

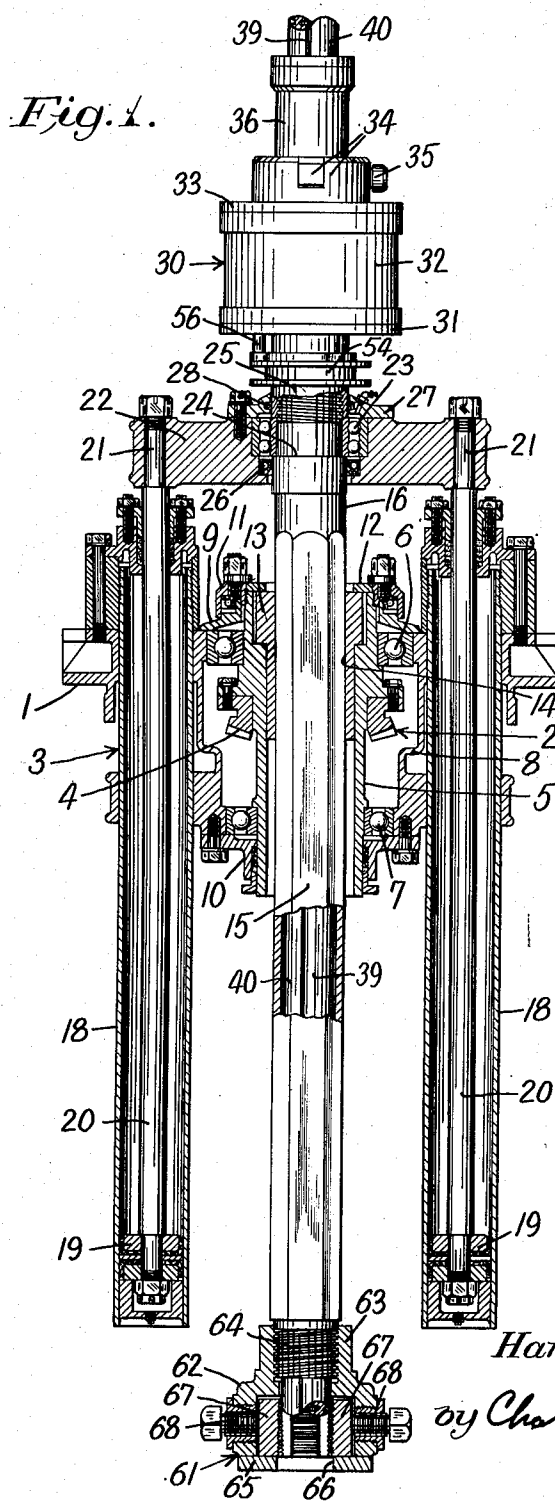
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DRILLING APPARATUS.

