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HYDRAULIC DRILLING DEVICE
Filed July 11, 1932
2 Sheets—Sheet 2

Fig. 4.

Fig. 5.

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ATTORNEY.
My invention relates to reciprocating mechanism and relates especially to a device for drilling wells by what is known as the standard or cable system, in which the well is dug by reciprocating a tool. This system of drilling is extensively used for shallow wells such as water wells and is also employed in the drilling of other wells.

Since I find my invention especially adapted to the drilling of shallow wells, it may be disclosed in its simple form as comprising a portable drilling rig especially suited for drilling water wells. Such portable well drilling rigs include a wheeled vehicle and a boom or derrick member adapted to be supported on the vehicle in a reclining position during the transportation of the vehicle, and having supports or braces for holding the derrick member in upright position on the drilling location. The upper end of the derrick member carries sheave or pulley means over which a cable may be run, and the portable drilling device is ordinarily equipped with a walking beam for reciprocating the cable tools in the hole. My present invention simplifies the portable drilling device so as to reduce the cost and weight thereof, and also provides a simple mechanism for reciprocating the cable tools in a very efficient manner, this reciprocating mechanism being under a wider range of control than is found where a walking beam is employed to reciprocate the tools.

In my simple form of portable drilling rig I provide a boom or derrick member of tubular form, for which a length of pipe may be employed, thereby avoiding the expense of fabricating the ordinary type of derrick member. At the upper end of the pipe a cylinder is formed which receives a piston adapted to carry a sheave member over which the drilling cable is carried.

A feature of the invention is that the reciprocation of the drilling cable is accomplished by hydraulically reciprocating the sheave member in vertical direction, this being accomplished by intermittently applying a fluid under pressure to the interior of the pipe forming the derrick member, which pipe connects directly with the cylinder formed at its upper end. The intermittent application of fluid under pressure is accomplished by use of an expandible contractile chamber member preferably comprising a cylinder which is detachably connected to the lower end of the upright pipe or derrick member and has a crank for reciprocating a driving piston therein, to thereby reciprocate a body of fluid such as water in the enclosed space formed by the cylinder, the upright pipe, and the walls associated therewith. When the driving piston is moved into its cooperating cylinder and the water is forced upwardly through the upright pipe, the piston in the cylinder at the upper end of the upright pipe is forced upwardly, this movement being reversed when the driving piston is moved outwardly in its cooperating cylinder. I find from actual experience in drilling wells by use of my invention that in addition to simplifying and cheapening the portable drilling rig I attain a very satisfactory drilling movement of the drilling cable and an exceptional ease of control of the drilling movement and the feeding of the drilling cable as penetration of the drilling tools progresses.

A further feature of the invention is that I provide means for cushioning and controlling the reciprocatory movement of the body of fluid employed in the hydraulic actuation of the device, thereby making it possible for the driller to easily obtain a drilling movement most efficient for the conditions under which he is operating.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawings, which are for illustrative purposes only:

Fig. 1 is an elevation view of a preferred form of the invention.

Fig. 2 is an enlarged, partly sectioned side view taken from the position indicated by the line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary elevation view taken from the position of the arrow 3 of Fig. 1.

Fig. 4 is an enlarged fragmentary cross sectional view on a plane represented by the line 4—4 of Fig. 1.

Fig. 5 is an enlarged fragmentary cross section on the line 5—5 of Fig. 3.

As shown in the drawings, my invention includes a base 11 preferably in the form of a vehicle having wheels 12 and 13 whereby it may be transported. This movable base 11 is provided with upstanding posts 14 at its forward end which are suitably reinforced by brackets 15. Swingably secured to the base 11 is a derrick member or boom consisting of a pipe 16 having a cross arm 17 near the lower end thereof, the ends of which cross arm are received in bearing 18 situated near the upper ends of the posts 14. Near the rearward end of the support 11 are posts 20 carrying a cross member 21 on
which the pipe 16 may rest when it is in reclining position employed during transportation of the drilling device. At the lower extremity of the pipe 16 an eye 23 is placed to which a block and tackle may be attached for the purpose of swinging the pipe 16 from its horizontal position shown in dotted lines in Fig. 1 to the upright position shown in full lines. When the pipe 16 is in upright position, it slopes forwardly so that the upper end thereof is in a vertical plane slightly outside the end of the base 11, and the pipe 16 is supported in this raised position by means of cables 24 which extend diagonally in the manner shown in Fig. 1 from the upper end of the pipe 16 to the forward or rearward end of the base 11. These cables 24 replace the comparatively expensive supporting braces not employed in portable drilling rigs to support the boom or derrick members, and are much lighter than such previously used members. When the pipe 16 is swung into upright position, the lower extremity 25 thereof engages a wedge 26 mounted on a cross member at the forward end of the base 11, as shown in Fig. 5. A bolt 28 which passes through the wedge and a plate 30 is employed to move the wedge 26 rightwardly or outwardly so as to bear forcibly against the lower extremity 25 of the pipe 16. Before the drilling operation is started, the forward end of the base 11 is locked by use of blocking members 31, as shown in Fig. 1.

