

June 30, 1970

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3,517,487

DRILLING MUD FLOW AND DIVIDER APPARATUS

Filed Aug. 16, 1968

5 Sheets-Sheet 1

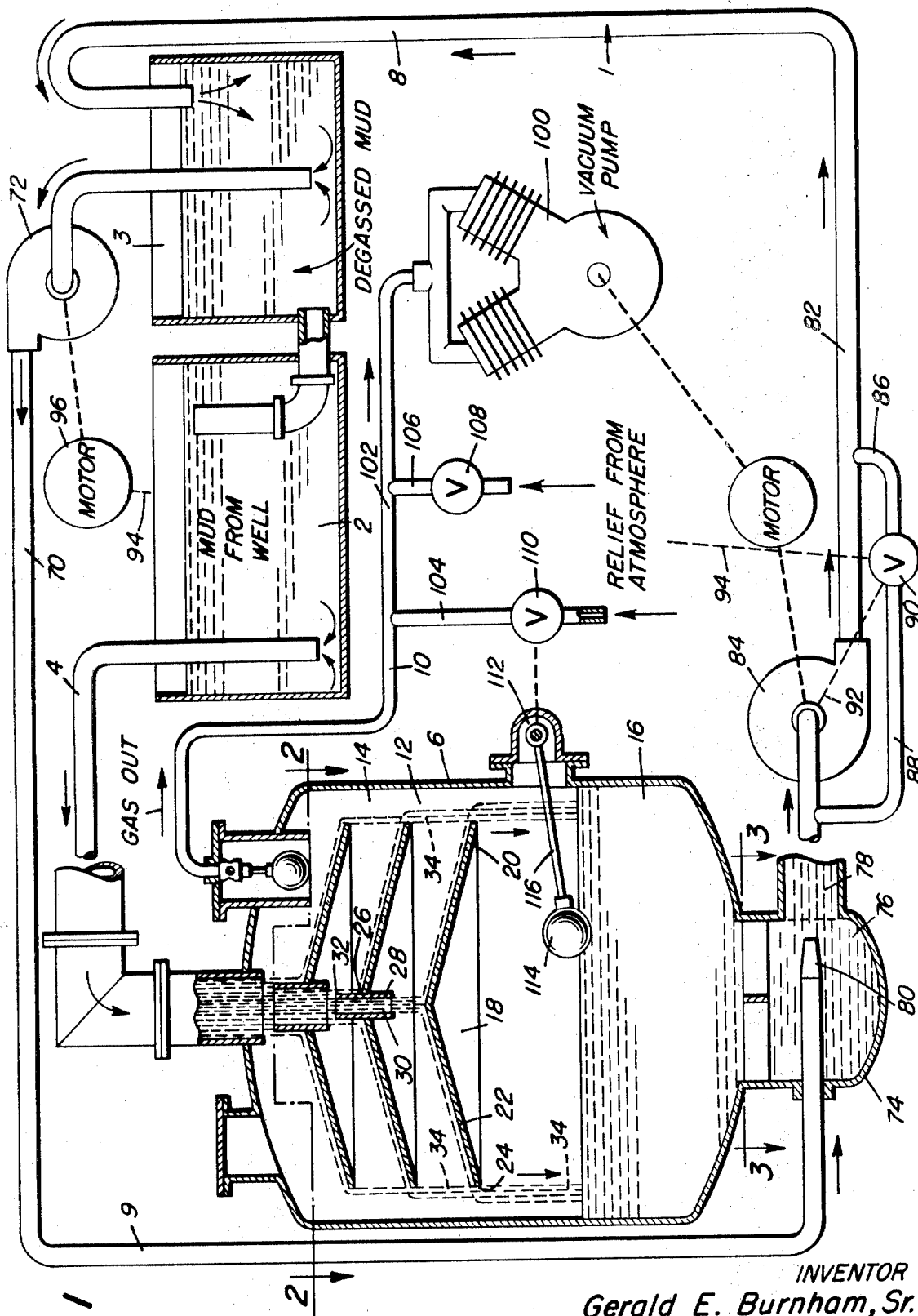


FIG. 1

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5 Sheets-Sheet 2