2,617,630

Filed Dec. 12, 1947

2 SHEETS--SHEET 1



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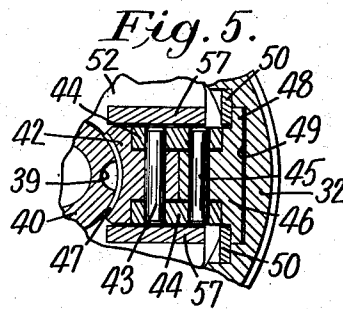
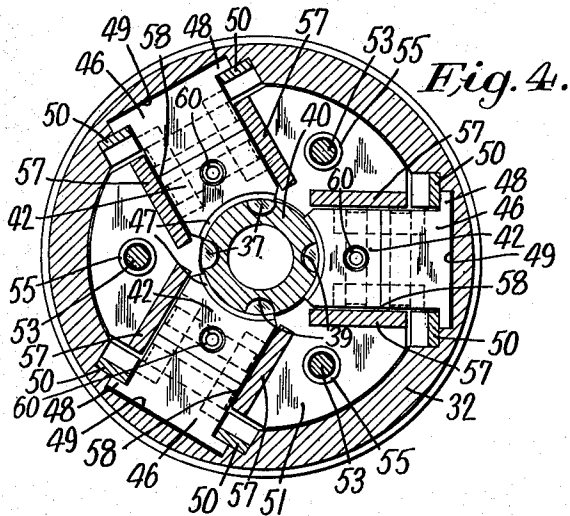
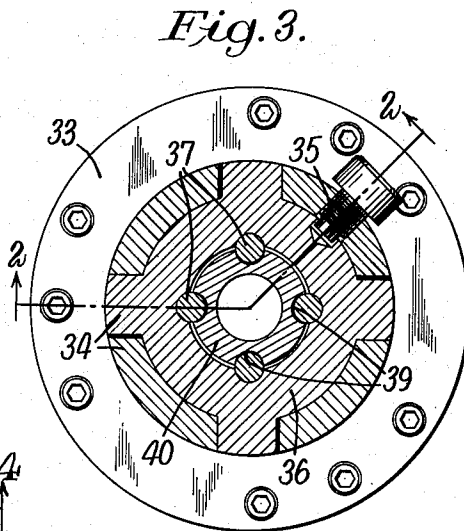
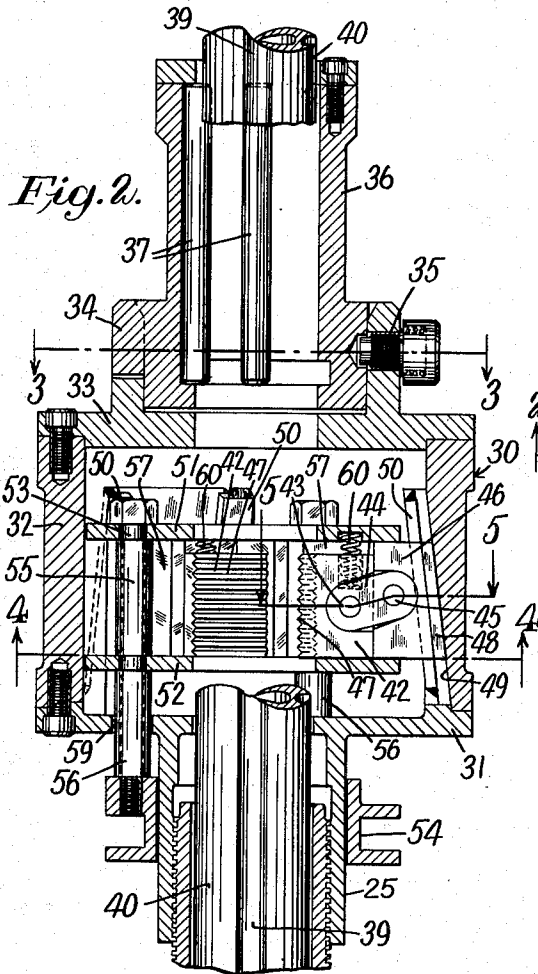
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DRILLING APPARATUS

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2 SHEETS--SHEET 2



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UNITED STATES PATENT OFFICE

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DRILLING APPARATUS

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Application December 12, 1947, Serial No. 791,342

13 Claims. (Cl. 255—22)

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This invention relates to drilling apparatus and more particularly to an automatic chuck and driver especially designed for use with a drill stem or kelly of a rotary type oil well drilling apparatus.

