

March 19, 1940.

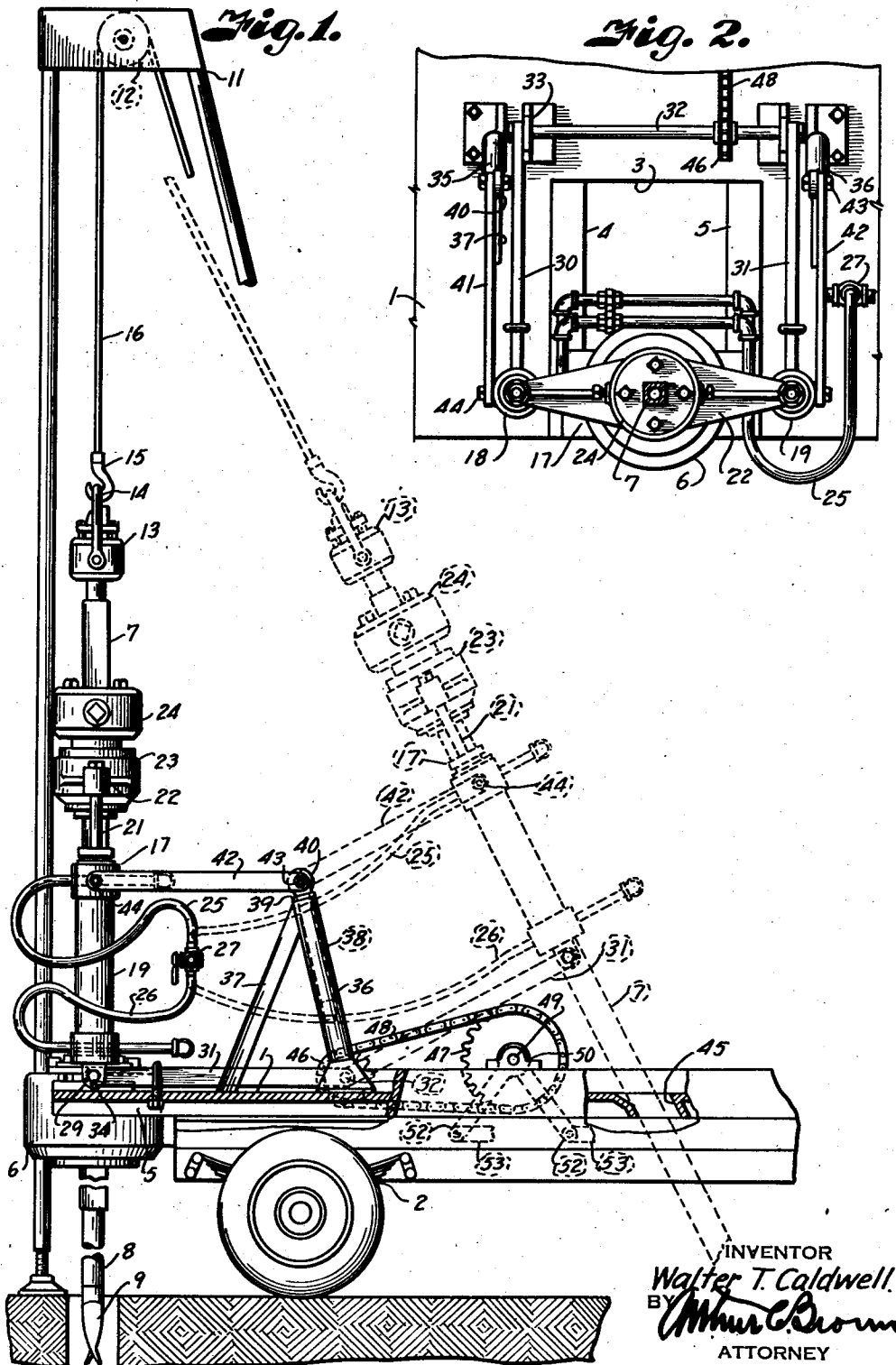
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DRILLING APPARATUS

