

Aug. 4, 1931.

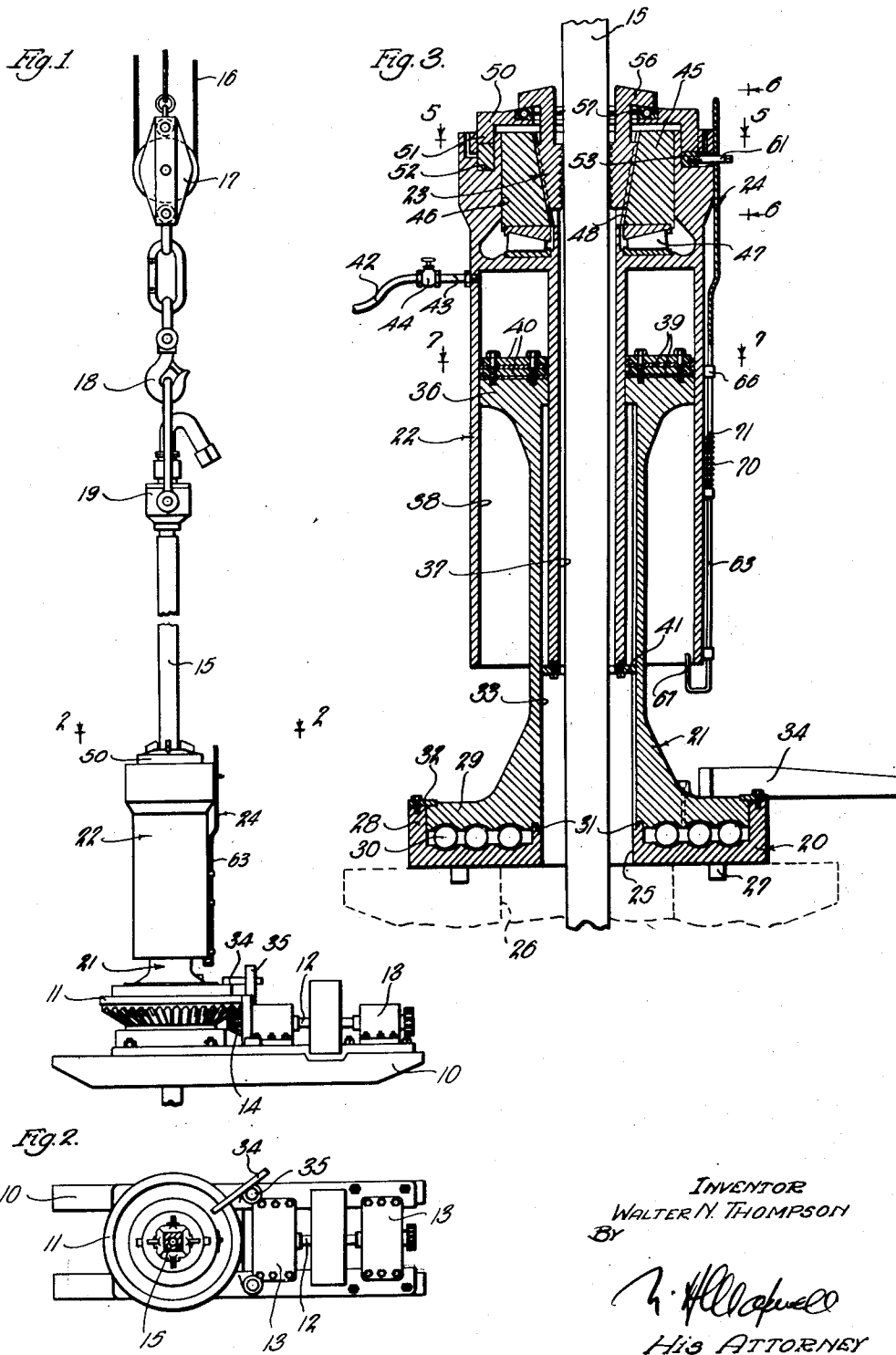
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1,817,467

FEED FOR WELL DRILLING TOOLS

Filed Nov. 3, 1930

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 4.