In an oil well drilling apparatus of the rotary type, there is usually provided, on a common base, drill rod rotating and feeding mechanisms, a hoisting mechanism, and a pump for drilling fluid. A drill stem or kelly is usually attached to the upper end of the drill rod line and may be either provided with splineways or polygonal cross section for engagement with a splined driver or a driver provided with a polygonal opening and rotated by a drive bushing or by a rotary table; and the drill stem or kelly is slidable axially through the driver and at times may be raised and lowered with respect thereto by the usual hoisting cable of the drilling apparatus. When drilling in relatively soft formations, the kelly may be fed by gravity axially downwardly through the driver or table under the control of the hoisting cable, and the hoisting cable may support the kelly to remove some of the weight of the drill rod line from the drill bit. When drilling in relatively hard formations, it is desirable to feed the drill stem or kelly toward the work by a hydraulic feeding mechanism to provide a positive feed and a sensitive control of the movement of the drill bit at the bottom of the drill hole, and it is further desirable automatically to disconnect the kelly from the feeding mechanism when the feed is retracted to a new feeding position. Also, when forward feed is again resumed, it is desirable automatically to connect the feeding mechanism to the kelly. Such automatic means for connecting the feed to and for releasing the feed from the kelly usually may comprise an automatic chuck which automatically grips during forward feed and automatically releases when the feed is retracted. Also, at times it is desirable to operate the jaws of the automatic chuck by manual means wholly independently of the movement of the feeding mechanism, as for example, to release the jaws during hoisting or lowering of the drill rod line. In such drilling apparatus, the drive bushing or rotary table usually has keys or a polygonal opening for rotating a splined or polygonal drive rod while permitting free axial movement of the drive rod with respect thereto. Further, in such drilling apparatus, it is desirable, at times, to provide an additional chuck which may be adjusted at will positively to grip the kelly so that the hydraulic feeding mechanism may be employed

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hydraulically to raise the drill rod line out of the hole independently of the hoisting cable. In such drilling apparatus, the drive bushing or rotary table may be stationary as regards bodily movement or may be carried by the feeding mechanism bodily to move up and down with the automatic chuck in conventional manners.

An object of the present invention is to provide an improved chuck mechanism for connecting the hydraulic feeding mechanism of a rotary drilling apparatus to or releasing the same from the drill stem or kelly. Another object is to provide an improved automatic chuck which automatically grips the drill stem or kelly when forward feed is effected and which automatically releases when the feed is retracted. A further object is to provide an improved automatic chuck having a novel arrangement of the chuck jaws and improved means for supporting and operating the jaws. Yet another object is to provide an improved chuck mechanism wherein the rotatable chuck casing carries the driver for the drill stem or kelly and embodying improved adaptor means whereby the driver may be releasably attached to the chuck casing. Still another object is to provide an improved automatic chuck for connecting a hydraulic feeding mechanism to a drill stem or kelly and which has chuck jaws which automatically grip the kelly for moving the latter downwardly in an axial direction with respect to the rotatable member or rotary table of the drilling apparatus. A still further object is to provide improved rotating means independent of the gripping means of the automatic chuck and rotatable with the chuck casing for rotating a drill stem or kelly. Another object is to provide an improved chuck mechanism embodying a chuck for gripping a drill stem or kelly to connect the hydraulic feeding mechanism to the kelly whereby the feeding mechanism may be operated hydraulically to raise the drill rod line from the drill hole independently of the hoisting cable of the drilling apparatus. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a vertical sectional view, with parts shown in full, taken through the feeding and rotating mechanisms of a rotary oil well drilling apparatus, with which an illustrative embodiment of the improved chuck mechanism and driver is associated.

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Fig. 2 is an enlarged vertical sectional view through the automatic chuck and driver which are shown in full in Fig. 1, taken on line 2—2 of Fig. 3.

Fig. 3 is a cross-sectional view taken substantially on line 3—3 of Fig. 2.

Fig. 4 is a cross-sectional view taken substantially on line 4—4 of Fig. 2.

Fig. 5 is a detail sectional view taken substantially on lines 5—5 of Fig. 2.

The rotary oil well drilling apparatus with which the improved chuck mechanism and driver are associated comprises a support 1 which may be mounted on a base, such as the platform of an automotive vehicle, and this support carries a rotating mechanism generally designated 2 and a feeding mechanism generally designated 3.

