including a neck extension on said rotating member and a collar swivelled on said neck, a packing sleeve carried by the piston and operating through said neck and packing means associated with said sleeve.

10. Hydraulic feed mechanism for rotary tables, comprising an annular cylinder, an annular piston operating therein, means for supporting said cylinder and piston on a rotary table, said piston having a head portion provided with a clamp socket and below that with a packing socket, drill stem clamp means adjustably entered in said socket and removable therefrom and packing means engageable in the packing socket and freely accessible when the drill clamp means is removed.

11. Apparatus of the character disclosed, comprising annular piston and cylinder members constructed for mounting in a rotary table, pipe holding means carried by one of said members, one of said members having a portion of less diameter than the cylinder and water connections swivelled to said portion of less diameter.

12. Apparatus of the character disclosed, comprising an annular cylinder adapted for mounting in a rotary table, an annular piston operating in said cylinder, said piston having upper and lower piston heads, pipe holding means carried by one of said heads and means for enabling the sealing of one of said piston heads to the cylinder.

13. Hydraulic feed mechanism for rotaries, comprising an annular cylinder of a size to fit in the bore of a rotary table and provided with an outstanding flange intermediate the upper and lower ends of the same to seat on top of the table whereby said hydraulic feed mechanism will rotate with the table, an annular piston operating in said cylinder, pipe holding means carried by said piston and swivelled means supported by said rotating hydraulic feed structure for supplying fluid under pressure to the cylinder.

14. In combination with a rotary table, a hydraulic cylinder adapted to be lowered down into the bore of said table, said cylinder being provided with a hydraulic swivel at the lower end of the same of less diameter than the bore of the table and therefore adapted to be lowered with the cylinder down into the table, a piston operating in said cylinder and means carried by said ap-

paratus for holding engagement with a drill pipe.

15. In apparatus of the character disclosed, an annular feed cylinder having an internal shoulder and a removable head at the lower end of the same, an annular piston operating in the cylinder, packing means and a packing compressing ring carried by the piston, said internal offset preventing removal of said ring past the same and a holding ring for said packing compressing ring, said holding ring being adjustably and removably secured to the piston and constructed to pass said offset.

16. The combination with a rotary table and drill pipe extending therethrough, of hydraulic feed mechanism including an annular cylinder and piston and a hydraulic swivel all applicable to, rotatable with and removable from the table as a unit and means carried by said rotating removable hydraulic feed unit for grippingly engaging said unit to the drill pipe and whereby said complete unit may be removed from the table attached to said drill pipe.

17. Hydraulic feed mechanism for rotaries, comprising a power cylinder and piston applicable to and removable from a rotary table, pipe holding means carried by said mechanism and means for temporarily securing the piston at one end of its stroke in the cylinder to prevent relative travel of the piston and cylinder in the course of removing or replacing the mechanism with respect to the table.

18. In combination with a rotary table for rotating a drill pipe, a power cylinder and piston associated with said table and provided with pipe holding means for controlling feed of the drill pipe rotated by the table and means for securing the piston immovable in the cylinder independently of fluid pressure employed in the operation of the device.

19. In combination with a rotary table, an annular cylinder and piston carried by said table, pipe holding means carried by the piston and a water swivel on the piston above the table.

20. In combination with a rotary table, an annular cylinder and piston carried by said table, pipe holding means carried by the piston and a water swivel supported by the cylinder below the table.

21. In combination with a rotary table and a drill pipe extending therethrough, an annular power cylinder and piston associated with the table, means for holding the drill pipe carried by the piston and means for packing the cylinder to the drill pipe, whereby said drill pipe forms one effective wall of the cylinder.

22. Hydraulic drill feed mechanism including a power cylinder and piston forming members of a hydraulic couple, said members being of annular form to pass a drill pipe, a drill pipe extending through said members, means for coupling one of the members to said drill pipe and means for packing one of the members to said drill pipe to thereby cause the latter to form one of the walls of said hydraulic couple.

23. In combination with a rotary table, a cylinder and piston carried by said table and forming a power couple rotating with the table for regulating feed of a drill pipe, one of said members of the power couple having a fixed relation to the table and the other member having a vertical travel in respect to the table, means on said vertically movable member for holding the drill pipe and a water swivel supported by the other, non-vertically traveling rotating member of the power couple.

In testimony whereof I affix my signature.

JAMES C. FORTUNE.