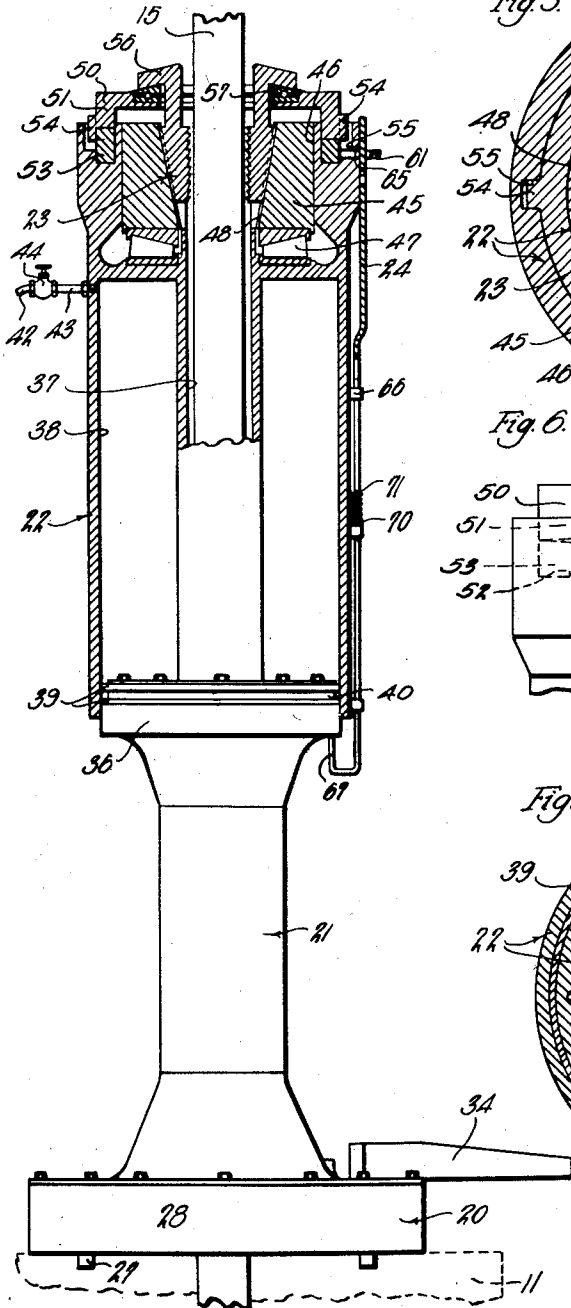


Fig. 5.

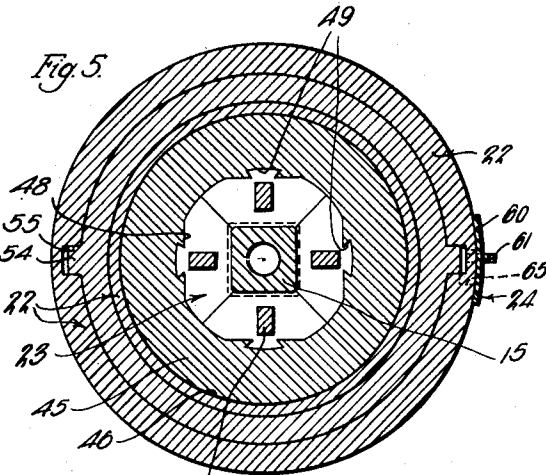


Fig. 6.

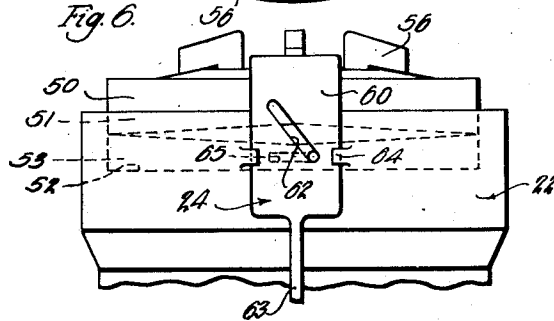
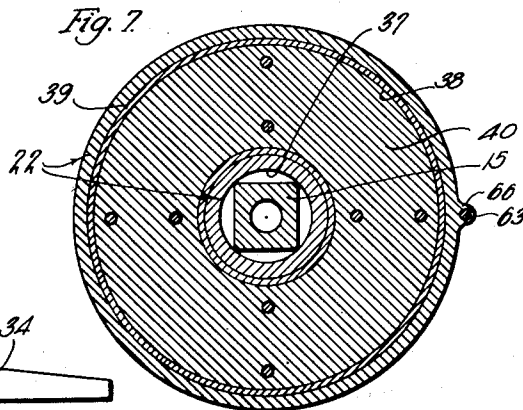