FIG. 2

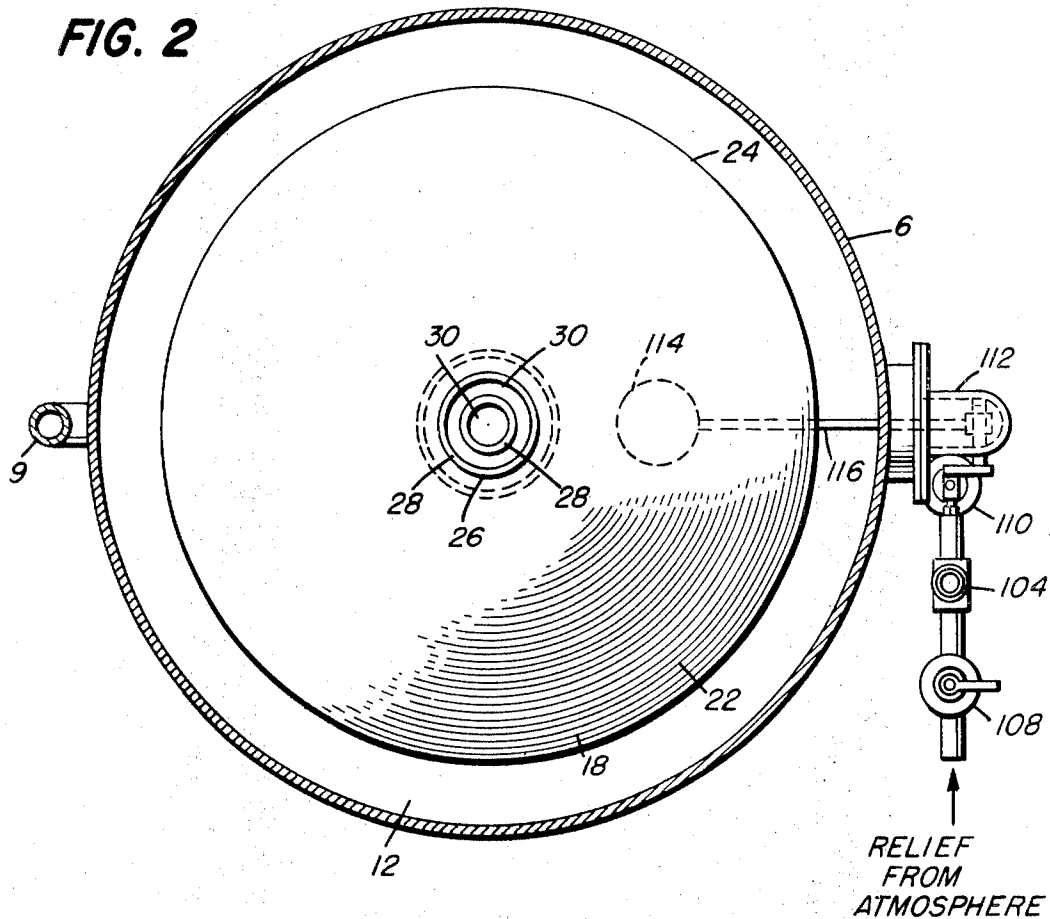
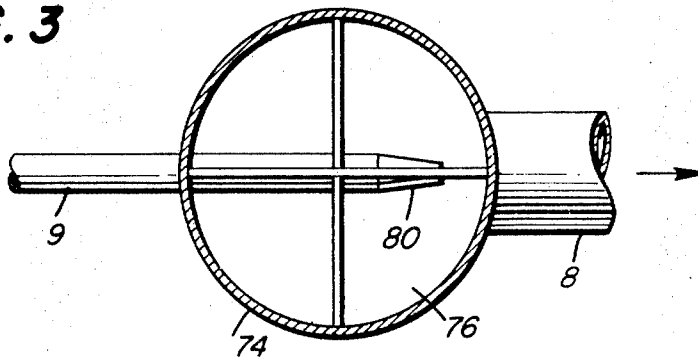


FIG. 3



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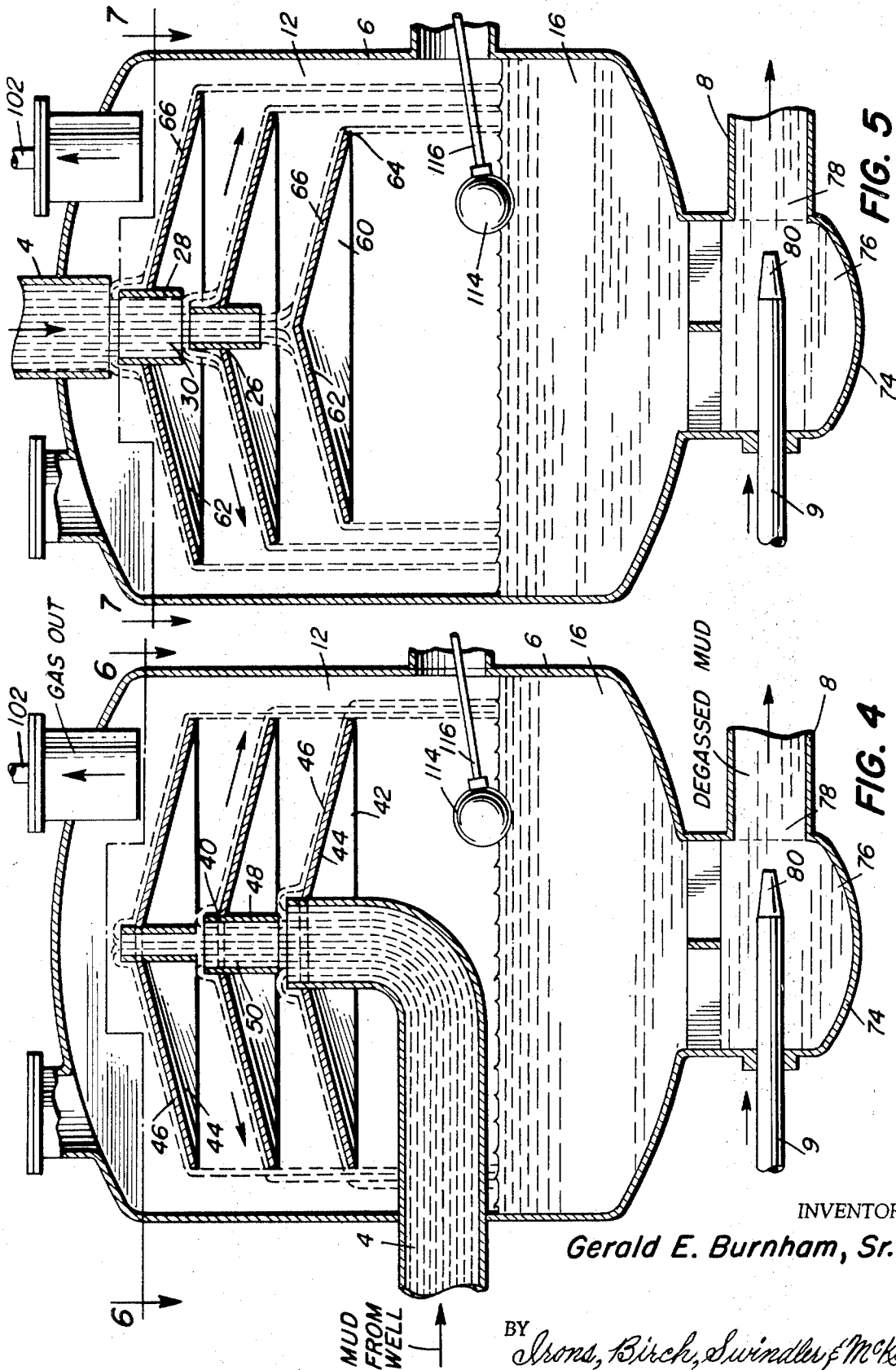
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DRILLING MUD FLOW AND DIVIDER APPARATUS

