Nov. 21, 1950 J. C. STRATTON 2,530,916

MUD CLEANING APPARATUS

Filed Sept. 7, 1948

FIG. 1.

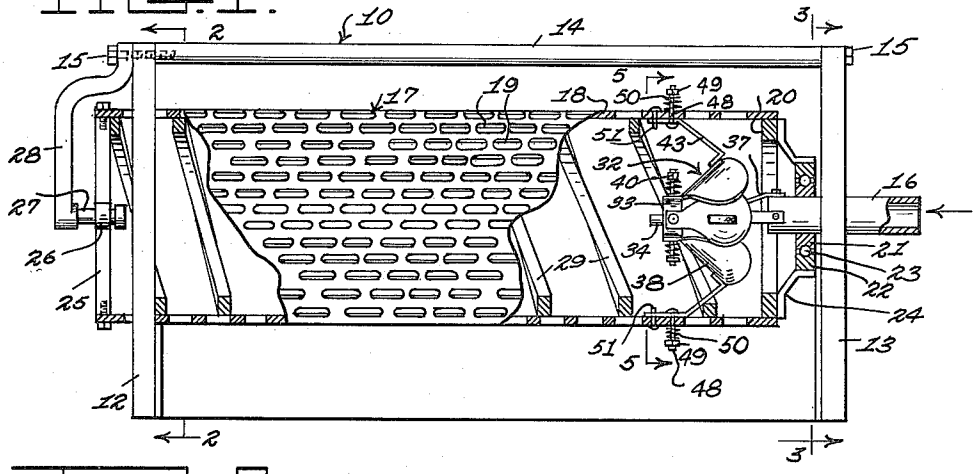


FIG. 2.

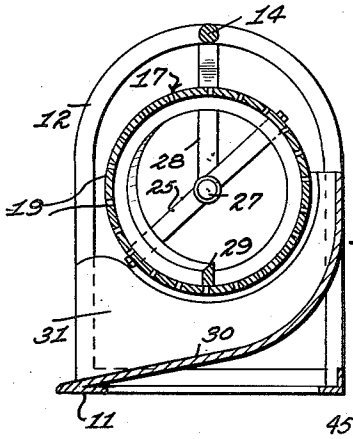


FIG. 4.

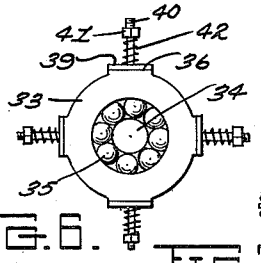


FIG. 5.

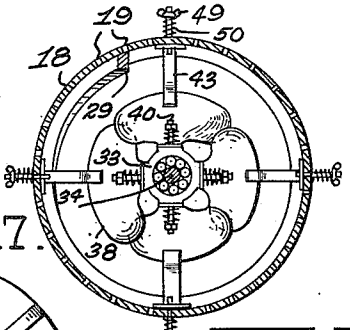


FIG. 6.

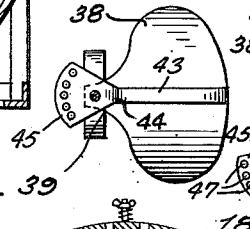


FIG. 7.

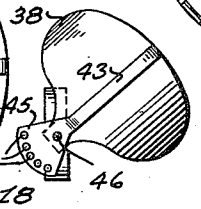


FIG. 9.

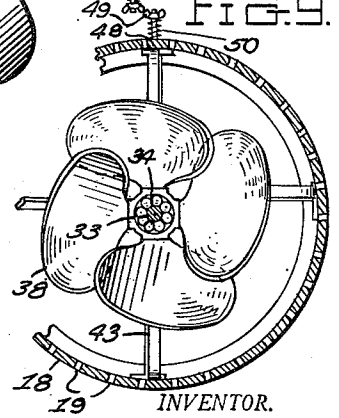


FIG. 3.

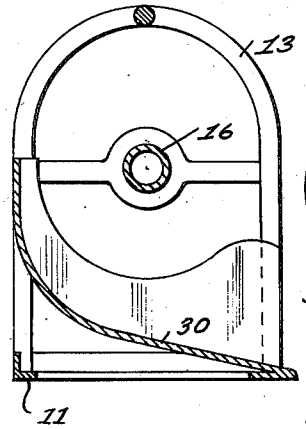
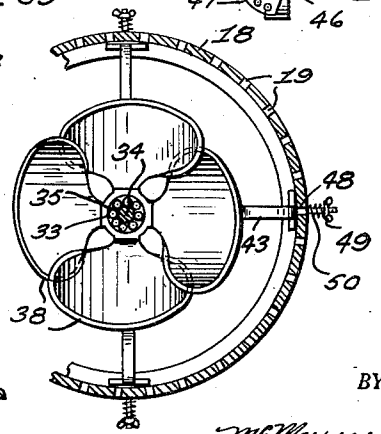


FIG. 8.