Fig. 7.



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FEED FOR WELL DRILLING TOOLS

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This invention relates to a drilling control or feed and relates more particularly to an hydraulic feed for rotary well drilling tools.

With the ordinary or standard rotary method of well drilling, a drive is provided for rotating the drill pipe, and hoisting equipment is provided to handle the vertical movement of the drill pipe. It is common practice to rotate the drill pipe by a rotary unit at a more or less constant speed while the driller operates the hoisting equipment to regulate the pressure with which the drill bears on the bottom of the bore. When the drilling resistance caused by the engagement of the drill with the formation becomes excessive, the driller operates the hoisting equipment to relieve the pressure of the drill on the formation. When drilling through certain types of formation, it has been found desirable to provide a control or feed for feeding the drill into the formation at a constant pressure. Mechanisms termed "automatic feeds" have been introduced to control the feed pressures and, in some instances, to correlate the rotary drive and the vertical feed pressure. Controls of this character are extremely complicated and expensive and cannot be applied to the standard types of rotary unit, but require the installation of expensive special machinery at the derrick.

It is a general object of the invention to provide a simple, practical, and effective feed for rotary well drilling tools.

It is another object of the invention to provide an hydraulic feed for well tools that may be readily mounted on, and used in connection with, a standard or typical rotary unit.

It is another object of the invention to provide a feed for drilling tools that is adapted to be mounted on a common rotary unit, and that is adapted to effectively control the vertical feeding of the drilling tools by engaging or carrying the usual kelly or drill stem.

It is another object of the invention to

provide a feed for drilling tools that is particularly simple and easy to control or operate.

It is another object of the invention to provide an hydraulic feed for drilling tools that may be automatically released from the drilling stem, so that it may be handled by the hoisting equipment in the derrick.

It is a further object of the invention to provide a feed for rotary well drilling tools that embodies but few sturdy parts, and that is simple and inexpensive of manufacture.

The various other objects and features of my invention will be best and more fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevation of the control provided by the present invention, illustrating it mounted on a typical rotary unit and in engagement with a drill stem carried by typical hoisting equipment. Fig. 2 is a top or plan view of the control, being a view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged vertical detail sectional view of the control, illustrating the device in an operative or intermediate position. Fig. 4 is a view similar to Fig. 3, illustrating the cylinder at the top of its stroke where the slips are released from the kelly. Fig. 5 is an enlarged transverse detailed sectional view taken as indicated by line 5—5 on Fig. 3. Fig. 6 is an enlarged side elevation of the upper portion of the feed, being a view taken as indicated by line 6—6 on Fig. 3, and Fig. 7 is an enlarged transverse detailed sectional view taken as indicated by line 7—7 on Fig. 3.

The drilling tool feed or control provided by the present invention is intended to be used in connection with standard or typical rotary well drilling equipment. Throughout the following detailed disclosure of the invention, it will be described in connection with

a typical rotary unit and as engaging a common kelly or drill stem normally carried by the usual hoisting equipment. The invention is not primarily concerned with the type of drilling equipment with which the feed is used, and the invention is not to be considered as restricted to the particular well drilling equipment illustrated in the drawings.

