May 1, 1928. 1,668,327

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WELL DRILLING AND VACUUM CLEAN-OUT MACHINE

Filed July 19, 1927

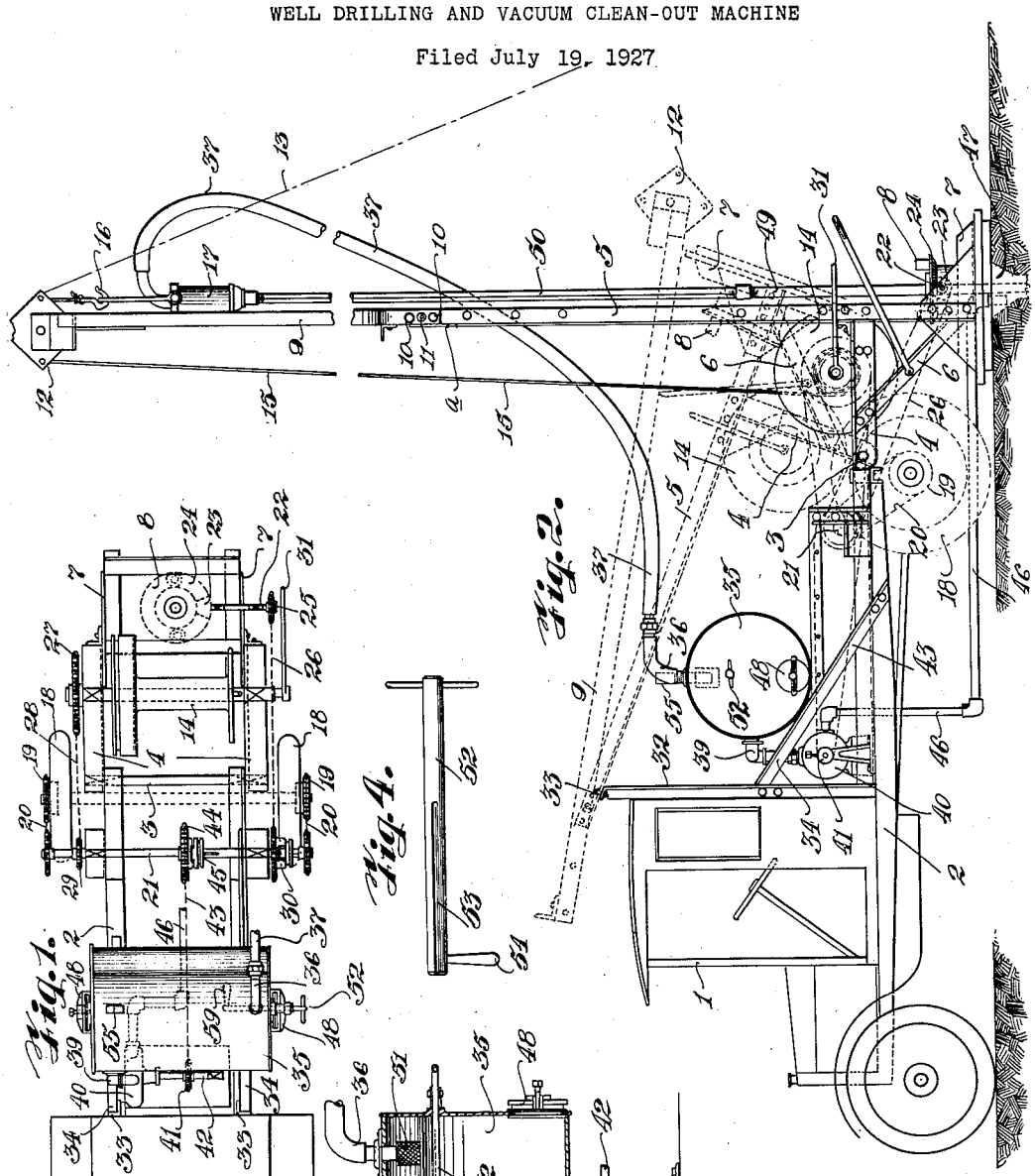


Fig. 2.

