G. W. HANSON.

EARTH BORING MACHINE.

APPLICATION FILED JULY 24, 1920.

1,375,092.

Patented Apr. 19, 1921.

2 SHEETS—SHEET 1.

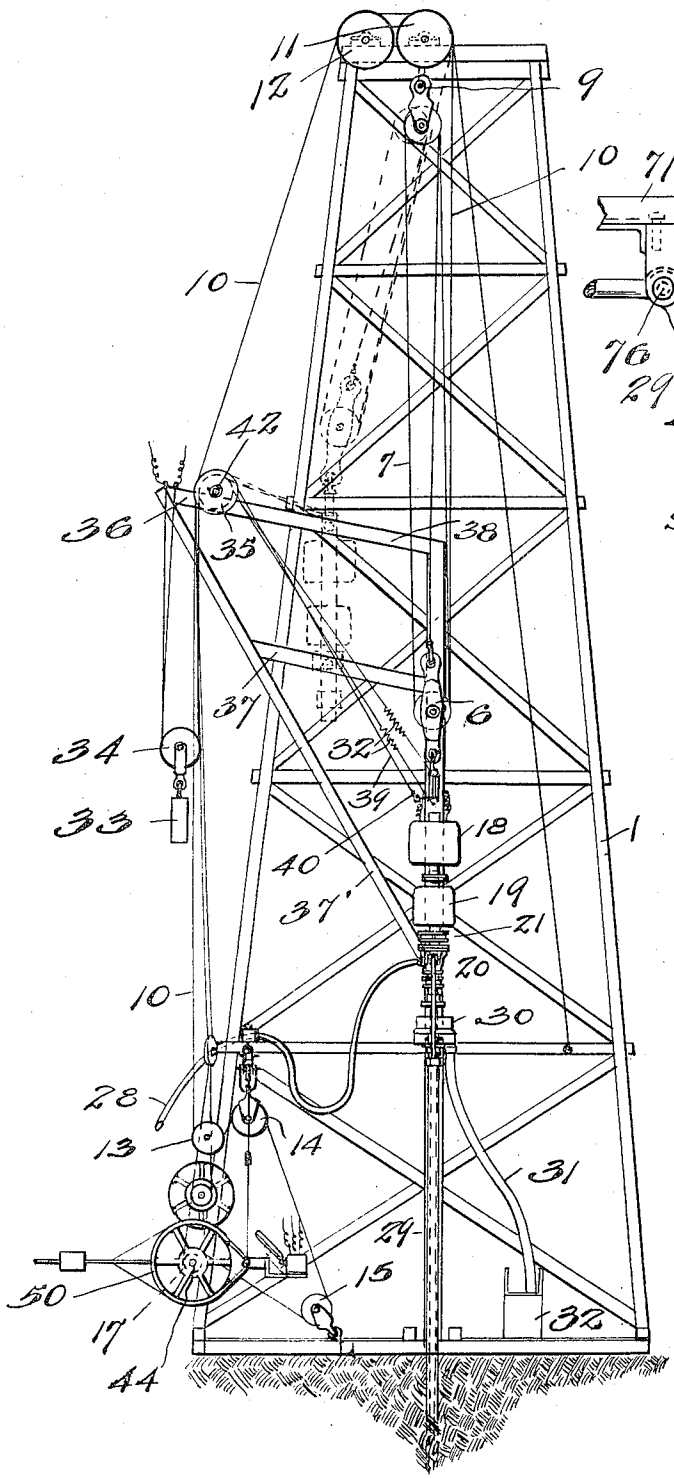



Fig. 1.

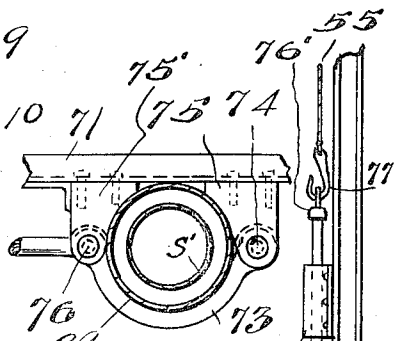



Fig. 7.

