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G. E. BURNHAM, SR., ET AL

3,362,136

APPARATUS FOR DEGASSING FLUIDS

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2 Sheets-Sheet 1

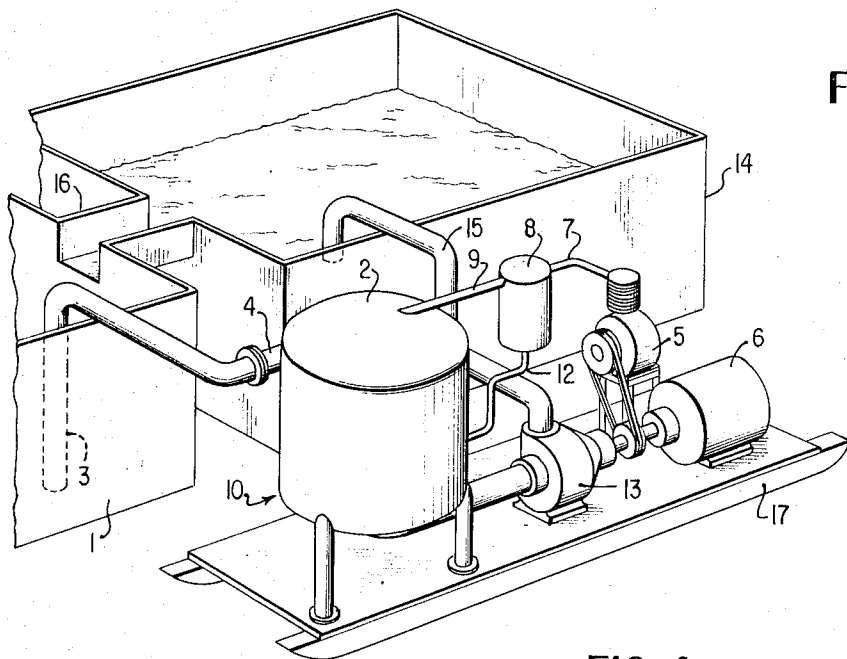


FIG. 1

FIG. 4

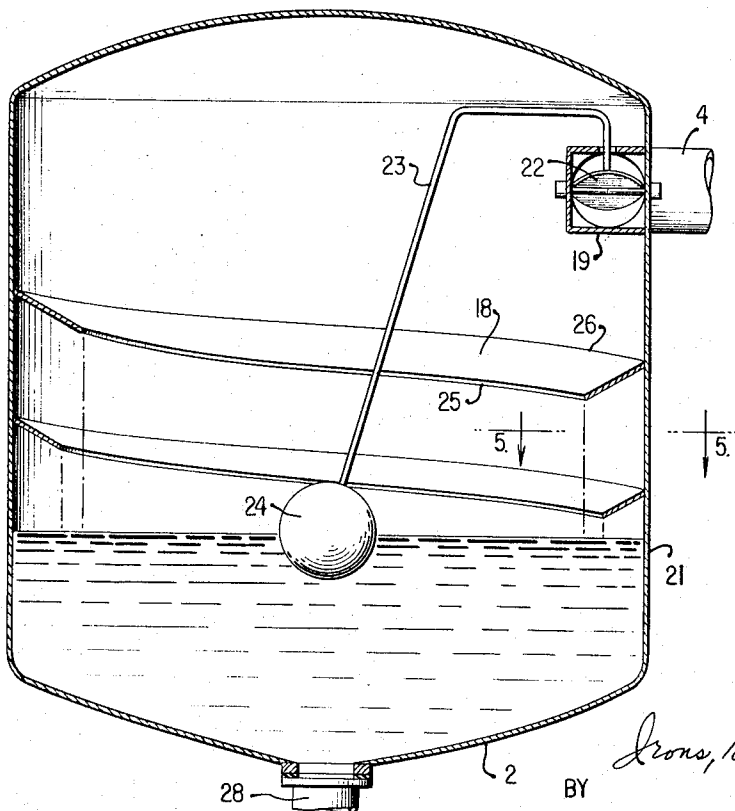
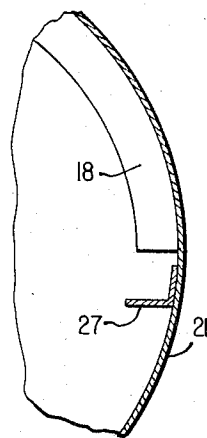