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2 Sheets-Sheet 1



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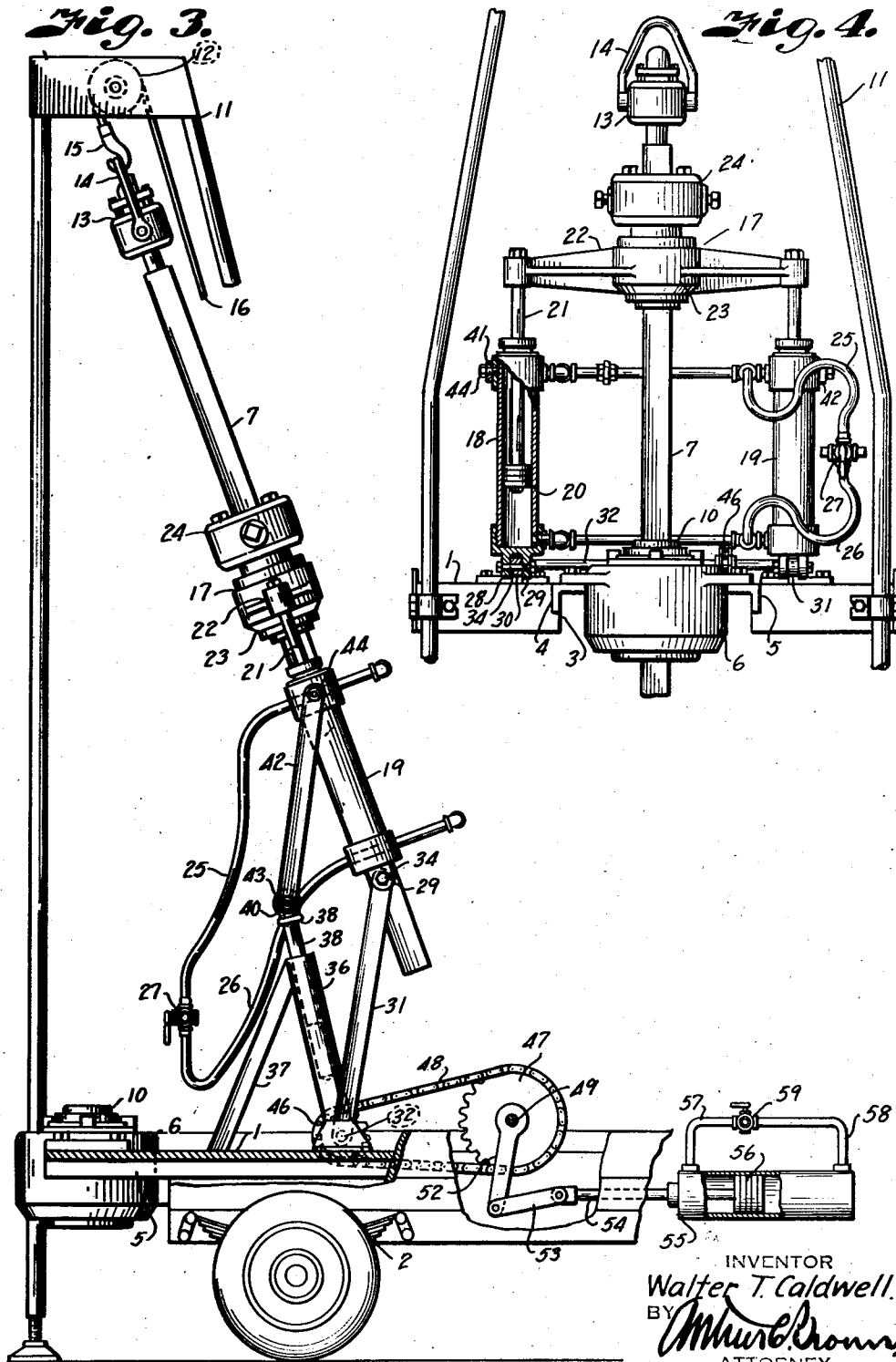
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UNITED STATES PATENT OFFICE

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DRILLING APPARATUS

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11 Claims. (Cl. 255—22)

This invention relates to drilling apparatus particularly of the portable type and primarily intended for use in drilling bore-holes in the prospecting for oil, gas and the like.