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5 Sheets-Sheet 3



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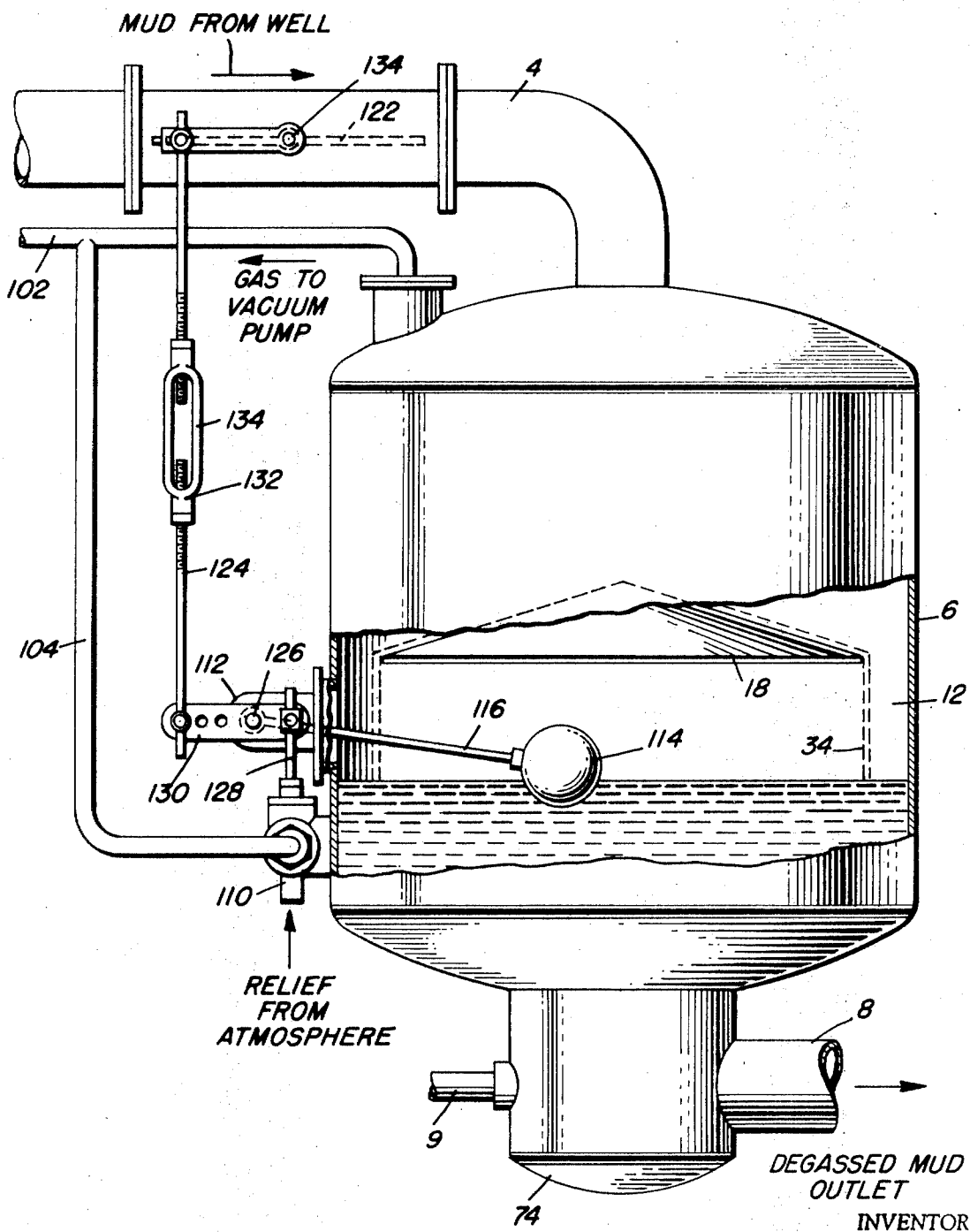
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DRILLING MUD FLOW AND DIVIDER APPARATUS

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5 Sheets-Sheet 5

FIG. 8



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1

3,517,487 DRILLING MUD FLOW AND DIVIDER APPARATUS

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3 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for degasification of drilling mud, including a vacuum tank having baffle means comprised of a stack of vertically spaced baffles with extending surfaces forming truncated cones with openings through the truncated portions and a single gas laden mud delivery means feeding upwardly through said openings. The diameters of the openings decrease in size upwardly through the stack so that a portion of the upflowing mud is blocked and diverted outwardly onto the upper surfaces of certain baffles to flow downwardly over said upper surfaces.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to an apparatus for use in the degasification of drilling mud. More particularly, this invention relates to a vacuum tank containing a new and improved apparatus for dividing the inflow of gas-laden mud into relatively thin layers or films whereby the reduced pressure within the tank effects a removal of entrapped gas from the drilling muds in an efficient and effective manner and further including new and improved assemblies for evacuating degassed mud from the vacuum tank in an efficient and dependable manner and controlling the inflow of mud to the degassing tank.

State of the prior art

Drilling muds are circulated through a well bore and around a drill bit. During a drilling operation of the nature of that associated with the drilling of wells for gas and oil such drilling mud is ordinarily an aqueous suspension of solid material. While this drilling mud performs numerous well-recognized functions such as lubricating and cooling the drill bit and stems and serving as a carrier to withdraw drill cuttings and sand from the well, it is particularly important as a means for providing a pressure in the well bore which prevents the escape of gas from the well.

During the drilling operation, the drill bit penetrates numerous rock formations, some of which contain gas at extremely high pressures. Were it not for the pressure exerted by the column of drilling mud disposed within the well bore, these gasses would enter said bore and cause what is termed in the art as "kicking" or "blow outs." In this manner, the drilling operation may be hampered or, as in the case of "blow outs," serious property damage and personal injury could result.