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MUD CLEANING APPARATUS

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3 Claims. (Cl. 210—199)

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This invention relates to rotary separating apparatus, and more particularly to apparatus for separating shale and other drill cuttings from oil well drilling mud.

It is among the objects of the invention to provide an improved separator or "shale shaker" for separating drill cuttings, such as shale, out of well drilling mud and conditioning the mud for further use, which separator is driven by pump-induced flow of mud from the well into the separator and requires no separate power plant for its operation, is operated at a speed dependent on the rate of flow and viscosity of the mud, is effective to remove most of the drill cuttings from the mud, deposit the cleaned mud in a suitable tank or pit provided therefor, and deliver the removed cuttings to a location outside the tank or pit from which location the cuttings may be removed by suitable disposal means, which is adjustable to vary its operating speed, and which is simple and durable in construction, economical to manufacture, and easy to install and operate.

Other objects and advantages will become apparent from a consideration of the following description and the appended claims in conjunction with the accompanying drawing, wherein:

Figure 1 is a side elevation of a rotary separator, illustrative of the invention, parts being broken away and shown in cross-section to better illustrate the construction thereof;

Figure 2 is a transverse cross-section taken substantially on the line 2—2 of Figure 1;

Figure 3 is a transverse cross-section taken substantially on the line 3—3 of Figure 1;

Figure 4 is an end elevation of a hub structure constituting an operative component of the device;

Figure 5 is a transverse cross-section taken substantially on the line 5—5 of Figure 1 and showing in elevation an impeller mechanism secured to the hub illustrated in Figure 4 and operative to rotate the separator drum;

Figure 6 is a top plan view of an impeller blade in one position of adjustment relative to the blade-carrying hub;

Figure 7 is a top plan view of the blade illustrated in Figure 6 showing the blade in a different position of adjustment;

Figure 8 is an elevation on a somewhat enlarged scale of the impeller mechanism looking in a direction from right to left of Figure 1 and showing the impeller blades in the position of adjustment illustrated in Figure 6; and

Figure 9 is a view similar to Figure 8 showing

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the impeller blades in the position of adjustment illustrated in Figure 7.

With continued reference to the drawing, numeral 10 generally indicates a frame for the separating apparatus which frame may conveniently include a rectangular base 11 made up of convenient structural members, such as angle iron, a pair of upstanding, U-shaped end structures 12 and 13, the legs at the open ends of which structures are rigidly secured to the ends of the base frame 11, and a top rod 14 extending between the upper ends of the end structures 12 and 13 and rigidly secured thereto by suitable means, such as the stud bolts 15 threaded through corresponding apertures provided in the upper or closed ends of the end structures and threaded into screw-threaded wells provided one in each end of the top rod 14. This construction provides a rigid frame for the apparatus, which frame may be operatively mounted upon a tank used as a reservoir for drilling mud or upon a suitable supporting frame extending over a pit in which the mud is stored during the interval of time after it has been pumped from the top of the well, and before it is returned to the bottom of the well through the drill stem tubing in the conventional manner.

The end structure 13 is provided with a transversely-extending strut or plate in which is provided a central aperture and a flow-line nipple 16 extends through such aperture to substantially its mid-length position and is rigidly secured to the transversely-extending strut or plate of the end structure 13, in a position such that it is substantially parallel to the frame base 11. This nipple 16 may conveniently comprise a short, cylindrical section of steel tubing to which the outlet of the sludge pump which pumps the mud from the top of the well is connected.

A cylindrical drum, generally indicated at 17, is mounted in the frame 10 substantially in axial alignment with the nipple 16. The drum 17 comprises a hollow cylinder 18 of steel tubing having a length substantially equal to the length of the frame 10 and provided with closely-spaced, elongated, narrow slots or apertures 19 extending through its wall. These slots 19 are of a width to permit the oil drilling mud to pass freely therethrough while maintaining most of the drill cuttings in the drum. The inner end of the nipple 16 extends into the adjacent end of the drum 17 and an annular flange 20 is secured in this end of the drum surrounding the inner end of the nipple. A suitable anti-friction bearing is provided for holding this end of the drum in centered

position relative to the nipple, and may comprise an inner-bearing race 21 secured on the nipple adjacent the frame end structure 13, an outer-bearing race 22 surrounding the inner race 21, anti-friction elements, such as bearing balls 23, operatively disposed between the inner and outer races, and spokes 24 secured to and extending between the outer side of flange 20 and the periphery of the outer-bearing race 22.