The rotating mechanism 2 is herein of a conventional design and includes a power operated rotating member, herein preferably in the form of a bevel gear 4, secured to a tubular shaft or drive sleeve 5, the latter suitably journaled in bearings 6 and 7 supported within a casing 8, herein preferably formed integral with the support 1. The casing 8 has usual detachable upper and lower heads 9 and 10 which carry suitable packings, the packing of the upper head sealingly engaging an inner surface on a member 11 threadedly secured to the upper end of the drive sleeve 5 and the lower packing sealingly engaging the exterior surface of the lower portion of the drive sleeve. These head packings serve to prevent oil leakage from the casing. The bevel gear 4 may be driven in any suitable manner from any suitable power source, such as by an engine carried by the platform of the automotive vehicle or by the vehicle engine itself. Arranged within and rotatable with the drive sleeve 5, and held therein by an upper plate 12 secured to the member 11, is a drive bushing 13 which has an opening 14 of polygonal cross section which receives a polygonal portion 15 of a rotatable spindle or drive rod 16. If desired, the drive bushing may carry keys which engage splineways on the spindle or drive rod.

The feeding mechanism 3 comprises a pair of parallel vertical feed cylinders 18 suitably rigidly secured to support 1 at the outer sides of the rotating mechanism 2. Reciprocable in these cylinders are feed pistons 19 having piston rods 20 which extend upwardly through the packed top heads of the feed cylinders. The piston rods 20 are rigidly fixed at 21 at their upper ends to the opposite sides of a cross frame 22 which carries a thrust bearing 23 in which the spindle or drive rod 16 is journaled. The spindle has a shoulder 24 engaging the bottom of the inner race of the bearing 23, and a sleeve portion 25, threaded on the upper end of the spindle engages at its lower side the top of the inner bearing race. Thus, the cross frame and bearing 23 serve as a thrust head for supporting the spindle 16 which carries the drill rod line. A packing 26, arranged within a recess in the cross frame, has sealing engagement with the exterior surface of the spindle. A cap 27, secured as by screws to the upper side of the cross frame, surrounds the sleeve portion 25 and carries a packing 28 sealingly engaging the exterior of the sleeve portion. The packings 26 and 28 serve to prevent oil leakage from the bearing recess. When fluid under pressure is supplied to the feed cylinders under the control of a suitable valve mechanism (not shown), the spindle 16 may be fed axially relative to the drive bushing 13, and the spindle is always ro-

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tated by the drive bushing, whenever the latter is driven, irrespective of the axial position of the spindle with respect thereto.

It will be evident that instead of mounting the drive bushing or rotary table on the stationary support 1, it may be carried by the cross frame 22 and suitably driven from its power source through suitable flexible or self-adjusting connections in the manner disclosed in my Patent No. 2,114,305, patented April 19, 1938.

Now referring to the improved chuck mechanism, and more particularly to the improved automatic chuck generally designated 30, it will be noted that the rotatable sleeve portion 25, which is threadedly secured to the spindle or drive rod 16, is herein preferably formed integral with a bottom plate or cover 31 detachably secured, as by screws, to a rotatable chuck casing 32. Also detachably secured, as by screws, to the top of the casing is a plate or cover 33. Detachably connected, as by interlocking lugs 34 and a releasable screw 35, to the top cover 33 of the chuck casing, is a driver casing or adaptor 36 carrying cylindrical keys 37 seated in concave recesses 38 in the inner wall of the casing and held against axial movement within the casing, as shown. These cylindrical keys slidingly engage splineways 39 in a conventional drill stem or kelly 40 which extends axially through the adaptor and chuck casings into the spindle 16. This kelly is attached in a usual manner at its lower end to the upper end of a conventional drill rod line (not shown) which carries a conventional rotary drill bit. In a drilling apparatus of the type disclosed, the kelly also carries, at its upper end above the adaptor casing 36, a conventional water swivel and lifting bail (not shown) so that drilling fluid may be conducted from the pump of the drilling apparatus through the swivel and kelly and drill rod line to the bottom of the hole to clear away the cuttings from the bit face. The usual hoisting cable of the drilling apparatus is connectible to the lifting bail in a well known manner to effect raising and lowering of the kelly and drill rod line in the drill hole. The keys 37 of the adaptor engaging the splineways 39 of the kelly 40 serve to rotate the kelly while the latter is free to slide axially relative to the adaptor and chuck casing. Instead of the keys and splineways, the kelly may be of polygonal cross section and engageable in a polygonal opening in the adaptor-casing in a well known manner.