Quantities of these gasses do, however, escape from the formations and are entrapped within the drilling muds. This entrapped gas results in a decrease in the density of the mud with a corresponding decrease in the pressure effected by the column of mud in the well bore. In addition, the entrapped gas also increases the viscosity of the mud thereby imposing a greater load on the pumping apparatus with resulting increased wear and potential overloading and system failure. It is, therefore, quite important both from the standpoint of safety and production that the entrapped gas within the drilling mud be removed such that the density and viscosity of the

2

mud may be controlled at predetermined levels relative to the anticipated pressures to be encountered during the drilling operation.

While various prior art assemblies employ baffle arrangements within a vacuum tank to spread the drilling mud into relatively thin layers, difficulties have been encountered in providing baffle arrangements within limited areas which provide both sufficient and controlled mud distribution.

As such a mud degassing apparatus is employed at the wellhead as a part of a drilling mud recirculation system, the degassing apparatus handles large quantities of drilling mud in a relatively rapid fashion. If the entire inflow of gas-laden mud is distributed directly to a single plate, or even a single layer of plates, such a degree of turbulence and channelization of the mud occurs that even distribution of the mud over the plates is seriously inhibited, thus decreasing the amount of gas removable by passage of the mud through the tank. In addition, the inability to control the distribution of the gas-laden mud on the baffle arrangement also results in a degree of unpredictability as to the quantity of gas which can be removed. This unpredictability inhibits the controlled replenishment of mud to the system for maintaining the desired pressure head in the well bore.

Additionally, considerable difficulty has been experienced in the art as a result of the problems attendant the evacuation of such vacuum tanks. The prior art assemblies have employed centrifugal pumps in an outlet conduit for evacuation of the vacuum tank. Such systems, however, have encountered numerous problems as a result of pump failure and the difficulty of maintaining the centrifugal pump in a constantly primed condition. As the viscosity of drilling materially increases when that mud is in a standing condition, the failure of an evacuation means can result in the manual evacuation and cleaning of a tank, a costly maintenance operation.

Further problems in the art stem from the lack of control over the inflow of mud to the degassing tank. If the mud evacuation means is unable to remove the mud at a rate, at least equal to the rate of inflow, there is an excessive build-up of mud in the mud receiving area of a tank. Typically, this build-up is inhibited by increasing the pressure in the tank which decreases the pressure differential between the tank and a source of mud. The pressure is increased until the flow is stopped. The pressure is then left at such an increased level until the mud evacuation means reduces the quantity of mud in the receiving area. The pressure is then decreased again in the tank and a surge of mud is driven to the tank. This stoppage of inflow has several detrimental effects. Due to the weight of the mud, such surges can be damaging to the apparatus. In addition, the surges reduce the quantity of gas removed from mud as it is impossible to obtain a desired degree of spreading of such mud into relatively thin layers. Secondly, drilling muds tend to considerably increase in viscosity upon standing, thus continuous flow through a system is highly desirable.

SUMMARY OF THE INVENTION

This invention includes a vacuum tank having a baffle structure or a flow dividing assembly operatively mounted therein and comprised of a vertical stack of spaced baffle plates, each of the plates defining an upper surface inclined relative to the horizontal. The individual plates within the stack further define aligned apertures there-through in communication with the inclined surfaces. The size of the respective apertures decrease in one direction through the stack of plates. An inflow of gas-laden drilling mud is directed through the aligned apertures in the baffle plates in the direction of decreasing aperture

size such that a portion of the mud flow passes through each of the apertures and the remainder is blocked by the respective plates and flows down the inclined surface of said plate in a relatively thin film or layer. Unlike the prior art assemblies, the inflow of mud is distributed throughout the baffle structure as opposed to the conventional method of distributing the gas-laden mud on the uppermost baffle plates for movement down some type of baffle structure. The aperture size may decrease either upwardly or downwardly through the baffle stack.

In addition, this invention includes a new and improved apparatus for the evacuation of a vacuum degassing tank including an ejector assembly comprising an ejector pot on the vacuum tank defining an ejector chamber in communication with the mud receiving area of the vacuum tank. The ejector pot also defines a degassed mud outlet. The ejector assembly further include an ejector means partially positioned in the ejector chamber for ejecting degassed mud under pressure into said ejector chamber and upward the degassed mud outlet. In this manner, mud within the ejector chamber and the mud receiving area of the vacuum tank are drawn therefrom and through the degassed mud outlet.

A degassed mud outlet assembly is operatively coupled to the outlet defined by the ejector pot and includes an outlet conduit and a centrifugal pump. The outlet conduit is operatively coupled to the degassed mud outlet and extends to a desired location such as a degassed mud tank. The centrifugal pump is operatively coupled in the outlet conduit and serves to move mud from that tank to the desired location. The centrifugal pump may be operated in combination with the ejector means such that the ejector means creates a flow into the outlet defined by the ejector pot and thereby maintains the centrifugal pump in a constantly primed condition, thereby efficiently and effectively increasing the flow from the vacuum tank and insuring such flow at all times of operation of the centrifugal pump.

A bypass assembly may be provided between the intake and outlet sides of the centrifugal pump such that the ejector assembly can continue the flow of mud from the vacuum tank upon failure or stoppage of the centrifugal pump. control means is provided between the centrifugal pump and a bypass valve in the bypass assembly for automatic opening of a bypass conduit upon stoppage of the centrifugal pump.

The ejector assembly which includes a pump and an ejector conduit extending between a source of degassed mud and the ejector chamber may also be employed as an auxiliary. The pumping means within the ejecting conduit may be operatively coupled to a power source other than that power source employed by the centrifugal pump with control means extending between said power sources or between the pump or bypass valve such that the ejector pump commences operation upon stoppage of operation of the centrifugal pump. Such a system insures a continued evacuation of the degassing tank.

It is an object of this invention to alleviate the aforementioned difficulties in the art by providing a new and improved apparatus for the degasification of drilling muds for use at a wellhead.