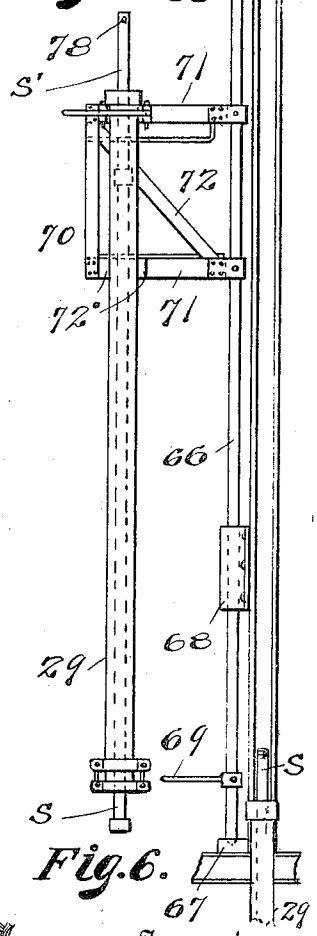



Fig. 6.

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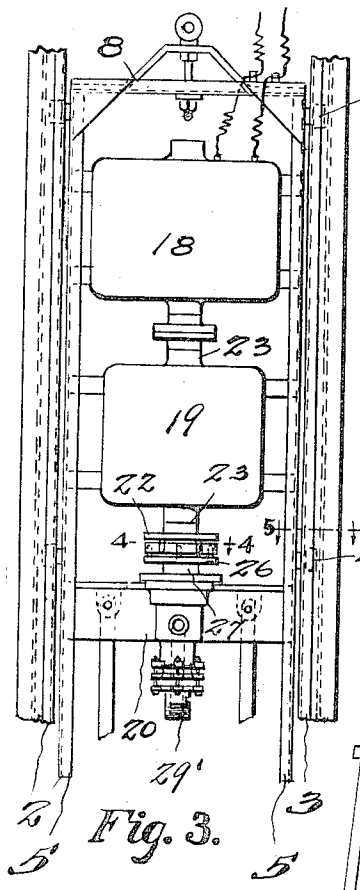


Fig. 3.

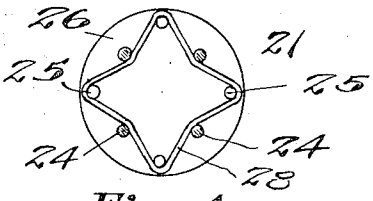


Fig. 4.

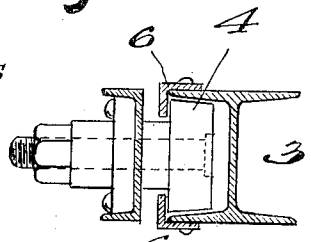


Fig. 5.



Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## EARTH-BORING MACHINE.

1,375,092. Specification of Letters Patent. Patented Apr. 19, 1921.

Application filed July 24, 1920. Serial No. 398,784.

*To all whom it may concern:*

Be it known that I, GUSTAF W. HANSON, a citizen of the United States, residing at Wichita, in the county of Sedgwick and State of Kansas, have invented certain new and useful Improvements in Earth-Boring Machines, of which the following is a specification.

The present invention relates to improvements in earth boring machines of the rotary, motor operated type, especially designed for drilling oil, gas, and water wells, and equally adaptable for other similar earth boring operations. The invention hereinafter set forth contemplates the production and utilization of an apparatus or outfit for oil well drilling, and involves improvements in certain parts of this type of machinery in order that highest efficiency may be attained in the application of power to the rotary stem of the drilling machine. By the use of my improved apparatus the downward movement of the well casing and drill bit is accomplished conjointly with the digging operations of the bit, through the instrumentality of suitable suspending means for the motor, well casing and drill stem whereby the shoe at the lower end of the casing is maintained in its proper position relative to the drill bit, as the drilling and reaming operations progress.

The invention also provides means whereby the connection between the motor and its rotated drill stem affords a safety device that may be broken or disconnected in the event of excessive resistance between the drill stem and its motor or power unit when cutting at low depths, thus eliminating the danger of breaking the drilling tools or parts thereof. Provision is made for the withdrawal of the rotary unit to position to permit utilization of impact devices to be used at the beginning of drilling operations and also for deep drilling in hard structures, whereby this latter form of cable drilling apparatus may be substituted for the rotary drill.

As a component element of the invention, for operating the drill, I utilize a self contained, suspended and adjustable unit, employing a suitable power device which may be either an electric motor, steam engine, or an internal combustion engine with proper connections.