The rotary unit illustrated in the drawings includes skids 10, a rotary table 11 projecting above the skids 10, a shaft 12 mounted on the skids through suitable bearings 13 and carrying a bevel gear 14 for rotating the table 11. The table 11 may be a typical or common rotary table for carrying slips, kelly bushings, etc. Throughout the following disclosure, the rotary table 11 will be considered as carrying a kelly bushing for engaging and driving the kelly 15. The kelly 15 and drilling string carried thereby is adapted to be suspended in the derrick from lines or cables 16 carrying a travelling block 17. The block 17 is provided with a hook 18 for carrying a swivel 19. The swivel 19 is applied to the upper end of the kelly 15 and is provided to discharge circulating fluid into the kelly. The kelly and drilling string are adapted to be rotated or driven by the rotary table, and may be operated vertically by the travelling block 17 and the other hoisting equipment of the derrick.

The feed provided by the invention includes, generally, a base plate 20 adapted to be mounted on the rotary table 11, a stationary body or piston 21 mounted on the base plate 20, a cylinder 22 slidably mounted on the piston 21 and operable by fluid under pressure, slips 23 carried by the cylinder 22 to engage the kelly 15 for supporting the drilling tools, and means 24 for automatically releasing the slips 23 from the kelly upon the cylinder reaching the upper end of its stroke.

The base plate 20 may be mounted directly on the upper side or top of the rotary table 11. The plate 20 is provided to support the body or piston 21 and is in the form of an annular bearing member. In accordance with the invention, the plate 20 is detachably mounted on the top of the table 11 in a central position, where its central opening 25 is in register with the opening 26 in the table and the opening in the kelly bushing (not shown). The opening 25 is sufficiently large to pass the various sizes of drill stems or kellys and the couplings of the drilling strings with considerable clearance. The base plate 20 is connected with the table 11 to rotate therewith. In the simple form of the invention illustrated in the drawings, spaced lugs 27 project downwardly from the lower side of the plate 20 to fit into suitable openings in the upper side of the rotary table 11. With this connection, the plate 20 may be easily and quickly mounted on and dismounted from the table 11. An upwardly projecting annular

flange 28 is provided at the perimeter of the plate 20.

The body or piston 21 is supported on the base plate 20 and projects upwardly therefrom. The piston 21 is an elongated tubular member having an enlarged lower end, or flange, 29. The flange, or enlargement, 29 fits into, or is surrounded by, the flange 28. The enlargement 29 is mounted on the base plate 20 through a suitable bearing. In the particular case illustrated, three rows or series of balls 30 are arranged in races formed between the base plate 20 and the lower side of the flange 29. An upwardly projecting flange 31 may be provided on the base plate 20 around the opening 25 to fit into a groove in the piston. The piston may be held against vertical displacement from the base plate 20 by an annular plate 32 mounted on the flange 28 and engaging or overlapping the upper side of the enlargement 29. The piston 21 is mounted on the base plate 20, so that its central longitudinal opening 33 is in register with the opening 25 of the plate. In accordance with the invention, the piston 21 is held against rotation. The piston may be held stationary in any suitable manner. In the simple form of the invention illustrated in the drawings, an arm 34 is mounted on the upper side of the enlargement 28 and projects outwardly beyond the plate 20. The arm 34 is adapted to engage a post 35 projecting upwardly from the rotary unit to hold the piston 21 against rotation.

The piston 21 is comparatively long, and projects upwardly some distance from the enlargement 29. An enlargement or head 36 is provided on the upper end of the piston 21. The head 36 is circular or annular.

The cylinder 22 is slidably mounted on the piston 21 and is operable upwardly by fluid under pressure and downwardly by the weight of the string of tools supported on the cylinder through the engagement of the slips 23 with the kelly 15. The cylinder 22 is an elongated member having a central longitudinal opening 37 freely passing the kelly 15. The cylinder 22 surrounds or encases the upper portion of the piston 21, and is provided with an annulus, or annular opening, 38 for slidably passing the head 36. The cylinder opening 38 extends upwardly into the cylinder from its lower end, and is comparatively long or deep so that the cylinder has a long stroke. A suitable packing or sealing means is provided on the head 36 to seal with the walls of the cylinder opening 38. In the particular case illustrated, two rings of packing 39 are clamped on the head 36 between plates 40. The packing rings 39 are operable to seal with the inner and outer walls of the cylinder opening 38. Means is provided for holding the cylinder 22 against rotation on the piston 21. A suit-

able key connection 41 may be provided between the inner walls of the opening 38 and the walls of the opening 33 of the piston.