In addition, it is an object of this invention to provide a new and improved baffle arrangement or flow divider for use in a vacuum tank wherein the inflow of gas-laden mud to the tank is effectively and efficiently distributed in a desired manner throughout all or a part of the baffle structure to therefore avoid the problems attendant the disposition of a large quantity of mud on the uppermost baffle layers of a baffle arrangement.

It is a further object of this invention to provide such a baffle arrangement comprised of a plurality of vertically stacked baffle plates, said plates having an inclined upper surface and defining at least one aperture therethrough. The apertures of the respective plates are positioned in aligned relation such that the flow of mud can be directed

therethrough. The size of the respective apertures decreases in one direction through the stack of baffle plates such that a portion of the inflow passes through the apertures and the remainder of the mud flows down the inclined surfaces of the respective plates to fall from the lower edge of said inclined surface in a descending curtain of mud into a mud receiving area at the lower portion of the tank.

It is a further object of this invention to provide such an apparatus to insure the controlled and even distribution of drilling mud throughout the baffle arrangement to thereby increase materially the predictability of the quantities of entrapped gas removable thereby such that controlled replenishment of drilling mud to the recirculation system is facilitated.

It is also an object of this invention to provide such an apparatus whereby the even distribution of drilling mud throughout the baffle arrangement facilitates the formation of relatively thin, even layers or films of gas-laden mud such that the environment of reduced pressure within the tank may operate on the gas-laden mud to remove entrapped gas therefrom in an effective and efficient manner.

As a further object of this invention, I have provided a new and improved tank evacuation assembly for effectively and efficiently evacuating degassed mud from the vacuum tank.

It is also an object of this invention to provide such an evacuation assembly including both a centrifugal pump operatively mounted within an outlet conduit extending from the tank and an ejector assembly positioned in communication with the mud receiving area in the lower portion of the tank for directing a flow of mud into the outlet conduit in such a manner as to draw mud from the mud receiving area into, and to push said mud through, the outlet conduit thereby providing either an auxiliary pumping unit for evacuation of the mud degassing tank, for instance, upon failure of the centrifugal pump or a combination pumping assembly of the pump and ejector whereby the centrifugal pump is maintained in a constantly primed condition to thereby insure the dependability of the system and also to increase its efficiency.

It is also an important object of this invention to provide a dual control on the vacuum degassing tank responsive to a float positioned in the degassed mud within the receiving area of the tank for simultaneously controlling the pressure level in the tank and the mud inflow to the degassing tank whereby the mud flow will be decreased as the pressure is increased responsive to an increase in the quantity of degassed mud in the receiving area, thus the rate of flow of mud to the tank will generally be controlled and continuous.

Other objects and advantages of the novel features of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein embodiments of this invention are set forth by way of illustration and example. It is, however, expressly understood that the drawings are for the purpose of illustration only and are not intended to define the limits of the invention. Further, the drawings merely illustrate preferred embodiments incorporating the features of this invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially schematic view showing a degasification system employing the features of this invention and including a vertical sectional view through the center axis of a degassing tank embodying the features of this invention.

FIG. 2 is a horizontal sectional view taken on line 2—2 of FIG. 1 showing the uppermost baffle plate of the baffle arrangement in plan view.

FIG. 3 is a horizontal sectional view taken on line 3—3 of FIG. 1 showing the ejector pot in plan view and a vortex breaker positioned across said ejector pot.

5

FIG. 4 is a vertical sectional view through the center axis of a degassing tank employing a modified form of the baffle arrangement or flow divider embodying the features of this invention.

FIG. 5 is a vertical sectional view through the center axis of a degassing tank employing a modified form of the baffle arrangement or flow divider embodying the features of this invention.

FIG. 6 is a horizontal sectional view taken on line 6—6 of FIG. 4 showing the baffle arrangement in plan view.

FIG. 7 is a horizontal sectional view taken on line 7—7 of FIG. 5 showing the baffle arrangement in plan view.

FIG. 8 is a side elevational view of a modified form of a degasification system of the nature of that illustrated in FIG. 1 including a dual control for effecting and efficiently controlling the rate of flow of mud to the degassing tank, and including a portion of the degassing tank broken away for viewing of the float in its operative position in the degassed mud of the receiving area.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In reference to FIG. 1, an overall system for use in the degasification of drilling mud is illustrated and designated by the reference numeral 1. It should be recognized, however, that the flow dividing baffle structure can be utilized in other and different degasification systems employing other and different degassed mud evacuation means as well as the fact that the evacuation means illustrated in FIG. 1 can be employed with other and different degassing tanks and baffle structures and within other and different degassing systems.

Basically, the degasification system 1 includes a gas-laden mud tank 2, a degassed mud tank 3, a gas-laden mud inlet conduit 4, and a degassing or vacuum tank 6. The degassed mud tank 3 is operatively coupled to the vacuum tank 6 by a degassed mud outlet assembly 8 which provides a flow passage from the vacuum tank 6 to the tank 3 for degassed mud. The system 1 also includes a gas outlet assembly 10 operatively coupled to the vacuum tank 6 for providing an environment of reduced pressure within the pressure chamber 12 of the degassing tank 6.

The pressure chamber 12 defined by the degassing tank 6 includes an upper portion comprising a baffle structure housing area 14 and a lower portion defining a degassed mud receiving area 16. Within the baffle housing portion 14, a flow dividing baffle assembly or structure 18 is operatively mounted. The baffle structure, as illustrated in FIG. 1, includes a plurality of vertically spaced baffle plates 20, each defining an inclined upper surface 22. In the illustrated embodiment, the inclined upper surfaces 22 of the plates 20 extend through a conical plane each terminating in a lower edge 24, said edge 24 generating a circle, as best illustrated in FIG. 2. The individual baffle plates 20 may be mounted to the interior of the degassing tank 6 by suitable braces, not shown herein.