A single strut 25 extends diametrically across the opposite end of the drum, internally thereof, and is provided at its mid-length location with a cylindrical hub 26. An axle 27 projects inwardly from the lower end of a bracket 28, the upper end of which is rigidly secured to the upper end of the frame end structure 12 by the corresponding stud bolt 15, and a suitable anti-friction bearing is preferably interposed between the axle 27 and the hub 26 to rotatably support the corresponding end of the drum on the frame 10. A spiral rib 29 extends around the interior of the drum cylinder from the internal, annular flange 29, to the opposite end of the drum and is secured to the cylinder wall of the drum. The purpose of this rib is to move the mud and drill cutting aggregate introduced into the drum from the nipple 16 toward the opposite end of the drum, the mud being discharged through the slots 19 and the cuttings being discharged from the drum at the end thereof opposite the nipple from which location the cuttings may be removed by suitable disposal means, as may be necessary.

A base plate 30 is carried by the frame 10 below the drum 17 to receive the mud discharged through the drum slots 19 and this plate is preferably curved downwardly from one side of the frame to the opposite side so that the mud will be discharged to such other side of the frame and into the tank or pit above which the apparatus is mounted. This base plate 30 preferably has upstanding end walls 31 to prevent the mud discharged from the drum from flowing outwardly of the ends of the base plate.

An impeller mechanism, generally indicated at 32, is carried by the drum 17 at the inner end of the nipple 16 to impart rotation to the drum when subjected to a pump-induced flow of drilling mud through the flow-line nipple 16.

The impeller mechanism, as illustrated, comprises an annular hub 33 journaled on an axle 34 by means of an anti-friction bearing 35, and provided with angularly-spaced-apart flats 36 on its periphery. The axle 34 is carried by suitable angularly-spaced-apart bars 37 attached to and extending from the inner end of the nipple 16 inwardly of the drum 17 to the axle. In the arrangement illustrated, there are four flats 36 on the hub 33 and four impeller blades 38 are pivotally secured to the hub, one at each of the flats 36. The blades 38 are somewhat elliptical in shape and are longitudinally curved and each is provided substantially midway of the longer side of the ellipse at one side thereof with an outwardly-extending apertured lug 39 for attaching the blade to the hub 33. Four screw-threaded studs 40 extend radially outwardly of the hub 33, each substantially centered relative to a corresponding flat 36 and each of these studs passes through the aperture in the lug of a corresponding impeller blade 38, a nut 41 is threaded onto the outer end of each stud and a coiled compression spring 42 surrounds each stud between the corresponding nut 41 and the corresponding impeller blade lug 39, so that the impeller blades may be manually turned relative to the hub about the axes of the corresponding studs 40 to adjustably vary the angle of incidence of the impeller blades to the flow of mud from the inner end of nipple 16.

Four braces 43 extend one from the outer end of each impeller blade 38 to the wall of the drum cylinder 18 and each brace terminates at its end 44 remote from the corresponding impeller blade in a sector of a circle 45 having a central aperture 46 and a series of apertures 47 adjacent the arcuate edge thereof. A respective bolt 48 extends through the central aperture 46 in each brace end and through a corresponding aperture provided in the cylindrical wall of the drum and the braces 43 are so inclined relative to the drum and the impeller blades that each bolt 48 is substantially in axial alignment with a corresponding stud 40 radially of the drum cylinder. Each bolt 48 extends outwardly of the drum and a nut 49 is threaded onto the outer end of each such bolt. A respective compression spring 50 surrounds each bolt 48 between the nut 49 and the outer surface of the drum cylinder to resiliently urge the bolt outwardly of the drum. Four locking pins 51 extend through angularly-spaced-apart apertures in the drum cylinder and one through the sector-shaped end of each impeller blade brace 43. These locking pins extend through selected apertures 47 to operatively hold the impeller blades in positions of adjustment to provide a desired rotational speed for the drum 17 incident to the rate of flow and viscosity of the mud passing into the drum through the nipple 16.

