United States Patent [19]

Thompson

[11] **3,852,197**

[45] **Dec. 3, 1974**

[54] **MUD AND SHALE SEPARATING APPARATUS**

[75] Inventor: **James Gordon Thompson,** Calgary, Alberta, Canada

[73] Assignee: **Key Oilfield Supply & Rental Ltd.,** Calgary, Alberta, Canada

[22] Filed: **Mar. 16, 1973**

[21] Appl. No.: **342,128**

[52] **U.S. Cl.** **210/143,** 210/389

[51] **Int. Cl.** **B01d 33/22**

[58] **Field of Search** 210/384, 388, 389, 141, 210/143

[56] **References Cited**

UNITED STATES PATENTS

392,218	11/1888	Moore	210/141 X
2,329,295	9/1943	Reagan	210/388 X

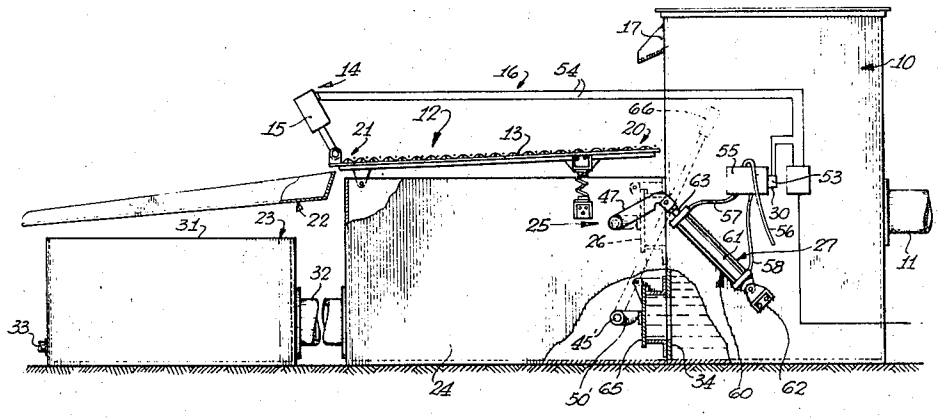
Primary Examiner—Roy Lake

Assistant Examiner—Craig R. Feinberg

[57] **ABSTRACT**

An apparatus for separating mud from the mud and shale mixture forced to the surface from a drill hole and including an arrangement which prevents the mud, which is normally collected for reuse, from being wasted in the event of a power failure. The mixture is collected in a tank as it returns to the surface, and from the tank it is deposited on a vibrating screen so that the cuttings or shale are separated from the mud which passes through the screen and into a collecting tank. A passage is provided between the mixture tank and the collecting tank, the passage having a door which is normally closed to prevent by-pass of the mixture into the collecting tank. A door operating device is provided in series with a power supply to a screen operating motor, and the door operating device is arranged to permit the door to open when power is not being conducted to the motor so that the mixture passes directly into the collecting tank and does not continue to flow from the mixture tank and on to the then stationary screen.