Fluid under pressure, say, oil, may be discharged into the upper end of the cylinder opening 38 for operating the cylinder 22 upwardly. In the drawings, I have illustrated a flexible hose or conduit 42 connected with a pipe or nipple 43, communicating with the upper end of the cylinder opening 38. A suitable valve 44 may be provided at the connection of the flexible conduit 42 with the nipple 43. Fluid under pressure may be applied to the opening 38 under pressure from a suitable remote source of supply and by suitable pressure developing means. The flexible conduit 42 may extend to a convenient point in the derrick where a valve may be provided for controlling the supply and discharge of fluid to and from the cylinder opening 38.

The slips 23 are mounted in the upper end of the cylinder 22 to engage the kelly 15 for supporting the drilling tools. A set or plurality of slips are rotatably mounted in the upper end part of the cylinder. In the drawings, I have shown four like slips 23, one for engaging each face of the kelly. It is to be understood that any suitable type of slips may be employed for co-operating with drill stems or kellys of various characters. Teeth or gripping parts are provided on the inner parts of the slips 23 for gripping the kelly 15. The slips 23 are removably carried by a ring or bushing 45. The bushing 45 is annular in form and is rotatably carried in a recess 46 in the upper end of the cylinder 22. The bushing 45 may be rotatably supported by a suitable roller bearing 47 in the bottom of the recess 46. The walls of the opening 48 in the bushing diverge upwardly and outwardly, and the outer sides of the slips 23 are shaped to slidably fit the walls of the opening. Suitable dovetailed connections 49 may be provided between the outer sides of the slips 23 and walls of the opening 48. The slips 23 are forced into effective gripping engagement with the kelly 15 upon downward movement in the opening 48, and are released from the kelly upon movement upwardly in the opening.

It will be apparent how the kelly 15, driven by the rotary table 11, may be supported on the cylinder 22 by the slips 23 and bushing 45. The kelly and drilling tools may be fed or allowed to feed downwardly by permitting the fluid in the opening 38 to discharge through the conduit 42 at a desired rate. The rate of downward movement of the cylinder and kelly 15 may be readily controlled by valve means in connection with the conduit 42. The hoisting mechanism in the derrick may be employed to carry a portion of the weight of the drilling tools, and the strain taken by the hoisting mechanism may be re-

lated to the rate of flow of fluid through the conduit 42 to cause the bit to be fed into the formation at any desired speed. When the cylinder 22 reaches the lower end of its stroke, fluid under pressure may be discharged into the cylinder opening 38 to return the cylinder to an up position. The slips 23 may be left in engagement with the kelly 15 when the cylinder 22 is returned to the up position so that the string and the drilling tool is raised. This is desirable, as it is not good practice to permit the entire weight of the drilling string to be supported on the bottom of the well bore through the drilling tool. Further, it may be desirable to raise the drilling tools to free them from cuttings, etc., in the bore.

The means 24 acts to automatically release the slips 23 from the drill stem or kelly 15 upon the cylinder 22 reaching the upper end of its stroke to permit the drilling string to be lowered into the bore by the hoisting mechanism to bring the drilling tool into engagement with the bottom of the bore or to a point adjacent the bottom of the well bore. The means 24 is in the nature of an automatic cam means and includes an upper ring 50 mounted above the bushing 45. The central opening in the ring 50 is in register with the upper end of the tapered opening 48. A downwardly projecting annular flange 51 is provided at the periphery of the ring 50. The flange 51 extends into an annular groove 52 in the upper end of the cylinder 22. A cam ring 53 is rotatably mounted in the groove 52 below the flange 51. The upper side of the cam ring 53 and the lower side of the flange 51 are in the form of co-operating cam faces, operable to cause upward movement of the upper ring 50 upon rotation or partial rotation of the cam ring 53 relative to the upper ring. The co-operation between the rings 50 and 53 retains the upper ring 50 spaced above the top of the bushing 45. The upper ring 50 is held against rotation by pins or lugs 54 projecting outwardly from the flange 51 and slidably fitting notches 55 in the upper end of the cylinder 22. Upward movement of the ring 50 causes disengagement of the slips 23 from the drill stem or kelly 15. Each of the slips 23 is provided with an upwardly-projecting arm 55. A lug or finger 56 projects outwardly from the upper end of each of the arms 55 to engage over the upper side of the ring 50. A suitable anti-friction bearing ring 57 may be provided in the upper side of the ring 50 to engage the fingers 56.