In order to provide a maximum number of plates within a given volume, the individual baffle plates 20 are conically shaped such that they may be nested with only a minimum of spacing between the plates. The wide spacing between the plates in the illustrated embodiments is merely for simplicity of illustration. A plurality of plates 20 may be disposed between each of those plates 20 illustrated in the figures.

The plates 20 define apertures 26 therethrough, said apertures 26 being disposed in communication with the upper inclined surfaces 22. The apertures 26 of the plates 20 are disposed in vertically aligned relation such that a substantially vertical flow of mud may be directed through the aligned apertures in either an upward or downward direction. The size or area of the apertures 26 decreases in size either upwardly or downwardly of the stack depending upon the direction of flow of the gas-laden mud from the inlet conduit 4. As illustrated in FIG. 1, the size of the apertures 26 decreases downwardly of the stack 18 with

6

the lowermost plate 20 being solid such that the mud passing through the aperture 26 of the overlying plate is distributed over the upper surface 22 of the lowermost plate 20.

In FIG. 4, the situation is reversed with the apertures 26 decreasing in size upwardly through the stack and the inflow of gas-laden mud to the degassing tank being directed upwardly through the baffle stack 18. While it is contemplated that the baffle plates disposed within the stack 18 may take various shapes or forms and the apertures 26 may be located in various positions relative to those plates, it has been found particularly desirable to provide the apertures 26 approximately at the apex of a conically shaped plate as illustrated in FIG. 1. In this manner, maximum distribution of the mud is obtained over a maximum number of plates within a given volume, thereby minimizing the size requirements of the degassing tank while maximizing the distribution of mud within the tank.

In the illustrated embodiment, the apertures 26 have sleeve members 28 mounted therein, each of which defines a through flow bore 30. As illustrated, both the sleeve members 28 and the flow bores 30 decrease in cross sectional area downwardly through the stack 18 such that a portion of the mud flow to a particular baffle plate 20 passes through the flow bore 30 in the respective sleeve member 28 and the remainder is blocked by the upper edges 32 of the sleeve member 28 and/or the upper surface 22 of the respective plate 20, said blocked mud flowing downwardly of the inclined upper surface 22 and falling from the lower edge 24 of the respective plate 20 in a circularly disposed descending curtain of mud 34.

Referring to FIG. 4, a baffle arrangement 42 is illustrated comprised of a plurality of vertically spaced plates 44 each having an aperture 40 therethrough. The baffle plates 44, as illustrated, are shaped like those illustrated in FIG. 1. Like apertures 26, apertures 40 are positioned in aligned relation approximately at the apex of the conical plane defining the upper surface 46 of the plates 44. The inlet conduit 4 extending from the gas-laden mud tank 2 extends through the side of the degassing tank 6 and upwardly through the lowermost baffle plate 44. A sleeve member 48 is positioned through each of the aligned apertures of the overlying baffle plates 44 and defines aligned through flow bores 50 of diminishing cross sectional area upwardly through said baffle stack 42, the bores 50 also being aligned with the flow of the inlet conduit 4. As the sleeve members 48 are spaced apart, openings are defined in the flow passage between each of the plates 44 whereby mud flowing upwardly through the conduit 4 and the lowermost plate partially flows outwardly or laterally through the opening defined between that plate 44 and its overlying plate 44 and flows down the upper surface 46 of the lowermost plate 44. The remainder of the gas-laden mud passes upwardly through the sleeve member 48 of the overlying plate 44, and in this manner throughout the remainder of the stack 42, thereby evenly distributing the mud throughout the various baffle plates 44 within the stack 42.

Another modification of a flow dividing baffle arrangement is illustrated in FIGS. 5 and 7 where a baffle stack designated by the reference numeral 60 is illustrated. The individual plates 62 within the baffle stack 60 are shaped and positioned like the plates 20 in the baffle stack 18. A distinguishing feature between the baffle stack 60 and the baffle stacks 42 and 18 resides in the inseting of the lower edges 64 of the upper surfaces 66 of the respective plates 62 of the baffle stack 60. As best illustrated in FIG. 7, the lower edges 64 define concentric rings. The lower edge 64 of an underlying baffle plate is inset toward the center axis of the tank 6. In this manner, the drilling mud falling from the lower edge 64 of the plates 60 forms a plurality of concentrically disposed, circular, descending curtains of mud as the mud falls from the lower edge 64 into the mud receiving area 16

of the tank 6. While the inseting or the lower edges 64 of the plates 62 reduces somewhat the surface area of distribution of the mud, the mud falls in separate thin curtains from the lower edge 64 and therefore the environment of reduced pressure can act upon the curtains of reduced thickness continuing to extract entrapped gas from the mud as the mud falls into the receiving area 16.

Referring to FIG. 1, the degassing tank 6 may be evacuated by the combined action of the ejector assembly 9 and the outlet assembly 8. The ejector assembly 9 includes an ejector conduit 70 extending from the degassed mud tank 3 to the degassing tank 6 and a centrifugal pump 72 operatively coupled within the ejector conduit 70. The ejector assembly 9 further includes an ejector pot 74 illustrated herein as integral with the degassing tank 6 and positioned beneath the mud receiving area 16. The ejector pot 74 defines an ejector chamber 76 in communication with the mud receiving area 16. The ejector pot 74 further defines a mud outlet 78 through which degassed mud from the ejector chamber 76 and the mud receiving area 16 is evacuated from the tank 6. An end 80 of the ejector conduit 70 terminates within the ejector chamber 76, as illustrated, spaced from and opposite the outlet 78. In this manner, the centrifugal pump 72 drives degassed mud from the degassed mud tank 3 through the conduit 70 and expels or ejects this degassed mud into the ejector chamber 78 in the direction of the outlet conduit 78. The flow of mud from the ejector conduit 70 draws mud from the ejector chamber 78 and ultimately from the mud receiving area 16 into and through the outlet 78 and pushes the mud through the outlet conduit 82 of the outlet assembly 8.