8 Claims, 4 Drawing Figures



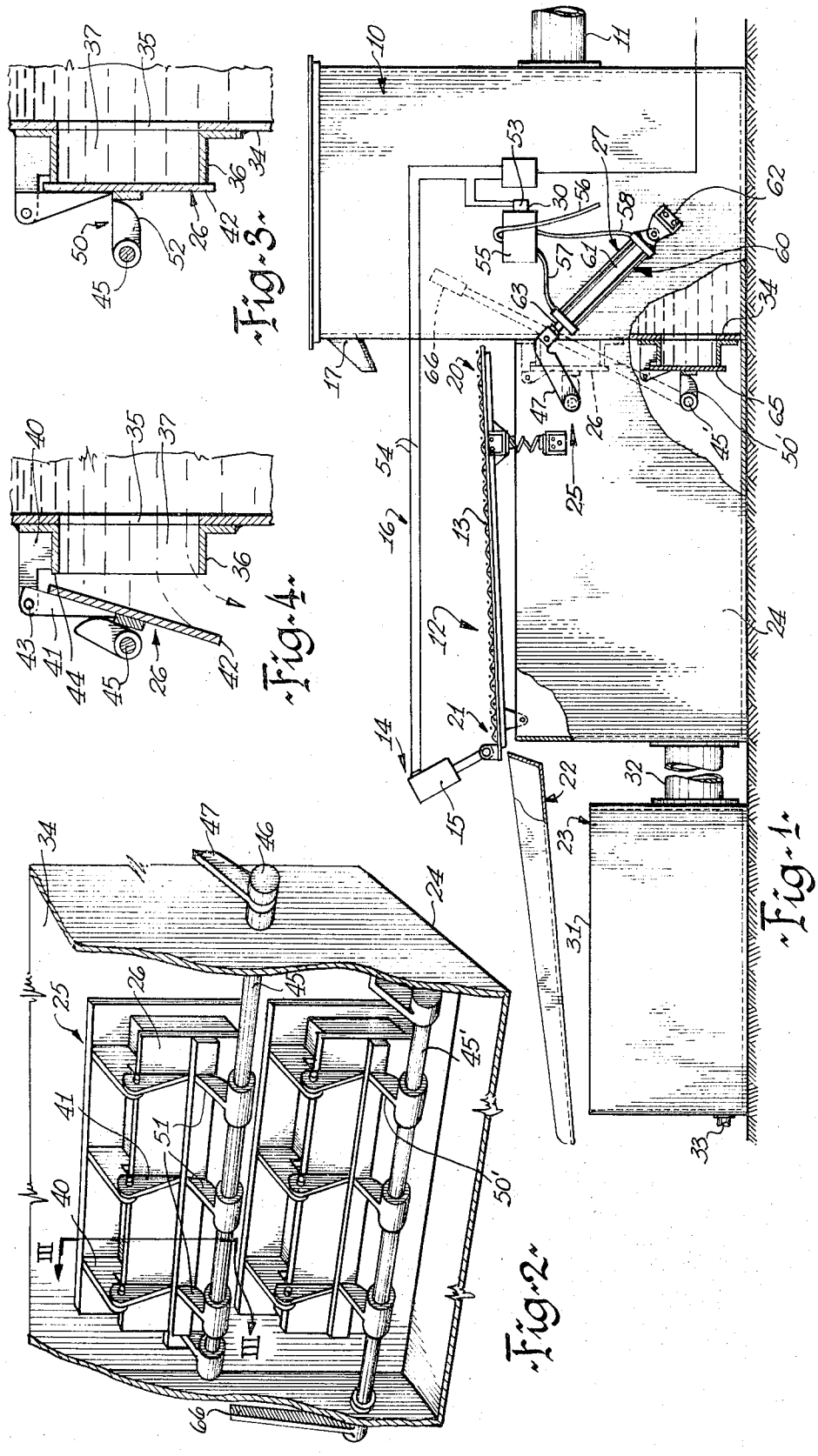


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

MUD AND SHALE SEPARATING APPARATUS

This invention relates to an apparatus for separating mud from the mud and shale mixture forced to the surface from a drill hole, and more particularly to an arrangement which prevents the waste of mud in the event of a power failure.

In drilling operations used in drilling oil an gas wells, drilling mud is circulated under pressure down the centre of the drill pipe and forced back to the surface carrying with it shale and samples of the cuttings. The surfacing mixture of mud and material cut from the drill hole are collected, and the mud is then separated from the other material usually by way of a vibrating screen arrangement. The samples of the cuttings may be salvaged from the screen for geological examination, and the mud which has passed through the screen is collected for reuse. The remaining material or waste products on the screen are conveyed by the vibrating screen to the end thereof and are permitted to flow to a sump disposal pit. Each drilling rig is usually equipped with its own electrical generator, and accordingly, a power failure or other types of interruptions of electricity to the mud and shale separating equipment is not uncommon. If the supply of electricity is terminated the means for driving the vibrating screen ceases to function, and as a result a major portion of the mixture which may continue to flow onto the screen passes directly over the screen and into the sump disposal pit from which it may not be readily salvaged. The mixture includes the drilling mud, the initial cost of which may be in the neighborhood of $20.00 per barrel, and accordingly, each power failure or interruption experienced on the drilling rig can result in a significant financial loss.