Fig. 1.

Fig. 4.

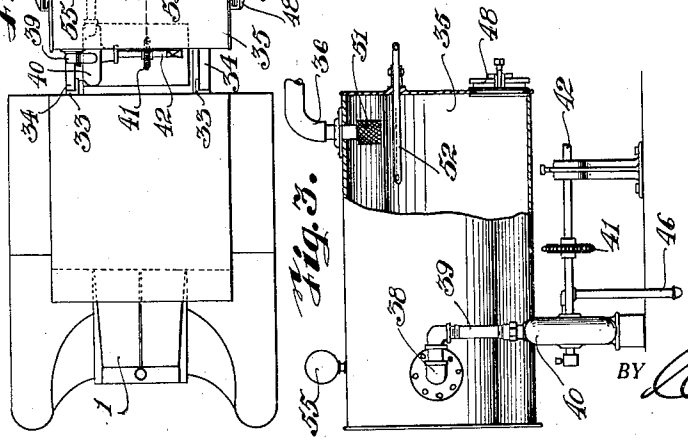


Fig. 3.

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Patented May 1, 1928. 1,668,327

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WELL-DRILLING AND VACUUM CLEAN-OUT MACHINE.

Application filed July 19, 1927. Serial No. 206,991.

This invention relates to well drilling and especially well cleaning machines of the type wherein a column of water is kept flowing downwardly between the wall of the hole and the drill pipe and upward through the drill pipe, and by thus circulating the water, the cuttings are removed from the hole in advance of the drill bit, and the principal object of the invention resides in the provision of a new and improved drilling and cleaning machine by which this method of drilling and cleaning of wells may be advantageously applied to present day operations, by which is brought about a considerable reduction in operating costs, yet increasing to a remarkable degree the speed and efficiency in carrying out the operation of drilling or cleaning a well.

Another object of the invention resides in the portability of the machine, by which it may be readily and quickly transported from one location to another, and by reason of a novel collapsible mast and associated parts, only a very short time is required in setting up the machine for operation, and reducing the same again for transportation to another location.

Still another object of the invention resides in an improved mast structure, carrying at its lower end a portable rotary table equipped with a driving means so arranged relative to the rear wheel of the self propelled conveyance upon which the apparatus is mounted, so as to be operated thereby.

With the foregoing objects as primary the invention has particular reference to its salient features of construction and arrangement of parts by which said objects are attained and which will become manifest as the description proceeds, taken in connection with the accompanying drawings wherein:

Figure 1 represents a diagrammatic view of a motor truck showing the invention installed thereon.

Figure 2 is a side elevational view of the motor truck showing the invention prepared for operating, and illustrating in dotted lines, the mast folded upon the truck for transportation.

Figure 3 is a detail view partly in section of the improved vacuum settling tank and pump, and

Figure 4 is a detail view of the proof stick for removing samples of strata from the settling tank without breaking the vacuum therein.

In continuing more in detail with the invention it may be stated that in the established rotary processes it is the practice to introduce the drilling lubricant into the well through the drill pipe as the drill bit descends, and wall up the cuttings between the drill pipe and the wall of the hole made by the drill bit. Especially in cases where considerable sand or loose formation is encountered, "walling up," the hole is greatly depended upon to avoid caving of the wall. This practice often results in passing up, or sealing out a productive sand.

Aside from these well known disadvantages in old methods of drilling, the operation of obtaining samples of strata is one which requires that the drill bit be withdrawn from the hole, and a sand testing tool lowered therein to remove a quantity of strata for examination, after which the drill pipe assembly is again run into the hole and drilling resumed. This operation is obviously slow and requires considerable effort on the part of the drillers.