In the accompanying drawings I have illustrated one complete example of the physical embodiment of my invention utilizing an electric motor as the power unit, in which the parts are combined and arranged according to one mode I have so far devised for the practical application of the principles of my invention. It will be understood that changes and alterations may be made in the construction illustrated, within the scope of my appended claims, without departing from the spirit of my invention.

Figure 1 is a view in elevation of a rig or equipment of the standard type tower or derrick employed in connection with my oil well drilling machinery.

Fig. 2 is a similar view, as seen from a point at right angles to Fig. 1.

Fig. 3 is a similar view, enlarged, showing the safety connecting device between the power unit and the drill head.

Fig. 4 is a transverse sectional view at line 4—4 of Fig. 3 illustrating the belt-pin safety device or safety connection between the power unit and drill head.

Fig. 5 is a sectional detail view showing the relation of guide rollers of the power-unit movable frame to the fixed frame of the derrick or tower on line 5—5 Fig. 3.

Fig. 6 is a detail side elevation of the crane portion of the outfit detached.

Fig. 7 is an enlarged detail top plan view of the clamp device of the crane of Fig. 6.

In the form of the invention as illustrated particularly in the assembly views of Figs. 1 and 2, a standard type of derrick or tower 1 is employed having the usual braces and cross bars, in the vertical axial center of which is constructed a fixed guide frame comprising the spaced parallel columns 2 and 3, preferably of H-shape, and designed to form trackways or guides for the rollers 4, arranged in pairs, and journaled on the sides at the upper and lower ends of a traveling or vertically movable supporting frame 5. The vertically movable frame is preferably fashioned of channel irons, and the rollers are journaled in these channel irons or plates, and project therefrom to travel within the inner channels of the H-columns. Angle irons 6 may be attached to the guiding columns for the retention of the rollers within their channels.

The movable frame 5 is held in suspension in its guiding columns through the instrumentality of a double block 6 and tackle 7, attached at its lower free end to the upper cross bar 8 of the movable frame, and

supported at its upper fixed end from the tower at 9. A suspending or hoist cable 10 is connected with this tackle, and passes over the pair of sheaves 11 and 12 at the top of the tower, and from thence is guided by sheaves 13, 14, 15, 16 (Fig. 1) to the drum 17 of the hoisting apparatus. The frame 5 may be altered to conform to different forms of power units as required.

In the movable frame is fixed the power unit, in this instance illustrated as an electric motor 18 rigidly attached to the movable frame and vertically disposed in order that its armature shaft may be utilized in connection with a reducing gear inclosed within the housing 19, located below the motor 18. The motor, through the reducing gears, is connected with the drill head 20 of the drilling machine by means of a safety device indicated as a whole at 21 in Figs. 1 and 2, and shown in detail in Fig. 4. This safety device comprises a "pin-belt" coupling composed of the disk 22 fixed on the lower end of the shaft 23 of the reducing mechanism, which disk is provided with a series of four downwardly projecting pins 24 co-acting with a complementary set of upwardly projecting pins 25 on the disk 26 fixed on the upper end of the main rotary drilling shaft or spindle 27. A flexible belt 28, of leather or other suitable material, is circumferentially disposed and interposed between these two sets of pins to afford a flexible connection therebetween, and it will readily be apparent that the flexible belt forms the joint or connecting medium between the pins to transfer the rotary motion of the shaft 23 to the drill spindle 27. The function of this safety device is to provide a comparatively weak connection in the rotary moving parts which may be broken if the resistance of the drilling device, for any reason, becomes excessive, and the breaking of the connection at this point eliminates possibility of breaking the drill stem, casing or any other part of the tools or machinery. The broken parts of the safety joint may readily be replaced, with comparatively slight expense and minimum loss of time and labor when the break is above the surface of the ground.

In Fig. 1 the inflow of water from a circulation pump is provided through the hose 28 to the drill head 20, and the well casing is indicated at 29 from which the outflow of water is through the overflow basin 30 and outflow hose 31 to the settling tank and sump by way of the trough 32 (Fig. 2).

The electric motor 18 is furnished with electric current through the cables 32, which are held in tension by means of the counterweight 33 and sheave 34 utilizing the double sheave 35. The cables are suspended from the extended bracket 36 attached to the tower 1, through the instrumentality of the tension device thus providing for movement of the motor and its frame, in connection with the drilling operations.