The cam ring 53 is automatically rotated upon the cylinder 22 reaching the upper end of its stroke. The means for rotating or partially rotating the cam ring 53 when the cylinder approaches the upper end of its stroke is in the nature of an automatic cam means, and includes a plate 60 slidably

mounted on the outer side of the cylinder 22, a pin 61 projecting from the cam ring 53 and operable in a cam slot 62 in the plate, and an operating rod 63 for operating the plate.

5 The plate 60 is vertically disposed on the exterior of the cylinder 22 adjacent its upper end. The plate is guided for vertical movement by guide projections 64. The pin 61 projects radially outward from the cam ring

10 53 and extends through an elongated slot 65 in the cylinder 22. The inner end of the pin 61 may be screw-threaded into an opening in the ring 53 so that the pin is readily removable. The pin 61 extends outwardly

15 through the oblique or angularly disposed cam slot 62 in the plate 60. The pin 61 extends into the lower end of the cam slot 62 when the slips 23 are in the operating position on the kelly 15.

20 The operating rod 63 projects downwardly from the lower end of the plate 60 and extends to a point below the lower end of the cylinder 22. The rod 63 may be guided by guides 66 on the side of the cylinder 22.

25 The lower end portion of the rod 63 is bent to have an upwardly projecting arm 67. The arm 67 may normally project upwardly into the lower end of the cylinder opening 38. The arm 67 is adapted to engage the

30 lower side of the piston head 36 upon the cylinder 22 approaching the upper end of its stroke. It will be apparent how engagement of the arm 67 with the head 36 will cause downward movement of the rod 63 and the

35 plate 60 relative to the cylinder 22. Downward movement of the plate 60 causes co-operation between the pin 61 and the cam slot 62 so that the cam ring 53 is partially rotated. Partial rotation of the cam ring

40 53 upon downward movement of the plate 60 causes the co-operation between the cam faces of the rings 50 and 53 to raise the ring 50 so that the slips 23 are shifted upwardly out of engagement with the kelly 15. The

45 lower end of the rod 63 and arm 67 are in a position where they may be readily engaged and operated by a driller at the rotary unit so that the slips may be released from the kelly at will.

50 The present invention provides means for automatically returning the rod 63 and the plate 60 to a down position relative to the cylinder 22 when the arm 67 is disengaged from the head 36. The means for automati-

55 cally returning the various parts of the means 24 to their normal positions is in the nature of a spring means and includes a helical compression spring 70. The spring 70 surrounds the rod 63, and its upper end is carried by or

60 engages a pin 71 on the rod. The lower end of the spring 70 engages a guide 66 upon downward movement of the rod relative to the cylinder so that it is compressed. Upon disengagement of the arm 67 from the head

65 36, the spring 70 automatically returns the rod and the plate 60 to their up positions, so that the slips 23 are returned to a position in engagement with the kelly 15.