The present invention is designed to overcome these, as well as other objectionable features, by reason of its peculiar construction, through the medium of which water circulation is reversed, since it is found by drawing the earth cuttings through the drill pipe from the bit, it is possible for the driller to observe the strata encountered without the admixture of previous strata held in suspension or eroded by the rising of the flow of water against the wall of the hole as occurs in the old rotary processes. By the present invention the nature of the various stratas can be observed in their entirety as occurs in core drilling without interrupting the drilling operation, the strata being deposited in the settling tank employed with the invention, in layers corresponding to the subterranean formation. It is further found that upon examination of the hole formed by the present improved machine, that the same retains a uniform contour and is free from pockets or cavings as occurs in old processes, this condition being due to the fact that the strata in the present process is not subjected to the scouring effects of water jets, as forced against it in other hydraulic processes, thus eliminating the ever present danger of cavings.

While it is known that machines and apparatus for raising earth cuttings by suction, in dredging and drilling, have heretofore been constructed, such apparatus has not been adapted for the rotary process of drilling and cleaning of wells, and as previously pointed out herein, it is the object of the invention to provide an improved machine whereby such means of raising the cuttings may be successfully applied for the production and cleaning especially of oil wells.

With the foregoing in view, particular reference is made to Figures 1 and 2 of the drawings, in which a motor truck 1 is shown, upon the chassis 2 of which is mounted the elements hereinafter referred to as constituting the invention.

Upon a shaft 3 laterally extending across the rear end of the chassis 2 is mounted a frame composed of members 4, which is capable of being turned upon the chassis in the manner shown in broken lines in Figure 2, but when in operative position, extends rearwardly of the chassis 2 on a plane level with the latter.

A collapsible mast is provided and is composed of two sections to allow for such collapsibility, the lower section 5 being bolted to the rearmost end of the frame referred to and braced thereon by angular braces 6. The lower mast section 5 rests upon shoes 7, and intermediate the posts comprising this section is situated a rotary table 8. It is apparent that through this arrangement the rotary table rests practically upon the ground, hence lending to its stability.

The elements forming the upper mast section 9 are held relatively operative by being bolted at 10 opposing the pivotal joint 11, connecting the two sections together, and converge inwardly at their tops whereby to support the crown pulley and housing 12. The mast, of course, may be of any height and when in upright position as shown in Figure 2 is stabilized by guy wires or cables 13.

The pivoted frame composed of members 4 also carries a cable drum 14, about which a cable 15 is wound and which extends over the crown pulley 12, carrying upon its free end a hook 16, which in drilling or cleaning wells, supports the swivel 17.

The hubs of the truck rear wheels 18 have bolted thereto sprockets 19, and through roller chains 20, shown in broken lines for the sake of clarity, rotation is imparted to a lateral jack shaft 21 on the truck chassis proper. A more comprehensive view of this arrangement is shown in Figure 1, a plan view.

A short rotary drive shaft 22 is provided near the foot of the mast and has on one end a bevel gear 23, enmeshing the larger gear 24 of the rotary table 8, while the opposite end of the shaft carries a sprocket 25, which latter, by reason of the chain 26, is rotated from the jack shaft 21 to impart rotation to the rotary works. On the opposite side of the machine shown in Figure 2, but clearly shown in Figure 1, is a large sprocket 27, mounted upon the lateral shaft supporting the cable drum 14. A chain 28 surrounds this as well as a smaller sprocket 29 to rotate the drum. Suitable clutch means 30, is carried on the jack shaft 21, for releasing the rotary drive. Also the drum shaft is provided with an operating lever 31, arranged at a convenient location with respect to the driller's position, to control the cable drum and cable.

Among the important features of the invention is the novel means for holding the mast in folded position upon the truck 1 in the manner suggested by dotted lines in Figure 2. It will be noted in this figure that the lower mast section 5 is flanged and apertured at *a* immediately below the engaging point of the upper section 9. In folding the mast upon itself, the upper end of the lower section 5 comes to rest upon the upright support 32 directly behind the driver's seat, in order that the aperture *a* in the mast will come to rest upon the top of the support 32, which is also apertured. A bolt 33 is then passed through the members to hold the same rigid. The support 32 is braced by the angular member 34 bolted to the truck chassis 2. The very convenient manner of handling the mast, and the readiness with which it may be set up for operation is apparent, as well as its practical relationship with respect to the rotary table 8, lending to the latter maximum strength and endurance.