The outlet assembly 8 includes a centrifugal pump 84 operatively coupled in the conduit 82 and a bypass assembly 86 which connects the inlet and outlet sides of the centrifugal pump 84 and is disposed around the pump 84. The bypass assembly 86 includes a bypass conduit 88 and a bypass valve 90. The bypass valve 90 may be operatively coupled by a control circuit 92 of a conventional nature to the centrifugal pump 84 such that the valve 90 will open the bypass conduit 88 upon stoppage of the centrifugal pump 84 and conversely will be closed to close the conduit 88 upon a commencement of operation of the centrifugal pump 84. It is contemplated that the ejector assembly 9 and the outlet assembly 8 will be used in combination such that the ejected mud and the mud drawn by said ejected mud will maintain the centrifugal pump 84 in a constantly and fully primed condition to therefore materially increase the effectiveness of the mud evacuation operation. It is also contemplated that the ejector assembly 9 can, at times or continually, be employed simply as an auxiliary unit for use only upon failure of the centrifugal pump 84 in the outlet assembly 8. In this instance, a control circuit 94 of a conventional nature can be utilized for connecting either the centrifugal pump 84 or the bypass valve 90 to the motor 96 of the centrifugal pump 72 to commence the operation of the ejector assembly 9 upon failure of the centrifugal pump 84 and conversely to stop the operation of the ejector assembly 9 upon commencement of the operation of the centrifugal pump 84. Thus, the danger of allowing the mud to sit in the vacuum tank for an appreciable period of time is alleviated.

The gas outlet assembly 10 illustrated herein is comprised of a reciprocating vacuum pump 100 operatively coupled to the pressure chamber 12 of the tank 6 by a gas outlet conduit 102. A pair of venting conduits 104 and 106 are operatively coupled to the conduit 102. A manual relief valve 108 is operatively coupled in conduit 106 for venting the vacuum pump 100 to the atmosphere when desired. A relief valve 110 is operatively coupled in the venting conduit 104 and is operatively connected to a float valve actuator 112 in a conventional manner. The actuator 112 includes a float 114 mounted on an arm

116 and positioned within the mud receiving area 16 of the pressure chamber 12. The float 114 moves with the level of degassed mud within the receiving area 16 and the actuator 112 is set responsively to the arcuate movement of the arm 116 to open and close valve 110 to vent pump 100 to the atmosphere when the level within the mud receiving area 16 reaches a predetermined point. By venting the vacuum pump 100 to the atmosphere, the pressure is increased within the pressure chamber 12 and thereby the flow of mud to the inlet conduit 4 is decreased or stopped depending upon the amount of venting employed. Once the evacuation means has evacuated a sufficient quantity of the degassed mud to lower the level of mud within the receiving area 16 to a second lower predetermined point, the actuator 112 closes the valve 110 causing the vacuum pump 100 to draw from the pressure chamber 12, reducing the pressure within chamber 12 and increasing or starting the flow of gas-laden mud through the inlet conduit 4.

Referring to FIG. 8 a modified form of the degassing system is illustrated including a dual control assembly for effectively and efficiently controlling the rate of inflow of mud to the degassing tank 6. The dual control assembly is basically comprised of an elliptical valve 122 operatively mounted within inlet conduit 4 extending between the gas-laden mud tank 2 and the degassing tank 6, the float valve actuator 112 and the relief valve 110 along with a linkage assembly 124 connecting the actuator 112 to the elliptical valve 122.

As previously discussed, the relief valve 110 is operatively mounted in the vent conduit 104 and is selectively operable to gradually open said conduit 104 to the atmosphere to effectively vent the gas outlet conduit 102 when the level of degassed mud in the degassed mud receiving area 16 of the degassing tank 6 rises. The float 114 mounted on arm 116 is swung through an arc defined by the level of mud in the receiving area 16 and about a pivot 126. The arm 116 is operatively connected to the valve stem 128 of the relief valve 110 and moves the valve stem 128 gradually to open and close the relief valve 110 responsively to the mud level. This gradual opening and closing increases and decreases respectively the amount of venting of the gas outlet conduit effected through the relief valve 110.

As illustrated in FIG. 8, the valve stem 128 is connected to a linkage arm 130 which is also mounted on the pivot 126. As the valve stem 128 is operatively connected to one end of the linkage arm 130 and an adjustable linkage 132 is mounted at the opposite end of the linkage arm 130 and is also operatively connected to the elliptical valve 122, the movement of the valve stem 128 by float arm 116 also effects a movement of the adjustable linkage 132 and the elliptical valve 122.

As illustrated in FIG. 8, the elliptical valve 122 is positioned in a neutral setting. As the level of degassed mud rises in the mud receiving area 16, the float arm 116 will raise the valve stem 128 and the linkage arm 130 will swing about pivot 126 pulling the adjustable linkage 132 downwardly and swinging the elliptical valve 122 about pivot 134 to decrease the size of the flow opening through the inlet conduit 4. As the linkage 132 is provided with a turnbuckle 134, it is possible to adjust the length of linkage 132 and thereby vary the relative setting of the elliptical valve 122 and the valve stem 128. In this manner any relative condition of control between the size of the flow opening and pressure level in tank 6 can be effected.

In operation, the gas-laden mud is drawn from the gas-laden mud tank 2 to the conduit 4 by the vacuum exerted in the pressure chamber 12 of the tank 6 by the vacuum pump 100. The gas-laden mud entering the chamber 12 through the conduit 4 is partially distributed over the upper surface 22 of the uppermost plate 20 in the baffle stack 18 with the remainder of the mud flowing

through the flow bore 30 in the sleeve member 28 of the uppermost plate 20. The portion of the flow extending through the uppermost plate 20 is partially blocked and distributed to the upper surface 22 of the underlying plate 20 with the remainder of the flow extending through the flow bore 30 in the sleeve member 28 of that underlying plate and thence downwardly through the stack of baffles 18 in a similar manner dividing a portion of the flow at each plate 20 within the stack 18. The lowermost plate in the stack is solid, in the illustrated embodiment, and receives all of the flow through the flow bore 30 of its overlying plate 20.