The control or feed provided by the present invention may be employed whenever it is 70 desired to feed the drilling tools into the formation at a constant pressure. The plate 20 may be readily mounted on the rotary table 11, and the arm 34 may be arranged in engagement with a post on the unit to hold the 75 piston 21 against rotation. During normal operations, the drilling string may be supported by the hoist means in the derrick, and fluid pressure may be supplied to the opening 38 to raise the cylinder 22 to an up position. 80 During this initial arrangement of the cylinder to its up position, the slips 23 may be held out of engagement with the kelly 15. The weight of the drilling string, or a portion of the weight of the string, may be supported on the cylinder 22 by means of the 85 slips 23. The drilling tools may then be driven or rotated by the rotary unit, and the downward feeding of the tools may be regulated by controlling the rate of discharge of 90 fluid through the conduit 42 and the strain, if any, taken by the hoist means in the derrick. Upon the cylinder 22 reaching the lower end of its stroke, the rotation of the 95 drilling tools may be stopped and fluid pressure may be discharged into the opening 38 to return the cylinder to its up position. During this upward movement of the cylinder 22, the slips 23 may be left in engagement with 100 the kelly 15 so that the drilling tool is raised from the formation at the bottom of the bore. Upon the cylinder 22 reaching the upper end of its stroke, the hoist mechanism in the derrick may be set to suspend the drilling string. 105 When the arm 67 strikes the head 36, the cam ring 53 is rotated by co-operation of the pin 61 in the cam slot 62. Partial rotation of the cam ring 53 causes the upper ring 50 to be raised so that the slips 23 are lifted out of engagement with the kelly 15. The drilling 110 tools may then be lowered by the hoist means in the derrick so that the drilling tool is brought into engagement with the formation at the bottom of the well bore, or to a position adjacent the bottom of the well bore. A small 115 amount of fluid may then be discharged from the cylinder opening 38 so that the arm 67 is disengaged from the piston head 36.

Upon disengagement of the arm 67 from the head 36, the spring 70 returns the plate 60 120 to an up position and causes the cam ring 53 to be rotated in a reverse direction. Upon return of the ring 53 to its normal position, the upper ring 50 is permitted to lower so that the slips 23 are brought into gripping engagement with the kelly 15. The entire weight of 125 the string, or part of the weight of the string, may be supported on the cylinder through the slips 23, and the rotary table 11 may be rotated to drive the kelly. Fluid may be dis-

charged slowly from the conduit 42 to permit the drilling tools to feed downwardly, and the rate of downward feeding of the tools may be effectively controlled or governed by regulating the rate of discharge through the conduit.

It is to be noted that the present invention provides a simple and practical feed for drilling tools. The devices may be easily mounted on a typical rotary unit and may be used in connection with the standard equipment. The control includes but few simple, sturdy parts and is particularly easy to control and operate. The parts are not subjected to rotational strains, as the piston and cylinder are held stationary during operation. The slips 23 are supported by the bushing 45 which is mounted for rotation on the cylinder. The means for automatically releasing the slips 23 is simple and positive in its operation. The means 24 may be manually operated or controlled if desired to release the slips.

Having described only a typical preferred form of my invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A feed for well drilling tools, including a stationary piston, a cylinder slidable relative to the piston, and slips mounted on the cylinder for engaging a drilling tool.

2. A device for use in connection with a rotary table, and a drill stem driven thereby which includes a piston adapted to be mounted on the table, a cylinder having an opening slidably receiving the piston and an opening freely passing the drill stem, and a set of slips on the cylinder for releasably engaging the drill stem.

3. A device for use in connection with a rotary table, and a drill stem driven thereby which includes a piston adapted to be mounted on the table, a cylinder having an opening slidably receiving the piston and an opening freely passing the drill stem, and a set of slips on the cylinder for releasably engaging the drill stem.

4. A device for use in connection with a rotary table, and a drill stem driven thereby which includes a piston adapted to be mounted on the table, a cylinder having an opening slidably receiving the piston and an opening freely passing the drill stem, means whereby fluid may be discharged from the last-mentioned opening, and a set of slips on the cylinder for releasably engaging the drill stem.

5. A device for use in connection with a rotary table, and a drill stem driven thereby which includes a piston adapted to be mounted on the table, a cylinder having an opening slidably receiving the piston and an opening freely passing the drill stem, means

whereby fluid may be discharged from the last-mentioned opening and discharged into the last-mentioned opening under pressure, and a set of slips on the cylinder for releasably engaging the drill stem.

6. A feed for use in connection with a rotary table and a drill stem, including a bearing plate adapted to be mounted on the table, a piston mounted on the bearing plate, means for holding the piston against rotation, a cylinder having an opening passing the drill stem and an opening slidably receiving the piston, and releasable means for supporting the drill stem on the cylinder.