It is an object of the present invention to provide a mud and shale separating apparatus which will avoid the loss of drilling mud in theevent of a power failure on a drilling rig.

According to the present invention there is provided a tank for receiving mud and shale mixture from a drill hole. A vibrating screen, which has an infeed end and an outfeed end, is arranged to receive on the infeed end an outflow of the mixture from the tank. A motor means is provided for driving the screen so as to cause the mud to pass through the screen and the shale to be conveyed therealong during operation of the motor means which receives power through a conducting means. Collecting means are located below the screen for receiving the mud, and passage means define a communication between the mixture tank and the collecting means. A door is associated with the passage means and is movable between an opened position and a closed position for blocking the passage means. A door operating means is provided which has an actuator energizable by the same conducting means as the motor means and arranged to permit the door to move to the opened position when de-energized whereby the mixture is permitted to flow through the passage means when said motor means does not receive power. The mixture is thus collected for reuse and is prevented from being wasted by flowing to the sump disposal pit.

In a preferred embodiment of the invention the actuator of the door operating means has a motor of the type including a piston and cylinder device, there being provided a valve for controlling flow of pressurized fluid to the device. The actuator also has means for operation of the valve between first and second positions so that the piston is shifted between a door closed position and a door open position when said valve is in said first and second positions respectively, by admittance of the fluid to the cylinder.

In the accompanying drawings, which show one embodiment of the invention by way of example,

FIG. 1 is a side view of the apparatus of the invention having certain portions shown in section for the sake of clarity;

FIG. 2 is a perspective view, shown partially in section, of the door and passage arrangement between the mixture tank and collecting means;

FIG. 3 is a section view as seen from the line III—III of FIG. 2 with the door in a closed position; and

FIG. 4 is a view similar to FIG. 3, but with the door in an opened position.

Referring to FIG. 1, the reference numeral 10 denotes a tank which receives through an inlet conduit 11 mud which has been forced to the surface from a drill hole. The mud carries with it the cuttings and other like materials, which is referred to herein as shale, from the drill hole, and the mixture is thus received in the tank 10. Located adjacent the tank 10 is a separating device 12 in the form of a screen 13 which is mounted for vibrating in a well known manner. Motor means 14 are connected to the screen 13 for affecting the vibration of the screen. In the illustrated embodiment the motor means is shown in the form of an electric motor 15 which receives power through conductor means 16, the electrical motor being connected to the screen through an eccentric type drive or like mechanism (not shown) for transforming the rotary output of the motor to a reciprocating motion. The tank 10 has an outlet in the form of overflow weir 17 so as to permit the mixture within the tank to flow out of the tank and onto an input end 20 of the screen 13. Located immediately under an output end 21 of screen 13 is a chute 22 or other conveying means for conducting the shale, which has been transferred by the vibrating of the screen from the input end 20 to the output end 21, to a sump disposal pit (not shown). Located below the screen 13 is a collecting means 23, which includes an open-topped tank 24 situated immediately under the screen for catching the mud which is passed down through the screen when it is vibrated by motor means 14. Passage means 25 provides direct communication between tank 10 and tank 24. Passage means 25 is normally closed by a door 26, the operation of which is controlled by a door operating means 27. The door operating means includes an actuator 30 which is also energized by conductor means 16 and the actuator is so arranged that unless the conductor means are transmitting power the door 26 is maintained in a closed position to block any flow of the mud and shale mixture directly through passage means 25 and into tank 24.

In the illustrated embodiment, the tank 24 is connected to a mud storage tank 31 by way of a conduit 32. The mud storage tank 31 has an outlet conduit 33 from which stored drilling mud is pumped and forced under pressure down the centre of the drill pipe (not shown).