As best shown in Figs. 1 and 2, the upper end of the pipe 16 is provided with a cylinder 32 adapted to receive a piston 33. The cylinder 32 may be formed by inserting a metal liner in the upper end of the pipe 16 or by boring out the end of the pipe to give a smooth cylindrical surface in which the piston 33 may reciprocate. This piston 33 may be provided at its lower end with suitable sealing members such as piston rings 34, or the sealing of the piston may be accomplished solely by a stuffing box 35. The upper projecting portion 36 of the piston 33 may be provided with forks 37 carrying bearings 38 at the upper ends to receive the shaft 39 of a sheave member 41, the upper portion of which is protected by a guard 42 for preventing a cable member 43 from leaving the groove 44 of the sheave member.

The lower end of the pipe 16 is closed, and connecting therein is a nipple 45 to which a conduit member 46 may be attached by a coupling means 47 when the pipe 16 is in upright position. The conduit or pipe 46 is connected to the lower end of a cylinder 48, preferably supported in an upright position by lateral members forming part of the base 11. A piston 51 is adapted to be reciprocated in the cylinder 48 by means of a connecting rod 52, the upper end of which connects to a crank pin 53 carried by a crank member 54 which may have several holes, such as indicated at 55, to receive the crank pin 53 at different radial distances from the axis of a shaft 56 which carries the crank member 54. Mounted on one side of the base 11 are containers or chambers 57 and 58, the lower ends of which connect with the conduit 46 through pipes 60 and 61 having individual control valves 62 and 63 therein.

Power means for the operation of the drilling device may be in the form of a gasoline engine 65 which may be conveniently mounted at the rearward end of the base 11 and may drive a jack shaft 66 through suitable means such as a chain 67. As best shown in Fig. 4, the shaft 66 is provided with a gear 68 adapted to be driven by a pinion 70 mounted on a shaft 71 which carries a sprocket 72 adapted to be driven from a sprocket 73 on the shaft 66 by means of a chain 74. A standard form of clutch such as diagrammatically indicated at 75 is provided for drivably connecting the sprocket 72 to the shaft 71 whereby to drive the shaft 56 and consequently reciprocate the piston 51. The base 11 carries a drum 76 for winding the inner end of the cable member 43, this drum being wound on a drum member 77. A brake member 78 is provided for controlling the rotation thereof. On one end of the shaft 77 a gear 80 is mounted adapted to be driven by a pinion 81 mounted on a shaft 82 which carries a sprocket 83 and a clutch 84. The sprocket 83 is connected through a chain 85 with a sprocket 86 mounted on the shaft 66. In the practice of my invention it is also desirable to provide a sand reel 87 for winding a sand line 88, this sand reel being provided with a brake band 90 and being mounted on a shaft 91 carried at the rearward end of the base 11, as shown in Fig. 5. A toothed belt 92 is provided to drive through a clutch 93, the sprocket 92 being connected with a sprocket 94 on the jack shaft 66 through a chain 95. Sand line sheaves 96 may be mounted at the upper end of the pipe 16 by use of a bracket 97 in the manner shown in Figs. 1 and 2.

The operation of the invention is essentially as follows: On arriving at the drilling location, the rig is set up and the various parts thereof connected as shown in Fig. 1. With the valves 62 and 63 closed, the apparatus is not operated. With the member 100 having a valve 102 therein, the interior space formed by the pipe 16, the conduit 46, and the cylinder 48 is filled with a fluid, preferably water. Reciprocation of the piston 51 by use of the power driven mechanism previously described causes the water to be reciprocated through the pipe 46 and within the pipe 16, this reciprocation being transmitted to the piston 33 which reciprocates substantially vertically, and likewise produces a reciprocation of the outer 120 portion 103 which carries the members having tools at its lower end within a well 104 in the interior of the base of drilling. The reciprocation of the cable portion 103 is through a distance equal to twice the vertical movement of the piston 33. The downward drilling motion of the tools accomplished by use of the apparatus disclosed is of a very resonant character, for it is found that in the use of the device the piston 33 and the sheave 41 tend to move downwardly faster than the loop of the cable drops so that during the downward movement of the sheave 41 the inner side 107 of the cable member 43 is not stretched. When the piston reaches the lower end of its downward movement, the cable loop extending over the sheave catches up with the downward movement of the sheave and brings the downward movement of the cable to an abrupt stop so that a tension is placed in the cable as the drilling tools move into engagement with the bottom of the hole being drilled.

During the drilling action the valves 62 and 63 communicating with the cushioned chambers 57 and 58 may be closed, or, as conditions may require, one or more of these valves may be opened to a desired extent, thus permitting water from the conduit 46 to reciprocate back and forth against bodies of air or gas in the upper portion of the chamber 56 and 58. The chambers 57 and 58 accordingly may be employed...
to cushion the reciprocating movement of the actuating fluid in the pipe 16 and also to reduce the length of the stroke of the piston 33. The stroke of the piston 33 may be also varied by changing the length of stroke of the piston 51 by moving the crank pin 55 to another hole 55 in the crank member 54.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

I claim as my invention:

1. A device of the character described, including:
   a base structure; a pipe secured to said base structure in upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; means for reciprocating a body of fluid filling said pipe whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member.