7. A feed for use in connection with a rotary table and a drill stem, including a bearing plate adapted to be mounted on the table, a piston mounted on the bearing plate, means for holding the piston against rotation, a cylinder having an opening passing the drill stem and an opening slidably receiving the piston, slips for engaging the drill stem, and means supporting the slips on the cylinder for rotation.

8. A feed for use in connection with a rotary table and a drill stem driven thereby, which includes a piston mounted on the table having an opening passing the drill stem, a cylinder having an opening passing the drill stem and an opening slidably passing the piston, means for discharging fluid from and passing fluid under pressure into the last-mentioned opening, and slips carried by the cylinder for supporting the drill stem.

9. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for rotatably supporting the slip on the cylinder, and means for disengaging the slip from the drill stem.

10. A feed for a drill stem driven by a rotary table, which includes a piston to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for rotatably supporting the slip on the cylinder, and means for automatically disengaging the slip from the drill stem upon the cylinder approaching the upper end of its stroke.

11. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for rotatably supporting the slip

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on the cylinder, and cam means for disengaging the slip from the drill stem.

12. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem supported on the cylinder, and means for disengaging the slip from the drill stem, including a ring, an arm on the slip engageable by the ring, and a cam for operating the ring.

13. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for rotatably supporting the slip on the cylinder, and means for disengaging the slip from the drill stem, including a ring, an arm on the slip engaging the ring, a cam operable to raise the ring, and means for operating the cam.

14. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem supported on the cylinder, and means for disengaging the slip from the drill stem, including a ring carried on the cylinder for vertical movement, an arm on the slip operable by the ring, a lower ring, the rings having co-operating cam faces for causing vertical movement of the first-mentioned ring upon operation of the lower ring, and means for operating the lower ring.

15. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for rotatably supporting the slip on the cylinder, and means for disengaging the slip from the drill stem, including a ring carried on the cylinder for vertical movement, an arm on the slip operable by the ring, a lower ring, the rings having co-operating cam faces for causing vertical movement of the first-mentioned ring upon operation of the lower ring, and means for operating the lower ring, including a rod slidably carried by the cylinder and engageable by the piston.

16. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the

chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for mounting the slip on the cylinder so that it is operable into and out of supporting engagement with the drill stem, and means for automatically disengaging the slip from the drill stem upon the cylinder approaching the end of its stroke, including a ring in engagement with the slip and carried for vertical movement, a cam for operating the ring vertically, a slidable rod engageable by the piston, and an operative connection between the cam and the rod.

17. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into that chamber, a slip for engaging the drill stem, means for mounting the slip on the cylinder so that it is operable into and out of supporting engagement with the drill stem, and means for automatically disengaging the slip from the drill stem upon the cylinder approaching the end of its stroke, including a ring in engagement with the slip and carried for vertical movement, a cam for operating the ring vertically, a slidable rod engageable by the piston, and an operative cam connection between the cam and the rod.

18. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for mounting the slip on the cylinder so that it is operable into and out of supporting engagement with the drill stem, and means for automatically disengaging the slip from the drill stem upon the cylinder approaching the end of its stroke, including a ring in engagement with the slip and carried for vertical movement, a cam for operating the ring vertically, a slidable rod engageable by the piston, an operative connection between the cam and the rod, and means for returning the rod and cam to the unactuated positions upon disengagement of the rod from the piston.

19. A feed for a drill stem driven by a rotary table, which includes a piston adapted to be mounted on the rotary table, a cylinder having a chamber slidably receiving the piston, means for discharging fluid from the chamber and for passing fluid under pressure into the chamber, a slip for engaging the drill stem, means for mounting the slip on the cylinder so that it is operable into and out of supporting engagement with the drill stem, and means for automatically disengaging the slip from the drill stem upon the cylinder approaching the end of its stroke, including a

ring in engagement with the slip and carried for vertical movement, a cam for operating the ring vertically, a slidable rod engageable by the piston, an operative connection between the cam and the rod, and spring means for returning the rod and cam to the unactuated positions upon disengagement of the rod from the piston.

In witness that I claim the foregoing I have hereunto subscribed my name this 10th day of October, 1930.

WALTER N. THOMPSON.

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