Under the normal operating conditions, the drill mud which is pumped into the drill hole carries the shale from within the drill hole back to the surface and this mixture enters tank 10 through inlet conduit 11. The collected mixture in tank 10 overflows through weir 17,

and as it is conveyed along the screen **13** which is driven by motor means **14**, the mud passes through the screen **13** and into the collecting means **23**. The other material from the mixture continues along screen **13**, and cutting samples may be picked therefrom for geological examination. The shale otherwise is eventually passed off the output end **21** of the screen **13** and travels on to the sump disposal pit. The mud collected in open-topped tank passes into storage tank **31** and is eventually recirculated through the drill hole. The above-described operation is continuous under normal circumstances during the drilling operation. In the event of failure of the electrical generator associated with the drilling rig, for example, the electric motor **15** ceases to drive the screen, and door **26** is then automatically permitted to open to permit the mixture in tank **10** to pass directly to tank **24** in a manner which will be described in more detail below.

As is more clearly illustrated in FIGS. **2** to **4**, a wall **34** separates tanks **10** and **24**. The wall **34** is provided with an elongated rectangular opening **35**, and secured, as by welding, to wall **34** in tank **24** is a cowl **36** which encompasses opening **35** and provides a passage **37** therewith. Located above the cowl **36** and secured within tank **24** are a series of lugs **40** which provide with lugs **41** secured to the door, which is in the form of a rectangular plate **42**, a hinge having pins **43** defining a horizontal axis of pivot for the door. In the closed position, the door **26** hangs substantially vertical and abuts outer edge **44** of cowl **36** so as to close passage **37**.

Extending across the tank **24** adjacent door **26** and on the opposite side in the door as the cowl **36** is a shaft **45** which is mounted for rotation. The shaft **45** has one end **46** thereof projecting from the side of the tank, and a crank arm **47** is fixed to the end **46**. Secured to the shaft **45** is cam means **50** in the form of a plurality of cam plates **51**. Each cam plate **51** has a curved surface **52** arranged to engage a plate **53**, which extends the length of door **26**, as the shaft **45** is pivoted to move the cam means **50** from the position shown in FIG. **4** to that shown in FIG. **3** so as to push the door **26** to a closed position. When in the position shown in FIG. **3**, the cam means **50** holds the door **26** inn the closed position, i.e. in engagement with outer edge **44** of cowl **36**.

The actuator **30** in the illustrated embodiment includes a solenoid **53**. The conductor means **16** includes electrical lines **54**, **54** to which solenoid **53** is connected in series. Accordingly, when lines **54**, **54** are energized to conduct power to electric motor **15**, the solenoid **53** is energized. The solenoid **53** is mechanically connected to a valve **55** and when the solenoid is energized the valve **55** is held in one position. If the solenoid becomes de-energized the valve is moved to another position. In the illustrated embodiment, the valve controls the flow of compressed air from a supply line **56** alternatively to a pair of conduits or lines **57** and **58** which extends to opposite ends of a piston and cylinder type motor **60**. Cylinder **61** of the motor is pivotally connected by way of bracket **62** to the side of tank **10**, and piston rod **63** of the piston (not shown), which extends from the opposite end of the cylinder, is pivotally connected to the crank arm **47**.

When solenoid **53** is energized compressed air is admitted to the upper end of the cylinder **61** by way of line **57**, as shown in FIG. **1**, and the valve **55**, by way of line **58**, vents the lower end of the cylinder to atmosphere. The cam means **50** is thus held in the position shown in FIG. **3**, and the door **26** is maintained closed. If solenoid **53** is deenergized the valve is moved to permit flow of compressed air from line **56** to line **58**, and line **57** is vented so that piston rod **63** is forced from a retracted to an extended position which causes rotation of shaft **45** and cam means **50** to the position shown in FIG. **4**.