In this improved construction, arranged in the chuck casing 32 are chuck jaws 42, herein preferably three in number, pivotally connected by transverse pivot pins 43 to toggle links 44 which are, in turn, pivotally connected by parallel pivot pins 45 to sliding blocks 46. These chuck jaws have concave inner surfaces provided with transverse serrations or teeth 47 adapted to grip the cylindrical exterior surface of the kelly. Evidently, if a kelly of polygonal cross section is employed, the jaws would have straight teeth or serrations which would grip the flat surfaces on the kelly in an obvious manner. The sliding blocks 46 have integral guides 48 slidingly received in upwardly and inwardly inclined guideways 49 on the inner walls of the chuck casing, and the block guides are held in the guideways by side gibs 50 secured, as by welding, to the inner casing walls. The chuck jaws are arranged between parallel upper and lower horizontal plates 51 and 52 arranged within the casing chamber and secured to bolts 53, herein preferably three in number, which are threadedly secured at their

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lower ends to a shifter ring 54 surrounding the sleeve portion 25 beneath the lower plate 31. Spacing sleeves 55 and 56 respectively between the upper and lower plates and between the lower plate and the shifter ring serve to hold the plates in proper spaced relation. Pairs of parallel vertical plates 57, secured, as by welding, between the upper and lower plates, provide radially located recesses 58 in which the chuck jaws are guided, as shown in Fig. 4. The lower spacing sleeves on the bolts extend downwardly through openings 59 in the lower plate 31. Springs 60, acting between the upper plate 51 and the chuck jaws 42, yieldingly urge the latter downwardly and outwardly relative to the kelly. The shifter ring may be provided with any suitable operating means. When the shifter ring is moved downwardly, the blocks 46 slide outwardly along the guideways to effect release of the jaws, through the toggle links 44, from the kelly, and when the shifter ring is moved upwardly, the blocks slide inwardly along the guideways to move the chuck jaws, through the toggle links, into operative relation with respect to the kelly. During automatic operation of the chuck, upon initiation of upward movement of the chuck to take a new grip on the kelly, the toggle links will swing downward to release the jaws, but the jaws will be caused to maintain frictional contact with the exterior surface of the kelly while they slide upwardly along the kelly, which remains stationary and at that time may be supported through the drill rod line on the hole bottom or by a hoisting cable. When the feed is fully retracted, movement of the feed pistons may be reversed again to lower the chuck, thereby to cause the chuck jaws automatically to grip the kelly with a powerful toggle action provided by the toggle links. Thus, the kelly may be moved hydraulically downwardly to feed the drill bit toward the work. The shifter may be operated to release the chuck jaws during hoisting or lowering of the drill rod line.

The chuck mechanism also includes a manually operable bottom chuck, generally designated 61, for positively connecting the kelly to the hydraulic feeding mechanism so that the kelly may be hydraulically raised in the drill hole by the hydraulic feeding mechanism. This chuck comprises a casing 62 having an upper hub 63 threadedly secured at 64 to the lower end of the spindle or drive rod 16, as shown in Fig. 1. This casing has a detachable lower plate 65 provided with a central opening 66 through which the kelly extends. Guided for radial movement in the casing are chuck jaws 67 operated by screws 68. When the screws are threaded inwardly with respect to the chuck casing, the chuck jaws are moved inwardly into firm gripping engagement with the kelly. Thus, the kelly may be raised hydraulically by the feeding mechanism independently of the hoisting cable. The chuck jaws 67 are, however, released during normal drilling operations.