2. A device of the character described, including:
   a base structure; a pipe secured to said base structure in upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; and means for reciprocating a body of fluid filling said pipe whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member.

3. A device of the character described, including:
   a base structure; a pipe secured to said base structure in upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; means for reciprocating a body of fluid filling said pipe whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member; and cushion means connected with said pipe for cushioning the reciprocating movement of said fluid.

4. A device of the character described, including:
   a base structure; a pipe secured to said base structure in upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; means for reciprocating a body of fluid filling said pipe whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member; and cushion means connected with said pipe for cushioning the reciprocating movement of said fluid, said cushion means comprising a plurality of closed chambers connected at their lower end to said pipe, there being control valves disposed between said chambers and said pipe for selectively controlling the flow of fluid between said pipe and said chambers.

5. A device of the character described, including:
   a base structure having a support thereon; cylinder-piston means carried by said support; a sheave member connected to said cylinder-piston means so as to be reciprocated by the expansion and contraction of said cylinder-piston means; a cable member extended over said sheave member; one end of said cable member being held stationary and the other end of said cable member reciprocating in response to the reciprocation of said sheave member; a cylinder; conduit means connecting said cylinder to said cylinder-piston means; a piston in said cylinder; means for reciprocating said piston whereby to intermittently charge and discharge said cylinder-piston means with a fluid in timed relation to the movement of said piston to produce reciprocation of said sheave member; and cushion means connected to said cylinder-piston means and being adjustable during the operation of the device, for cushioning the movement of said fluid.

6. A device of the character described, including:
   a portable base structure; a pipe secured to said base structure pivotally so that it may be swung from horizontal position to upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; an expansile-contratilce chamber member connected to the lower end of said pipe, there being a body of liquid filling said pipe, said cylinder-piston means, and said expansile-contratilce chamber member; and means for actuating said expansile-contratilce chamber member whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member.

7. A device of the character described, including:
   a portable base structure; a pipe secured to said base structure pivotally so that it may be swung from horizontal position to upright position; cylinder-piston means at the upper end of said pipe and connected to said pipe; a sheave member connected to said cylinder-piston means so as to be vertically reciprocated thereby; a cable member extending over said sheave member; an expansile-contratilce chamber member mounted on said base structure; pipe means for connecting said expansile-contratilce chamber member to the lower end of said pipe when it is in upright position, there being a body of liquid filling said pipe, said cylinder-piston means, and said expansile-contratilce chamber member; and means for actuating said expansile-contratilce chamber member whereby to reciprocate said cylinder-piston means and consequently said sheave member and said cable member.

8. A device of the character described, including:
   a portable base structure; a pipe secured to said base structure in upright position, there being a cylinder formed within the upper end of said pipe; a piston operative in said cylinder; a sheave member connected to the upper end of said piston so as to be vertically reciprocated thereby; a conduit means connecting said piston to said cylinder-piston means; a piston in said cylinder; means for reciprocating said piston whereby to intermittently charge and discharge said cylinder-piston means with a fluid in timed relation to the movement of said piston to produce reciprocation of said sheave member; and cushion means connected to said cylinder-piston means and being adjustable during the operation of the device, for cushioning the movement of said fluid.
cated thereby when said pipe is in upright position; a cable member extending over said sheave member; and means for reciprocating a body of fluid filling said pipe whereby to reciprocate said piston and consequently said sheave member and said cable member.

9. A device of the character described, including: a portable base structure; a pipe secured to said base structure pivotally so that it may be swung from horizontal position to upright position, there being a cylinder formed within the upper end of said pipe; a piston operative in said cylinder; a sheave member connected to the upper end of said piston so as to be vertically reciprocated thereby when said pipe is in upright position; a cable member extending over said sheave member; an expansible-contractile chamber member connected to the lower end of said pipe, there being a body of liquid filling said pipe, said piston, and said expansible-contractile chamber member; and means for actuating said expansible-contractile chamber member whereby to reciprocate said piston and consequently said sheave member and said cable member.

10. A device of the character described, including: a portable base structure; a pipe secured to said base structure pivotally so that it may be swung from horizontal position to upright position, there being a cylinder formed within the upper end of said pipe; a piston operative in said cylinder; a sheave member connected to the upper end of said piston so as to be vertically reciprocated thereby when said pipe is in upright position; a cable member extending over said sheave member; an expansible-contractile chamber member mounted on said base structure; pipe means for connecting said expansible-contractile chamber member to the lower end of said pipe when it is in upright position, there being a body of liquid filling said pipe, said piston, and said expansible-contractile chamber member; and means for actuating said expansible-contractile chamber member whereby to reciprocate said piston and consequently said sheave member and said cable member.

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