With special reference to the vacuum process of water circulation, with which the invention is designed to operate, reference is primarily made to Figure 3, showing partly in section a settling tank 35, constructed so as to be entirely air tight and has an inlet 36, to which is connected a flexible hose 37, its opposite end being connected with the swivel 17.

An outlet 38 is also provided in the tank 35, to which is connected a pipe 39, communicating with a pump 40, driven, as apparent particularly in Figure 1, through sprocket 41, mounted on pump shaft 42, a chain 43 surrounding this sprocket and a sprocket 44 mounted on the jack shaft 21. A clutch 45 is provided for controlling the pump sprocket 44 with respect to the jack shaft.

In Figure 2 especially, a pipe 46 is shown leading from the pump 40, to the hole 47 being drilled or cleaned, to which reference will be later made in the description of operation.

The tank 35 is further provided with a

clean-out hole 48, with a clamp covering to avoid against breaking of the vacuum therein as will be presently explained.

Having designated and described the various parts comprising the invention, the operation of such parts will now be described, as for instance, in drilling a well.

The truck is driven to the desired location and backed up to where the rotary table 8 may be set down upon the point where the hole is to drilled. First, however, a small hole is dug, approximately 12″ in diameter. The bolt 33 holding the mast upon the support 32 is removed and the mast set up as shown in Figure 2. This operation sets the rotary table in operative position.

From a source of supply, the settling tank 35 is filled to overflow, then sealed. The water thus contained in the tank is used for the drilling operation, and replaces the usual slush pit used in other processes.

The rear wheels 18 of the truck are jacked up to clear the ground and the truck engine started, and by operating the clutch, 30, and 45, the water pump 40 is put into operation receiving its supply from the contents of the tank 35, and discharging through pipe 46 into the small hole previously dug in starting the well, as apparent in Figure 2.

The end of the drill pipe or stem 49 carrying the drill, not shown, is set into the hole, and through the kelly joint 50 is rotated by the rotary table 8, which in turn is driven through chain 26 from jack shaft 21, the latter being driven from sprocket 19 on the truck wheel hub.

The tank 35 being sealed to the atmosphere, and the operative end of the drill pipe being submerged in water, forms a water seal. From this, it is evident that the water displaced from the tank 35 by the pump will cause the water in the drill pipe 49 to rise, for the reason that the drill pipe is connected to the tank 35 through kelly 50, swivel 17 and hose 37.

It is thus obvious that a continuous circulation is established from the drill pipe and in the well to the tank and back again to the well.

Having thus established circulation of water, the drill pipe 49 is rotated and the drilling operation started, and since the drill bit used in the present equipment is provided with suitable ports, but not illustrated, the cuttings from the bit are buoyed to these ports and from there into the drill pipe by the flow of water from the well to the drill pipe. The cuttings having entered by the drill pipe are conveyed upward through the latter by the flow and discharged into the tank 35 where they are deposited and separate from the water. A screen 51 at the end of the tank inlet pipe 36 aids in such separation.

The cuttings are retained in the settling tank while the water continues on its course through the pump and back again to the well. As the drilling operation progresses, it is essential that the water level in the well be maintained within the limits of the efficiency suction head of the pump. This is readily accomplished by the addition of water from some outside source to the well. In practice it is best to keep the water level in the hole level with the surface of the ground.

The drill cuttings being thus drawn upward and deposited in the tank 35, the strata through which the drill is passing is being discharged in the tank in layers in progressive order, from which samples may be removed without interrupting the drilling operation nor breaking the suction in the tank. For this purpose a proof stick 52 is provided, and shown in detail in Figure 4. This member slides into the end of the tank 35 as shown in Figures 1 and 3 especially, and has therein a longitudinal slot or groove 53, maintained normally on the underside the cuttings, striking the stick opposite the groove as they fall from the inlet 36. The proof stick 52 has upon its inner end a sand level gauge 54, through which the level of cuttings within the tank 35 may be determined by simply rotating the stick.

When desired to make a test of strata, the proof stick is turned until the groove is in upright position, in which position it is permitted to remain a short time, to receive cuttings as they enter through inlet 36, after which it is withdrawn and a true sample removed from the groove.