With this apparatus, as the mud is pumped from the well through the flow-line nipple 16, it will be delivered into the drum 17 and will flow through the slots 19 of the drum cylinder to the base plate 30 from which it will be discharged to one side of the frame of the apparatus into a suitable reservoir tank or pit. The drum 17 will be rotated by the impeller mechanism 32 as the mud is pumped into the drum and will be moved by the spiral rib 29 longitudinally of the drum from the end of the drum adjacent the nipple 16 to the opposite end of the drum. During this passage, substantially all of the mud will pass in a cleaned condition through the slots 19 and the drill cuttings pumped into the drum with the mud will be moved by the spiral rib lengthwise of the drum and discharged therefrom at the end of the drum opposite the line-flow nipple 16 at a location from which the cuttings can be conveniently removed by suitable disposal means.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

What is claimed is:

1. A separating apparatus comprising a frame including spaced upstanding ends, a substantially horizontal tubular nipple mounted upon one end of the frame and projecting longitudinally inwardly of such end for a slight distance for receiving oil well mud to be separated, a bearing shaft mounted upon the opposite end of the frame and disposed in axial alignment with the nipple, a substantially cylindrical drum extend-

ing between the ends of the frame and having its opposite ends rotatably mounted upon the nipple and bearing shaft, the drum having perforations in its side and including an inner spiral vane secured to the inner surface of the drum and extending for substantially its entire length, a non-rotatable shaft positioned within said drum in axial alignment with and spaced from the inner end of the nipple and secured to said nipple, an annular ring rotatably mounted upon the shaft, a plurality of circumferentially spaced impeller blades secured to the annular ring for rotation therewith and extending radially outwardly of the ring and spaced radially from the inner surface of the drum, and generally radial brackets secured to the drum near the annular ring and having their inner ends secured to the impeller blades.

2. A separator apparatus, comprising a frame including spaced upstanding ends, a substantially horizontal tubular nipple secured to one end of the frame and spaced from the bottom of the frame for receiving oil well mud to be separated, a substantially horizontal bearing shaft secured to the opposite end of the frame and disposed in axially alignment with the nipple, a substantially horizontal perforated cylindrical drum disposed between the ends of the frame and having its opposite ends rotatably mounted upon the nipple and bearing shaft, a spiral vane secured to the inner surface of the drum and extending for substantially the entire length of the drum, a substantially horizontal non-rotatable shaft positioned within said drum in axial alignment with and spaced from the inner end of the nipple and secured to said nipple, radial studs secured to the annular ring for rotation therewith and spaced circumferentially about the ring, impeller blades pivotally connected with the radial studs and extending radially outwardly of the ring and axially thereof upon one side of the ring, the impeller blades being disposed adjacent to the end of the drum connected with the nipple, generally radial brackets secured to the impeller blades, radial bolts carried by the drum, the outer ends of the brackets being pivotally connected with the bolts, and pin means connecting the drum and brackets for locking the impeller blades in selected adjusted positions upon the radial studs.

3. A separator apparatus, comprising a frame

including spaced upstanding ends, a substantially horizontal tubular nipple secured to one end of the frame for receiving oil well mud to be separated, a substantially horizontal bearing shaft secured to the opposite end of the frame and disposed in axial alignment with the nipple, a substantially horizontal perforated drum arranged between the ends of the frame and having its opposite ends rotatably mounted upon the nipple and bearing shaft, the nipple extending into the drum, a substantially horizontal non-rotatably shaft positioned within said drum in axial alignment with and spaced from the inner end of the nipple and secured to said nipple, brackets connecting the nipple and non-rotatable shaft and supporting such shaft, an annular ring rotatably mounted upon the non-rotatable shaft, circumferentially spaced radial studs secured to the ring, inclined impeller blades pivotally mounted upon the studs for rotation with the ring and drum, the impeller blades extending axially of the ring upon one side thereof and toward the nipple and radially outwardly of the ring, inclined brackets secured to the impeller blades near their outer extremities and extending near the inner surface of the drum, outer axially extending plates secured to the inclined brackets and arranged adjacent to the inner surface of the drum and provided with main openings and a plurality of adjustment openings spaced from the main openings, radial bolts carried by the drum and extending through the main openings of the plates, and radial locking pins carried by the drum and adapted to enter the adjustment openings of the plates for locking the impeller blades in selected adjusted positions.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
686,263	Conley	Nov. 12, 1901
1,036,122	Kellogg	Aug. 20, 1912
1,301,683	Goddu	Apr. 22, 1919
1,485,552	Colby	Mar. 4, 1924
1,741,444	Slider	Dec. 31, 1929
2,206,593	Beebe	July 2, 1940
2,321,243	Range	June 8, 1943