Drilling apparatus of this character is equipped with a power augmenting device comprising one or more hydraulic cylinders which are supported over the bore-hole and adapted to be connected with the kelly rod of the drilling string for controlling and applying pressure thereto during drilling operation. The power augmenting mechanism, being located over the center of the drilling operations, interferes with manipulation of the drilling string as when adding sections of drill pipe, running in and pulling of the drilling string to change bits or perform other similar operations.

It is, therefore, a principal object of the present invention to provide the drilling apparatus with means for moving the power augmenting mechanism to and from drilling position.

Other objects of the invention are to provide a shifting mechanism for the power augmenting means which is of simple and inexpensive construction; to provide a shifting mechanism that is readily actuated by suitable power such as a hydraulic cylinder; to provide a shifting mechanism wherein the kelly rod may be retained in the power augmenting mechanism; to provide a shifting arrangement which facilitates connection and disconnection from the swivel head; and to provide a shifting mechanism which leaves the center of drilling operations free and clear for use by the driller.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational view of a drilling apparatus embodying the features of the present invention and showing the power augmenting device in drilling position in full lines and out of drilling position in dotted lines.

Fig. 2 is a plan view of the power augmenting device.

Fig. 3 is a side elevational view similar to Fig. 1, showing the power augmenting device being moved from drilling position.

Fig. 4 is an end elevational view of the power augmenting apparatus.

Referring more in detail to the drawings:

1 designates a platform which may be mounted upon the chassis of a motor vehicle 2 and on which the drilling mechanism is mounted so

that it is readily transported from one drilling location to another. The rear, central portion of the platform has a substantially rectangular shaped opening 3, and on which is mounted longitudinal guide rails 4 and 5 supporting a turntable 6, the turntable 6 being adapted to rotate a kelly rod 7 that is connected to the upper end of a drilling string 8 carrying a drill bit 9, as in conventional practice.

Mounted in the turntable 6 is a drive sleeve 10 having an opening therein corresponding to the cross-sectional area of the kelly rod so that when the sleeve is rotated by the conventional gear mechanism of the turntable (not shown), the kelly rod is rotated but is slidably movable therethrough progressively with the drilling operation. Also carried on the platform, and preferably connected therewith so that it is movable from a perpendicular position as shown to a reclining position relatively to the platform 1, is a tower or derrick 11 carrying crown pulleys 12 for suspending the drilling string. Attached to the upper end of the kelly rod 7 is a swivel 13 where-through a drilling fluid is delivered to the interior of the drilling string as in standard rotary drilling practice. The swivel head 13 has the usual bail 14 which is engaged by a hook 15 on the end of a drill cable 16, by which the kelly rod and drilling string are raised and lowered in the tower 11, the drill cable being wound upon the reel of a conventional hoisting drum (not shown), but which is ordinarily mounted on the platform 1.

In drilling certain formations it is desirable to apply pressure in a downward direction on the drill bit to promote cutting action thereof, however, when the depth of the hole increases, the weight of the drilling string becomes greater due to the necessarily greater length thereof, and it is desirable to partially relieve the pressure thereof on the drill bit. This is effected by a power augmenting mechanism, generally designated 17, and which includes a pair of cylinders 18 and 19 suitably spaced apart on the opposite sides of the turntable and which have pistons 20 slidable therein and connected by rods 21 with a cross head 22. The cross head 22 extends over the turntable and has a ring-like portion 23 through which the kelly rod is extended and which rotatably carries a chuck or suitable gripping device 24 adapted to grippingly engage the kelly rod. The cylinders 18 and 19 are supplied with a piston actuating fluid through conduits 25 and 26 that are connected with a four-way valve 27 controlling supply of the fluid to and from the

respective ends of the cylinders and a source of supply (not shown). For example, when the pressure fluid is admitted to the upper ends of the cylinders to act on the pistons in a downward direction, pressure is applied through the chuck 24, kelly rod 7, and drilling string 8 on the drill bit 9 to enhance the cutting action thereof, but when the pressure on the drilling string becomes too great so as to hinder cutting action of the drill bit, the pressure fluid may be reversed through the valve 27 so that the pressure medium is admitted to the under sides of the piston to act in supporting a portion of the load on the drill bit.