In some instances it is found advisable to employ the impact or concussion type of drilling tools, and change from rotary drilling to cable drilling. Therefore provision is made for shifting the power unit from its central position in the tower, to permit installation of the reciprocating mechanism of the cable drilling tool, which mechanism is actuated from the rotary motor unit and the rotary movement of the motor is transformed by suitable connections to reciprocal movement of the cable and drill bit.

In Fig. 1 two pairs of inclined guides, in the form of metal H-beams 37 and 38, attached to the tower are utilized, upon which the movable frame and its motor unit may be shifted laterally to the dotted position in Fig. 1, and there bolted or otherwise secured to the tower, for operating the cable drilling mechanism. In this shifted position of the power unit, the central portion of the tower is cleared of all obstructions, leaving sufficient space for installation of the cable drilling mechanism. The suspended power unit may be shifted to its lateral position by means of a hoist cable 39 attached at 40 to the upper end of the movable frame. The cable then passes over a sheave 41 journaled on a fixed shaft 42 in bracket 36 down to the drum 43 (Fig. 2) on the main, continuously revolving shaft 44, journaled in the frame of the lower part of the derrick or tower. The power unit and its frame are lifted by means of the suspending cable 10 and its tackle with the rollers 4 traveling in the guide columns 2 until the frame and unit are in position for lateral shifting. The drum 43 on the main continuously revolving shaft 44 is then turned to wind cable 39, drawing rollers 4 through openings in these guide columns and the rollers are thus guided into H-beam inclined guides, along which the rollers travel until the unit and its frame reach the designated position of dotted lines in Fig. 1. When returning the power unit and its frame to central position in the derrick, the cable 39 is released and the rollers are permitted to run down the guides again bringing the suspended frame into central position in the tower with the rollers 4 in the columns 2 and 3.

The different apparatus for suspending and elevating the movable frame 5 and its power unit; for shifting said unit to its new location preparatory for cable drilling operations and for actuating the substituted cable drilling mechanism, and the means employed for lifting the well casing and drill stem, are all actuated from the main pulley 45, in Fig. 2. The pulley is fixed on a hub or bushing 46 and the latter is loose to revolve on the shaft 47. The main

shaft 44 is driven from the driving pulley through the pinion 48 fixed on the bushing, and a gear wheel 49 fixed on the main shaft 44, thus providing for a continuous rotation of the main shaft while the apparatus is in operation.

For hoisting and suspending the movable frame and its power unit, the drum 17 on the main shaft 44 is employed, the cable 10 passing therefrom as heretofore described to the top cross bar of the movable frame. The drum 17 and its rigid brake wheel 50 are loose on the shaft 44 but may be caused to revolve therewith through the action of the clutch 51 for that purpose.

The drum 43, for the cable 39, by means of which the power unit and its frame are shifted laterally for cable drilling, is provided with a brake 52 and clutch 53.

The well casing and drilling stems are lifted from the ground through the operation of a drum 54 on the shaft 47 and its cable 55, which latter is passed over sheaves 56, and the free end of the cable may be attached to suitable auxiliary tools for connection with the well casing and drill stem. A usual brake device 57 and clutch 58 are provided for controlling the drum and cable, and the shaft 47 is driven from the main drive shaft 44 through spur gear 59 loose on shaft 44, and gear 60 keyed on shaft 47. A two way clutch device 61—62 revoluble with shaft 44 is utilized through member 61 to operate the drum 54 for winding the cable thereon and slowly lifting the well casing and drill stem, and member 62 is utilized in similar manner to permit the drum to run free to run out the cable 55 for lowering the drill stem or casing, the drum being controlled by the brake 57. A silent chain 63 from clutch member 62 is connected to the keyed pinion 64 on shaft 47 for accomplishing the reversed and rapid revolution of said shaft 47 for lowering the casing and stems.

In order to control, and regulate the pressure or load on the drilling bit at the bottom of the well casing and also the load of the casing, I provide a scale mechanism indicated as a whole at 65 in Fig. 2. This scale mechanism is actuated from the brake wheel 50 of the suspension mechanism of the rotary motor, drill head, well casing drilling tool, &c., and as it is made the subject matter of a co-pending application for patent a detailed description of the same is omitted from this case.

In Figs. 2, 6, and 7 a jib crane is illustrated that is utilized by attendants when manipulating the oil well casing and drill stem sections, for connecting and disconnecting the well casing and drill stem sections during boring operations.