As a result of this invention, an improved drilling apparatus is provided having an improved chuck mechanism whereby the feeding mechanism may be automatically released from the drill stem or kelly whenever the feed is retracted and is automatically connected to the kelly whenever forward feed is effected. By association of the adaptor of the kelly-driver with the automatic chuck, the kelly is rotated by the drive rod directly through the chuck casing. By the provision of manual operating means for the jaws

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of the automatic chuck, the latter may be operated at will independently of movement of the feeding mechanism. The automatic chuck greatly increases the overall feeding speed since when the chuck reaches its limit of forward feed, the feed pistons may be quickly retracted to a new feeding position without the necessity of manual adjustment of the chuck jaws, and the jaws automatically grip the kelly when forward feed is again resumed. The manually operable bottom chuck at the lower end of the drive rod enables hydraulic raising of the kelly in the drill hole independently of the hoisting cable. The structure is comparatively simple, rugged and compact, and may be readily applied to a drilling apparatus of a conventional design. Other advantages of the invention will be clearly apparent to those skilled in the art.

While I have in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A chuck mechanism comprising a rotatable and bodily movable casing through which a kelly is adapted to extend, a shifter operable exteriorly of said casing, spaced supports arranged within said casing and connected to said shifter whereby the latter may actuate said supports, chuck jaws guided for radial movement between said supports and adapted to grip a kelly to connect the latter for bodily movement with said chuck casing, sliding blocks, toggle links connecting said jaws to said blocks respectively and inclined with respect to the planes of movement of said radial jaws, and upwardly and inwardly inclined guideways on the inner wall of said casing and with which said blocks are slidably engaged, said blocks when said supports are actuated by said shifter being slidable along said guideways to move said radial jaws toward the kelly into light frictional contact with the latter, and said toggle links when said chuck casing is moved bodily in one direction relative to the kelly swinging toward parallelism with said planes to increase the gripping action of said jaws on the kelly.

2. A chuck mechanism as set forth in claim 1 wherein springs act between one of said supports in said jaws for urging the latter toward one position.

3. A chuck mechanism comprising a rotatable and bodily movable casing through which a kelly is adapted to extend, a shifter operable exteriorly of said casing, spaced supports arranged within said casing and connected to said shifter whereby the latter may actuate said supports, chuck jaws guided for radial movement between said supports and adapted to grip a kelly to connect the latter for bodily movement with said chuck casing, sliding blocks, toggle links connecting said jaws to said blocks respectively and inclined with respect to the planes of movement of said radial jaws, upwardly and inwardly inclined guideways on the inner wall of said casing and with which said blocks are slidably engaged, said blocks when said supports are actuated by said shifter being slidable along said guideways to move said radial jaws toward the kelly into light frictional contact with the lat-

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ter, and said toggle links when said chuck casing is moved bodily in one direction relative to the kelly swinging toward parallelism with said planes to increase the gripping action of said jaws on the kelly, and an adaptor casing attached to said chuck casing and carrying means adapted to rotate the kelly with said chuck casing.

4. A chuck mechanism comprising a rotatable and bodily movable casing through which a kelly is adapted to extend, a shifter operable exteriorly of said casing, spaced supports arranged within said casing and connected to said shifter whereby the latter may actuate said supports, chuck jaws guided for radial movement between said supports and adapted to grip a kelly to connect the latter for bodily movement with said chuck casing, sliding blocks, toggle links connecting said jaws to said blocks respectively and inclined with respect to the planes of movement of said radial jaws, and upwardly and inwardly inclined guideways on the inner wall of said casing and with which said blocks are slidably engaged, said blocks when said supports are actuated by said shifter being slidable along said guideways to move said radial jaws toward the kelly into light frictional contact with the latter, and said toggle links when said chuck casing is moved bodily in one direction relative to the kelly swinging toward parallelism with said planes to increase the gripping action of said jaws on the kelly, and springs acting between one of said supports and said jaws for urging the latter toward one position, said sliding blocks adapted to hold said jaws in light frictional contact with the kelly as aforesaid whereby upon movement of said chuck casing bodily in said one direction said toggle links effect movement of said jaws into a position to grip the kelly with a powerful toggle action.