It may be appreciated, therefore, that in the event the above-described normal operation is interrupted by a power failure solenoid **53** is de-energized which results in a shaft of the cam means **50** from that shown in FIG. **3** to that shown in FIG. **4**, and the hydrostatic head of the mixture permits the mixture to flow directly from tank **10** to tank **24**. As the level of the mixture drops, the flow over weir **17** is terminated so that the mixture, including the mud is not permitted to flow over the stationary screen **13** and onto chute **22**. When power is resumed, the cam **50** moves back to the position shown in FIG. **3** because of the retraction of the piston rod **63** brought about by the operation of valve **55** on energization of solenoid **53**. The door is thereby pushed to the closed position by the cam means **50** and subsequently held closed until the power is again interrupted.

In addition to the passage means **25** and door **26** arrangement there is further provided a substantially identical lower arrangement **65**. Associated with the lower arrangement **65** is a shaft **45'** and cam means **50'** of the same design as shaft **45** and cam means **50**. The shaft **45'**, however, has fixed to one end thereof a lever **66**, which may be manually operated in the case of an emergency to permit passage of the machine through the lower arrangement **65**. As an alternative to providing the additional lower arrangement **65** means could be provided to manually override to automatic control of shaft **45**.

Alternative embodiments to those described above in connection with the illustrated embodiment will be obvious to those skilled in the art without departing from the spirit of the invention as defined in the appending claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A mud and shale separating apparatus comprising a tank for receiving a mud and shale mixture from a drill hole, a vibrating screen having an infeed end, an outfeed end, said tank having outlet means for permitting a flow of the mixture from said tank onto said infeed end of said screen, motor means for driving said screen and thereby causing the mud to pass through the screen and the shale to be conveyed therealong during operation of said motor means, means for conducting power to said motor means, collecting means below said screen for receiving the mud passed through said screen, passage means defining communication between said tank and collecting means, a door movable between an opened position and a closed position for blocking said passage means, door operating means having an actuator energizable by the power conducting means, said door operating means on de-energization of said actuator permitting said door to move to said opened position whereby the mixture is permitted to flow through said passage means when power is not being conducted to said motor means.

2. An apparatus as defined in claim **1**, wherein said actuator of said door operating means comprises a

motor of the type including a piston and cylinder device, and a valve for controlling flow of pressurized fluid to said device, and means for operation of said valve between first and second positions whereby said piston is shifted between a door closed and a door opened position when said valve is in said first and second positions respectively by admittance of said pressurized fluid to said cylinder.

3. An apparatus as defined in claim **2,** wherein the screen driving motor means includes an electric motor, the conducting means including electrical lines extending to said electric motor, and wherein said actuator further includes a solenoid connected in series in said electrical lines, said solenoid being mechanically connected to said valve for moving said valve from said first position to second position when said electrical lines are de-energized.

4. An apparatus as defined in claim **3,** wherein said collecting means includes an open-topped tank below said screen, said passage means having an outlet opening in one vertical wall of said open-topped tank, said door having a hinge providing a horizontally disposed axis of pivot above said outlet opening whereby said door hangs in a substantially vertically disposed position when in the closed position.

5. An apparatus as defined in claim **4,** wherein said door operating means further includes a horizontal shaft extending across said open topped tank adjacent said door and on the side of said door opposite to said outlet opening, cam means secured to said shaft for engaging said door and holding said door in the closed position, a crank arm fixed to one end of said shaft, said piston being connected to said crank arm whereby said shaft is rotated when said piston is shifted from said first to said second position and said cam means are moved away from said door so as to permit said door to swing open under the influence of the hydrostatic head on the mud and shale mixture.

6. An apparatus as defined in claim **4** wherein said collecting means includes a mud tank in communication with said open-topped tank, means being connected to said mud tank for withdrawing mud therefrom for reuse.

7. An apparatus as defined in claim **3** wherein said pressurized fluid is compressed air, and further comprising means for supplying compressed air to the solenoid controlled valve, and a pair of conduits for conducting compressed air from said solenoid to opposite ends of said piston and cylinder device.

8. An apparatus as defined in claim **1,** including additional passage means between the mud and shale mixture tank and said collecting means, a second door movable between an opened and closed position for blocking said additional passage means, and manually operable means for permitting opening of said second door.

* * * * *