When the drilling operation is first started, the sleeve 10 engages the lower end of the kelly rod, but as the drilling gradually progresses the kelly rod follows through the chuck 24 until the chuck has approached the upper end thereof. It then becomes necessary to insert another drill pipe section in the drilling string. To apply a drill pipe section it is necessary to remove the power augmenting mechanism away from the turntable. I therefore provide means for bodily shifting the power mechanism, including the kelly rod, away from the turntable and depositing them in an out-of-the-way position, as now to be described.

In the illustrated instance the lower heads of the cylinders are shown as provided with spaced pairs of ears 28 and 29, preferably connecting shift arms or links 30 and 31 which have their rear ends fixed to a shaft 32 that is mounted in suitable bearings 33 on the platform, and which extends transversely thereof as clearly shown in Fig. 2. The forward ends of the arms are engaged between the ears and are connected therewith by pivot members 34 which extend through the ears and through the arms as shown in Fig. 4. The arms are of sufficient length so that the shaft 32 and its supporting bearings are spaced from the turntable to give sufficient room for the driller during work on the drilling string.

Mounted on the platform, with their lower ends in alignment with the ends of the shaft 32, are tubular posts 35 and 36 inclined in the direction of the turntable to cause inclination of the kelly rod in the direction of the crown pulley when the power device is in inoperative position. The upper ends of the posts are rigidly retained in position by brace legs 37. Slidably mounted in the upper ends of the posts are the stems 38 of dollies 39. The dollies 39 have heads 40 to which are pivoted the ends of shift arms 41 and 42 having their other ends pivotally connected with the heads of the respective hydraulic cylinders, the dolly heads being connected to the arms by suitable pivot members 43 and to the heads of the cylinders by pivot members 44.

Since the power augmenting mechanism must be supported perpendicular when in drilling position, the shift arms 41 and 42 are therefore shorter than the shift arms 30 and 31 so that when the power augmenting mechanism is moved to inoperative position it is inclined as above noted and the axis of the kelly rod substantially aligns with the crown pulley 12 as shown by the dotted lines in Fig. 1. In order to accommodate the kelly rod, the platform is provided with an opening 45 registering with a "rat-hole" that is drilled into the earth and cased by a suitable pipe of sufficient diameter to freely receive the kelly rod.

In order to shift the power augmenting mechanism to the dotted line position shown in Fig. 1,

the shaft 32 carries a sprocket 46 that is fixed thereon and which is actuated from a larger sprocket 47 through a chain belt 48 operating thereover. The sprocket 47 is rotatably mounted on a supporting shaft 49 carried in suitable bearings 50 on the platform to the rear of the post 36 and at one side of the opening 45, so that the mechanism does not interfere with movement of the power augmenting mechanism and the kelly rod. The sprocket 46 is of smaller diameter than the sprocket 47 so that the sprocket 47 need make only a partial revolution in effecting sufficient rotation of the sprocket 46 to carry the shift arms 30 and 31 from the full line position shown in Fig. 1 to the dotted line position.

Connected with the sprocket 47 is an arm 52 which is connected by a link 53 with a piston rod 54 of a hydraulic cylinder 55. The hydraulic cylinder 55 contains a piston 56 which is connected with the rod and which is shifted within the cylinder to effect rocking movement of the arm 52 in moving the power augmenting mechanism to and from its respective positions. The piston 56 is under control of a pressure fluid that is selectively admitted to the respective ends of the cylinder 55 through connections 57 and 58 with a four-way control valve 59.