The crane is constructed adjacent the tower and comprises a column or metal pipe 66, detachably supported at its lower end on the base block 67 and revoluble in the bearings 68, 68 that are attached to the tower or tower frame. A hand lever 69 on the column may be grasped and swung around horizontally in order to swing the column. Near the upper end of the column and at the required altitude is attached a frame or jib-part of the crane indicated as 70 and including the upper and lower horizontal arms 71 and brace 72 firmly secured to the column 66.

The frame 70 is provided with a platform or deck upon which the attendant stands in manipulating the well casing sections 29 and drill stem sections S, and the sections are supported from the jib frame as indicated in Fig. 6 by means of a pair of lugs 72′ on the lower arm 71 of the frame, and clamped to the frame by means of the clamp lever 73 at the upper frame arm. The clamp lever is curved to conform to the periphery of the well casing and is pivoted at 74 in one of the supporting blocks 75 75′ attached to the frame arm 71.

A pin may be passed through an opening in the lever and a similar registering opening in the block 75′ to lock the lever in its clamped position about the casing section.

At its upper end the column is provided with a cap and eye 76′ for attachment of the hook 77 on the end of the cable 55, and this hook is also designed for connection at 78 to the special drill stem section S′, in Fig. 6.

The jib crane is designed to swing through an arc of 45° to bring the sections, as indicated in Fig. 6, in the central position for coupling to the well casing and drill stem already in the ground.

When an additional casing section and drill stem section are to be connected, the power unit is first disconnected from the drilling tools, and elevated to position leaving the central portion of the tower clear for operations. The special short section S′ is connected to the drill stem section S and together with the additional casing section S they are lifted from the ground by hook 77 and cable 55 and hoisted to position in Fig. 6 where they are locked as shown.

The lower end of the additional stem section S is below the top of the drill stem, and therefore the additional sections must be lifted or elevated in order to make the proper connections. The hook 77 is attached to the column as indicated in Fig. 6 and the crane, with its clamped sections, is bodily elevated from its supporting block 67, by hoisting on the cable 55. The crane is now swung around by action of the hand lever 69, through an arc of 90° until the additional sections are located directly above the well casing and drill stem. Then by utilizing auxiliary tools as described in my co-

pending application for patent Ser. No. 400,713 filed August 2, 1920 the added well casing section and the added drill stem section are connected to the well casing and drill stem, after which the power unit and drill head are connected to the extended well casing and drill stem and the operation of digging continues. When not in use, of course the jib crane is swung around out of the way.

I claim—

1. The combination in an earth boring machine with a supporting tower, of a suspended vertically reciprocable power unit, a drill head, drilling tool and well casing supported from said unit, and means for laterally moving said power unit, when the latter is disconnected from said supported elements, to adjusted position for the purpose set forth.

2. The combination in an earth boring machine with a supporting tower and movable frame, of a suspended vertically reciprocable power unit fixed in said frame, a drill head, drilling tool and well casing supported from the unit, guide rollers on the movable frame and a guide frame for said rollers, and an inclined, laterally extended guide frame for said rollers whereby, when the unit is disconnected from its supported elements, the former may be moved to adjusted position, and may be returned by gravity to central location.

3. The combination in an earth boring machine with a supporting tower, combined hoisting and suspending cable, and a self-contained power unit, of a supporting frame for the unit suspended from said cable, guide rollers on said frame and guide columns for said rollers fixed to the tower, and laterally extended, upwardly inclined guide frames connected with said columns for said rollers whereby the unit may be moved to laterally adjusted position, and may return by gravity to central position.

4. The combination in an earth boring machine with a rotary power unit and alined drill head and drill tool, of a power transmission device therebetween adapted to break under excessive resistance from the rotary tool.

5. The combination in an earth boring machine with a rotary power unit and alined drill head, and a drill tool and well-casing suspended from said head, of a power transmission device between said unit and head adapted to break under excessive resistance on the part of the tool or casing.

6. The combination in an earth boring machine with a rotary power unit and alined drill head, a driving shaft and a driven spindle, of complementary transmission disks on said shaft and spindle, complementary pins on said disks, belt interlocked with said pins, and said belt breakable under excessive resistance on the part of the driven spindle.

7. The combination in an earth boring machine with a supporting tower, central, spaced columns, and a combined hoisting and suspending mechanism and cable, of a rectangular reciprocable frame suspended from said cable having rollers guided in said columns, an axially alined motor, transmission device and safety clutch operatively connected and supported in said suspended frame, and a drill head, drilling tool and well casing supported from said reciprocable frame.

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