The tank 35 is also equipped with a pressure gauge 55 by which the vacuum or suction created within the tank is determined.

This process is particularly adaptable to the cleaning out of wells where decline of production is caused by drifting of sand into the screen section of the casing, and in this, the procedure and operation is identical except that the drill pipe is introduced into the casing already in the hole.

Where decline is caused by clogging of the screen or immediate strata by paraffin, the apparatus can be successfully employed for circulating hot water or petroleum to the strata and screen so as to melt or dissolve the paraffin from the strata or screen and completely remove the same from the well through the drill pipe, which is impossible in other types of rotary processes, and in this manner increase production.

From the foregoing, it is apparent that through the extremely simple and practical drilling machine combined with the process of continuous water circulation, a well may be actually drilled or cleaned out to resume or increase production in a shorter time and in a more economical manner than machines dependent upon swabbing or bailing, since

in the improved machine, all foreign substance is completely removed instead of being pushed aside to again later interfere with production.

Manifestly the construction shown is capable of considerable modification and such modification as is in keeping with the appended claims is also considered within the spirit of the invention.

What is claimed is:—

1. A portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem embodying a motor truck, a frame pivoted at one end to the rear end of the truck for vertical swinging movement, a shaft carried by the frame, means to drive the shaft from the motor of the truck, a foldable mast composed of lower section rigidly secured to the rear end of the frame and an upper section hinged to the lower section, the lower end of the lower section extending below the frame, ground engaging shoes on said lower end of the lower section to hold the frame in horizontal position, a rotary for operating the drill stem carried by said shoes, means to drive the rotary from the shaft, and a vertical support carried by the truck and located in front of the frame, said support being engageable with the upper end of the lower mast section in folded position of the latter.

2. A portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem embodying a motor truck, a frame pivoted at one end to the rear end of the truck for vertical swinging movement, a shaft carried by the frame, means to drive the shaft from the motor of the truck, a foldable mast composed of a lower section rigidly secured to the rear end of the frame and an upper section hinged to the lower section, the lower end of the lower section extending below the frame, ground engaging shoes on said lower end of the lower section to hold the frame in horizontal position, a rotary for operating the drill stem carried by said shoes, and means to drive the rotary from the shaft.

3. In a portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem, a motor truck, a frame pivoted to the rear end of the truck for vertical swinging movements, a collapsible mast composed of movably connected sections, the lower one of which sections is rigidly secured to the frame and projects therebelow, ground engaging means carried by said lower section to hold the frame in horizontal position, a rotary for operating the drill stem carried by said lower section, means to operate the rotary from the motor of the truck, and means carried by the truck for supporting the mast collapsed and with said frame in its upwardly swung position.

4. In a portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem, a motor truck, a frame pivoted to the rear end of the truck for vertical swinging movements, a collapsible mast composed of movably connected sections, the lower one of which sections is rigidly secured to the frame and projects therebelow, ground engaging means carried by said lower section to hold the frame in horizontal position, a rotary for operating the drill stem carried by said lower section, and means to operate the rotary from the motor of the truck.

5. In a portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem, a motor truck, a frame pivoted to the truck for vertical swinging movements, a collapsible mast composed of movably connected sections, the lower of which is rigidly secured to the frame and which projects below the frame, ground engaging means carried by said lower section, a rotary for operating the drill stem carried by the ground engaging means, a cable drum on the frame, means to actuate the drum from the motor, and means to actuate the rotary from the motor.

6. A portable rotary well drilling and cleaning machine for elevating cuttings by fluid circulation through the drill stem, including a motor truck, a frame pivoted to the truck for vertical swinging movements, a mast having a lower portion rigidly secured to the frame and projecting therebelow, ground engaging means carried by said lower portion of the mast and formed to stationarily seat on the surface of the ground thereby to support the mast from the ground, a rotary for operating the drill stem carried by the ground engaging means, and means to operate the rotary from the motor of the truck.

In testimony whereof I affix my signature.

HI MANNING.