The gas-laden mud flowing over the upper surfaces 22 of each of the plates 20 in the baffle stack 18 falls from the lower edges 24 of the plates 20 in descending curtains 34 into the mud receiving area 16. As the gas-laden mud is distributed over the upper surfaces 24 and is falling in descending curtains 34 the environment of reduced pressure within the chamber 12 effectively and efficiently removes the entrapped gas from the drilling mud and evacuates the gas from the chamber 12 through the gas outlet conduit 102.

The embodiment of this invention illustrated in FIG. 4 provides a similar operation. The mud flow, however, is directed upwardly through the respective apertures 40 or flow bores 50 associated with each of the individual plates 44 of the stack 42. As the sleeve members 48 are vertically spaced from adjacent sleeve members 48, there is an opening provided which effects a reduced pressure at the outside of the flow. This reduced pressure combined with the overlying sleeve member 48 being a smaller size and thus blocking the outer portion of the flow, causes a portion of the mud to be expelled laterally from the flow and onto the upper surface 46 of the respective plates 44 in the stack 42. This mud flows downwardly of these upper surfaces and eventually into the mud receiving area 16 in the same manner as that previously described in relation to the baffle stack 18.

The additional embodiment illustrated in FIG. 5 operates in the same manner as that illustrated in FIG. 1 with the exception that the lower edges of the individual plates 62 within the stack 60 are inset downwardly of the stack 60 such that the mud falling from the lower edges 64 of the respective plates 62 falls in a pattern of concentric, circular, descending curtains into the receiving area 16.

The mud from the mud receiving area 16 is evacuated from the degassing tank 6 by either the combined action of the ejector assembly 9 and the outlet assembly 8 or by either of these assemblies 8 or 9 operating alone. It is preferred to operate these assemblies in combination in order to provide an efficient and effective evacuation of the mud. The mud level within the receiving area 16 is controlled through the float valve actuator 112 and relief valve 110 in the manner previously described.

The embodiment illustrated in FIG. 8 provides a dual control for selectively regulating the rate of mud inflow to the degassing tank 6 relative to the pressure level within the degassing tank 6 and the level of mud in the receiving area 16 to thereby maintain a steady, controlled rate of flow of gas-laden and degassed mud to and from the degassing tank respectively. Such a system will effectively reduce surges of gas-laden mud through the gas inlet conduit 4 as the flow to the gas tank is not often shut down completely and started again, rather the flow is decreased and increased selectively relative to the amount of degassed mud in the receiving area 16.

As the mud in the receiving area 16 rises, the float arm 116 swings about the pivot 126 and gradually lifts the valve stem 128, thereby gradually opening the relief valve 110 to increase the size of the venting opening to provide a venting of the gas outlet conduit 102. This venting of the conduit 102 causes an increase in pressure within the degassing tank 6 thereby decreasing the pressure differen-

tial between the degassing tank 6 and the gas-laden mud tank 2 effectively reducing the flow of mud through the inlet conduit 4. As valve stem 128 is raised, the elliptical valve 122 in the inlet conduit 4 is swung, by means of the adjustable linkage 132 and the linkage arm 130, gradually through an arc defined by the movement of stem 128 to partially close the inlet conduit 4. In this manner, as the pressure differential between the tanks 6 and 2 decreases, the size of the opening through the conduit 4 is decreased thereby allowing a continuous flow of mud through the conduit 4 to the tank 6 while reducing the quantity of flow to such a degree that the degassed mud outlet assembly 8 can effectively handle the degassed mud and reduce the level of degassed mud in the receiving area 16.

As the level of mud in the receiving area 16 is lowered, the venting is decreased and the size of the flow opening through conduit 4 is increased to gradually increase the flow of mud to the tank 6.

It is to be understood that the forms of the invention herein shown and described are to be taken as preferred examples of the invention and various changes and modifications in the arrangement of parts and the interconnection of components may be resorted to without departing from the spirit of the invention or the scope of the appended claims. All such variations and modifications which come within the spirit and scope of the appended claims are intended to be included herein as fully and completely as if they had been specifically illustrated, described, and claimed. Thus, the modifications specifically disclosed are exemplary only and are not intended to be limiting on the scope of the invention. The scope of the invention is defined by the following claims.

What is claimed is:

1. An apparatus for the degasification of drilling muds comprising:

- (a) a tank;
- (b) means coupled to said tank for drawing a vacuum in said tank;
- (c) baffle means operatively mounted in said tank, said baffle means being comprised of a stack of vertically spaced baffles, each of said baffles including an outwardly and downwardly extending upper surface forming a truncated cone, each of said baffles defining an opening through the truncated portion thereof in communication with said conical upper surfaces, said openings being axially aligned;
- (d) gas laden mud supply means operatively associated with said baffle means for supplying a flow of drilling mud upwardly through said openings, said gas laden mud supply means including only a single gas laden mud delivery line, said line extending upwardly through the lowermost baffle in substantially aligned relation to said openings; and
- (e) a plurality of means adjacent and above certain of said baffles respectively for blocking and diverting a portion of said mud from its upward flow to a downward flow across the upper surface of the respective baffles, such that mud is forced upwardly through said openings and is in part respectively diverted onto the upper surface of certain of said baffles for flow downwardly over the upper surfaces of the respective baffles.

2. An apparatus as recited in claim 1 wherein said blocking and diverting means is defined by said baffles, certain of said baffles including a plurality of sleeve members mounted respectively in vertically spaced relation, said sleeve members defining said axially aligned openings in the form of through bores, said bores having diameters of decreasing size upwardly through said baffle stack.

3. An apparatus as recited in claim 1 wherein said blocking and diverting means is comprised of the portion of the overlying baffles adjacent said openings, said openings being of decreasing size upwardly through said stack

whereby only a portion of the mud passing through the aperture of an underlying baffle is passed through the overlying baffle.

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5

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