In using the drilling mechanism constructed and assembled as described, and assuming that the power augmenting mechanism is in drilling position as shown by the full lines in Fig. 1, and assuming that the drilling has progressed to the point where it is necessary to introduce an additional section of drill pipe into the drilling string, the chuck 24 is loosened so that the kelly rod may be raised therethrough until the upper end of the first joint of drill pipe projects from the turntable a sufficient distance to apply the usual slips in supporting the drilling string while the kelly rod is disconnected. In this position the lower end of the kelly rod is clear and free of the turntable but is carried in the chuck of the power augmenting mechanism. After uncoupling the kelly rod from the supported end of the drilling string, the valve 59 is opened to admit pressure medium to the rear end of the cylinder 55 and to allow discharge of the pressure medium from the forward end of the cylinder. The piston 56 is therefore moved under pressure of the fluid to effect swinging movement of the arm 52 in a clockwise direction and corresponding movement of the sprocket 47 since it is rigidly connected therewith.

The sprocket 47 imparts clockwise movement to the sprocket 46 through the chain connection 48 causing the shift arms 30 and 31 to move in a clockwise direction, as shown in Fig. 3, carrying the lower ends of the power cylinder therewith. A corresponding movement will be imparted to the upper ends of the cylinders through connection thereof with the dolly heads 40. Since the arms 41 and 42 are shorter than the arms 30 and 31, the stems of the dollies will rise in the posts so as to permit swinging of the shorter shift arms over the tops of the posts to the opposite side, and deposit the power device in an inclined position so that the kelly rod may be lowered through the opening 45 into the "rat-hole." When the power augmenting mechanism has been moved to the dotted line position, the valve 59 is closed to retain pressure in the respective ends of the cylinder 55, thereby supporting the power mechanism in the position shown. In this position the chuck is readily reached by the driller standing on the

platform 1 so that it may be loosened to allow lowering of the kelly rod into the "rat-hole" by the cable 16. When the kelly rod has been completely lowered, the hook 15 is readily disconnected from the swivel head so that the cable may be used in operating the elevators (not shown) in adding another section of drill pipe as in conventional practice. After the section of drill pipe has been added and lowered into the well, and supported by the spider on the turntable, the hook 15 is again connected with the bail of the swivel and the kelly rod withdrawn from the "rat-hole". The valve 59 is then actuated to reverse inlet and outlet of pressure medium, thereby effecting reverse movement of the shift arms 30 and 31 so that the power augmenting mechanism carrying the kelly rod is returned to drilling position. When in perpendicular position, as shown in Fig. 1, the kelly rod is connected with the projecting section of drill pipe and the spider removed therefrom so that the drilling operation may continue. If it is necessary to use the power augmenting means it is made effective by tightening the chuck to the kelly rod and controlling the valve 27 so as to admit pressure medium to the cylinders 18 and 19 in obtaining the desired degree of chuck movement.

From the foregoing it is obvious that I have provided a drilling apparatus of the character described with a shifting mechanism which is of simple construction and which facilitates movement of the power augmenting mechanism to and from drilling position.

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

1. A drilling apparatus of the character described including a platform, a derrick on the platform, a crown pulley on the derrick, a kelly rod suspended from the crown pulley, a power augmenting device adapted to grip the kelly rod, means for swingingly supporting the power augmenting device on the platform for bodily movement from the perpendicular position in the derrick to an inclined position whereby the kelly rod maintains its alignment with said pulley, a hydraulic cylinder, a piston reciprocable in the cylinder, and a driving connection connecting the piston with the power augmenting device including means for compounding movement of the piston.

2. In a drilling rig of the character described, a platform, a turntable on the platform, said platform having an opening spaced from the turntable, a power augmenting device supported over the turntable when in a drilling position, a kelly rod drivingly engaged by the turntable and grippingly engaged with the power augmenting device, bracket means fixed to the platform, links of differential length connecting the power augmenting device with the bracket means for swingingly moving the power augmenting device from over said turntable to an inclined position where the kelly rod is adapted to be lowered through said opening, and means compensating for the shorter of said links during movement of the power augmenting device.

3. In a drilling rig, a platform, a turntable carried by the platform, a power augmenting device, said platform having an opening spaced from the turntable, a pair of spaced posts supported on the platform and inclining in the direction of the turntable, dolly heads slidably movable on said posts, a pair of shifting arms pivotally connecting an upper portion of the

power augmenting device with the dolly heads, a second pair of shifting arms pivotally connected with lower portions of the power augmenting device, a shaft mounting said last named arms, means journalling the shaft at the base of said posts, and means for rotating the shaft to effect movement of the power augmenting device from a position over the turntable to a position in registry with said opening.