5. In a drilling apparatus, a chuck having a rotatable and axially movable casing through which a kelly is adapted to extend, gripping jaws guided for radial movement in said casing for connecting the kelly to said casing for axial movement therewith, shiftable guiding means arranged within said casing for guiding said jaws during such radial movement thereof, operating means at the bottom of said casing for shifting said guiding means axially relative to said casing, operating connections between said casing and said jaws and actuated by said shiftable guiding means to effect movement of said jaws into and out of gripping relation with the kelly, and a driver attached to said casing and having driving means engaging the kelly for rotating the latter with said casing independently of said jaws.

6. In a drilling apparatus, the combination comprising a rotatable and axially movable drive rod through which a kelly is adapted to extend, a chuck carried by said drive rod for rotating and axial movements therewith and having a casing secured to said drive rod, said chuck embodying gripping means contained in said casing and operable to engage the kelly to connect the latter to said drive rod for axial movement therewith in one direction, shiftable guiding means contained in said casing and shiftable axially relative thereto, said guiding means providing radial guideways for said gripping means, means for shifting said guiding means axially, operating connections between said casing and said gripping means and actuated by said shiftable guiding means to effect engage-

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ment of said gripping means with said kelly, and an adaptor attached to said chuck casing and extending axially with respect to the chuck, said adaptor having means drivingly engaging the kelly at points spaced from said gripping means axially of said chuck for rotating the kelly with said chuck casing.

7. In a drilling apparatus, the combination comprising a rotatable and axially movable drive rod through which a kelly is adapted to extend, a chuck carried by said drive rod for rotating and axial movements therewith and having a casing secured to said drive rod, said chuck embodying gripping means contained in said casing and operable to engage the kelly to connect the latter to said drive rod for axial movement therewith in one direction, a shiftable guiding support contained in said casing and shiftable axially relative thereto, operating connections between said casing and said gripping means and actuated by said shiftable guiding support for effecting movement of said gripping means into engagement with said kelly, said support providing radial guideways and said gripping means comprising jaws guided in said guideways, means for shifting said support axially with respect to the chuck, and an adaptor attached to said chuck casing and extending axially of the latter, said adaptor having means drivingly engaging the kelly at points spaced from said gripping means axially of said chuck for rotating the kelly with said chuck casing.

8. In a drilling apparatus, the combination comprising a support, a drive bushing journaled in said support, an axially movable hollow drive rod connected to said drive bushing for rotation therewith irrespective of the axial position of said drive rod with respect thereto, hydraulic feed cylinders carried by said support and containing reciprocable pistons having piston rods projecting through one end of said cylinders, a cross frame to which said piston rods are secured, a thrust bearing carried by said cross frame by which said drive rod is rotatably supported by said cross frame, a driver rotatable with said drive rod and disposed above said cross frame and embodying driving means for engaging and driving a kelly extending axially through said drive rod, and a chuck carried by said drive rod for rotating and axial movements therewith and disposed above said cross frame and spaced axially of said drive rod with respect to said driver for connecting said feed pistons to the kelly upon axial movement of the drive rod for moving the kelly axially with said chuck, said chuck comprising a casing secured to said drive rod, said casing having guideways on its inner walls disposed obliquely with respect to the axial line of the chuck, blocks guided for movement along said guideways, chuck jaws guided for radial movement into and out of engagement with said kelly, toggle links connected between said blocks and said jaws, and operating connections for shifting said blocks along said guideways to move said radial jaws toward the kelly into light frictional contact with the latter, and said toggle links when said chuck is moved axially in one direction relative to the kelly swinging about their connections with said blocks to increase the gripping action of said jaws on the kelly.