4. In a drilling rig, a platform, a turntable carried by the platform, a power augmenting device, said platform having an opening spaced from the turntable, a pair of spaced supports mounted on the platform and inclining in the direction of the turntable, dolly heads slidably movable on said supports, a pair of shifting arms pivotally connecting an upper portion of the power augmenting device with the dolly heads, a second pair of shifting arms pivotally connected with lower portions of the power augmenting device, a shaft mounting said last named arms, means journalling the shaft at the base of said supports, and means for rotating the shaft to effect movement of the power augmenting device from a position over the turntable to a position in registry with said opening.

5. In a drilling rig, a platform, a turntable carried by the platform, a power augmenting device, said platform having an opening spaced from the turntable, a pair of spaced posts supported on the platform and inclining in the direction of the turntable, dolly heads slidably movable on said posts, a pair of shifting arms pivotally connecting an upper portion of the power augmenting device with the dolly heads, a second pair of shifting arms pivotally connected with lower portions of the power augmenting device, a shaft mounting said last named arms, means journalling the shaft at the base of said posts, a hydraulic cylinder carried by the platform, a piston slidable in the cylinder, a piston rod carried by the piston, a driving connection between said shaft and the piston rod, and means for admitting pressure medium to said cylinder for effecting movement of the power augmenting means from a position over said turntable to a position in registry with said opening.

6. In a drilling rig, a platform, a turntable carried by the platform, a power augmenting device, said platform having an opening spaced from the turntable, supports on said platform, a pair of shifting arms pivotally connecting an upper portion of the power augmenting device with the supports, a second pair of shifting arms pivotally connected with lower portions of the power augmenting device, a shaft mounting said last named arms, means journalling the shaft at the base of said supports, a hydraulic cylinder carried by the platform, a piston slidable in the cylinder, a piston rod carried by the piston, a sprocket on said shaft, a larger sprocket rotatably mounted on the platform, a chain operating over said sprockets, a crank arm connected with the last sprocket, means connecting the crank arm with the piston rod, and means for admitting pressure medium to said cylinder for effecting movement of the power augmenting device from a position over said turntable to a position in registry with said opening.

7. In a drilling apparatus, a supporting platform, a power augmenting device, bracket means on said platform, means having pivotal connection with the power augmenting device and said bracket means, an oscillatory actuator having driving connection with one of said piv-

otal connections, a reciprocatory actuator, and means connecting the reciprocatory actuator with said oscillatory actuator.

8. In a drilling apparatus, a supporting platform, a power augmenting device, bracket means on said platform, means having pivotal connection with the power augmenting device and said bracket means, an oscillatory actuator having driving connection with one of said pivotal connections, a reciprocatory actuator, and means connecting the reciprocatory actuator with said oscillatory actuator including a transmission mechanism for increasing relative movement of said actuators.

9. In a drilling apparatus, a supporting platform, a power augmenting device, bracket means on said platform, means having pivotal connection with the power augmenting device and said bracket means, a sprocket having driving connection with one of said pivotal connections, a larger sprocket rotatably mounted on the platform, a chain operating over said sprockets, a crank connected with the larger of said sprockets, and a reciprocatory hydraulic actuator connected

with said crank for effecting movement of the power augmenting device.

10. In a drilling apparatus, a power augmenting device, means pivotally supporting the power augmenting device for movement into and out of a drilling position, an oscillatory actuator having connection with said power augmenting device to effect movement of the power augmenting device to and from said drilling position, a reciprocatory actuator, and a driving connection between the reciprocatory actuator and the oscillatory actuator.

11. In a drilling apparatus including drill rotating means, a power augmenting device, means pivotally supporting the power augmenting device for swinging movement to and from a drilling position relatively to the drill rotating means, a driven member having connection with the power augmenting device, a driving member, a connection between the driving and driven members, an arm connected with the driving member, and a reciprocatory actuator having driving connection with the driving member.

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