9. In a drilling apparatus, the combination comprising a support, a drive bushing journaled in said support, an axially movable hollow drive rod connected to said drive bushing for rotation

therewith irrespective of the axial position of said drive rod with respect thereto, hydraulic feed cylinders carried by said support and containing reciprocable pistons having piston rods projecting through one end of said cylinders, a cross frame to which said piston rods are secured, a thrust bearing carried by said cross frame by which said drive rod is rotatably supported on said cross frame, an automatic chuck secured to said drive rod for rotating and axial movements therewith and disposed above said cross frame and embodying means for gripping a kelly extending axially through said drive rod upon downward feeding movement of said feed pistons and for releasing the kelly upon retraction of said pistons, said chuck comprising a casing secured to said drive rod, a guiding support shiftable axially within said casing and providing radial guideways, said gripping means comprising jaws guided in said guideways, said jaws having limited yielding movement in said guideways axially of the chuck, means for shifting said support axially, operating connections for said jaws actuated by said shiftable support for effecting yielding engagement of said jaws with said kelly, and a driver carried by said chuck and rotatable with said chuck, said driver embodying means drivingly engaging the kelly at points spaced axially with respect to said gripping means for rotating the kelly with said chuck and said drive rod.

10. In a drilling apparatus, the combination comprising a rotatable and axially movable drive rod through which a kelly is adapted to extend, rotating means for said drive rod, means for axially moving said drive rod in opposite directions, a chuck carried by said drive rod for rotating and axial movements therewith and including a casing secured to said drive rod and gripping means guided for rectilinear movement radially within said casing and movable in one direction upon axial movement of said drive rod in one direction for automatically connecting the kelly to said drive rod and movable in the opposite direction upon axial movement of said drive rod in the opposite direction for automatically releasing the kelly from said drive rod, means for effecting such radial, rectilinear movement of said jaws during aforesaid axial movements of said drive rod, said jaw moving means including wedge blocks guided for movement along guideways on said casing inclined slightly upwardly and inwardly with respect to the axial line of the chuck and toggle links connected between said blocks and said jaws, and a driver carried by and rotatable with said chuck casing and extending axially of the latter, said driver embodying means drivingly engaging the kelly at points spaced axially of the latter with respect to said gripping means for rotating the kelly through said rotatable chuck casing.

11. In a chuck mechanism and driver for a kelly of a rotary type wall drilling apparatus, the combination comprising a rotatable chuck casing through which a kelly is adapted to extend, chuck jaws guided for radial rectilinear

movement in said casing and movable in one direction relative to said casing upon bodily axial movement of said chuck casing in one direction into a position to grip the kelly and movable oppositely relative to said casing upon bodily axial movement of said casing in the opposite direction to release the kelly from said chuck casing, means for rotating and bodily axially moving said chuck casing, operating means for effecting such radial, rectilinear movement of said jaws during aforesaid axial movements of said chuck casing, said operating means including wedge blocks, guideways on said casing inclined upwardly and inwardly toward the axial line of the chuck, toggle links connected between said blocks and said jaws and means engaging said blocks for moving the latter along said guideways, yieldable means acting on said jaws for yieldingly urging said jaws toward one position and yieldable to permit movement of said jaws toward kelly gripping position upon movement of said casing in said one direction, and a driver secured to said chuck casing and extending axially of the chuck, said driver having means drivingly engaging the kelly for rotating the kelly with said chuck casing, said driver including an adaptor casing carrying driving means for engaging the kelly at points spaced axially of the chuck with respect to said chuck jaws.

12. In a drilling apparatus, a chuck having a rotatable and axially movable casing through which a kelly is adapted to extend, gripping jaws guided for radial movement in said casing for connecting the kelly to said casing for axial movement therewith, shiftable guiding means arranged within said casing for guiding said jaws during such radial movement thereof, operating means at the bottom of said casing for shifting said guiding means axially relative to said casing, and operating connections between said casing and said jaws and actuated by said shiftable guiding means for effecting movement of said jaws into and out of gripping relation with the kelly.

13. A drilling apparatus as set forth in claim 12 wherein said gripping jaws have limited movement relative to said guiding means axially of the chuck, and yieldable means is arranged between said guiding means and said jaws for yieldingly urging the latter toward releasing position.

HARRY C. JOHANSEN.

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