FIG. 5



INVENTORS.
GERALD E. BURNHAM, SR.
VERGNE E. SMITH

Irons, Bick, Swindler & McKee

ATTORNEYS.

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FIG. 2

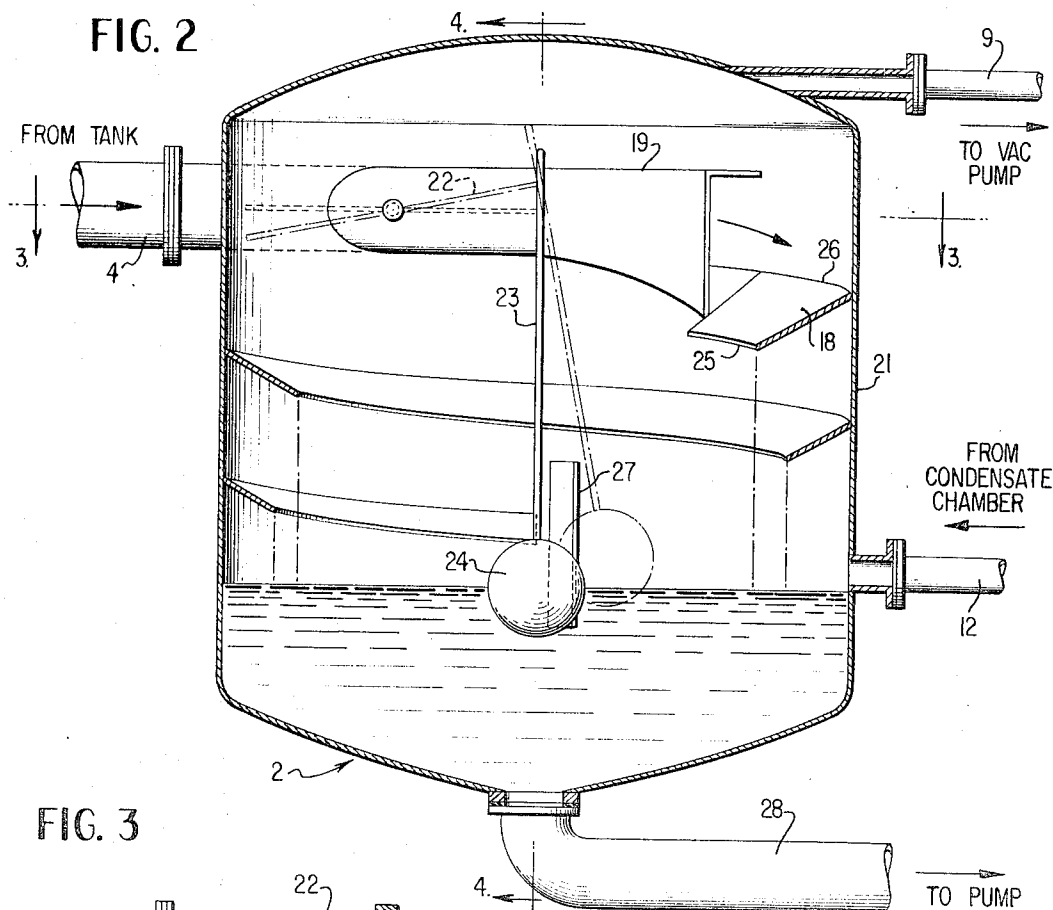
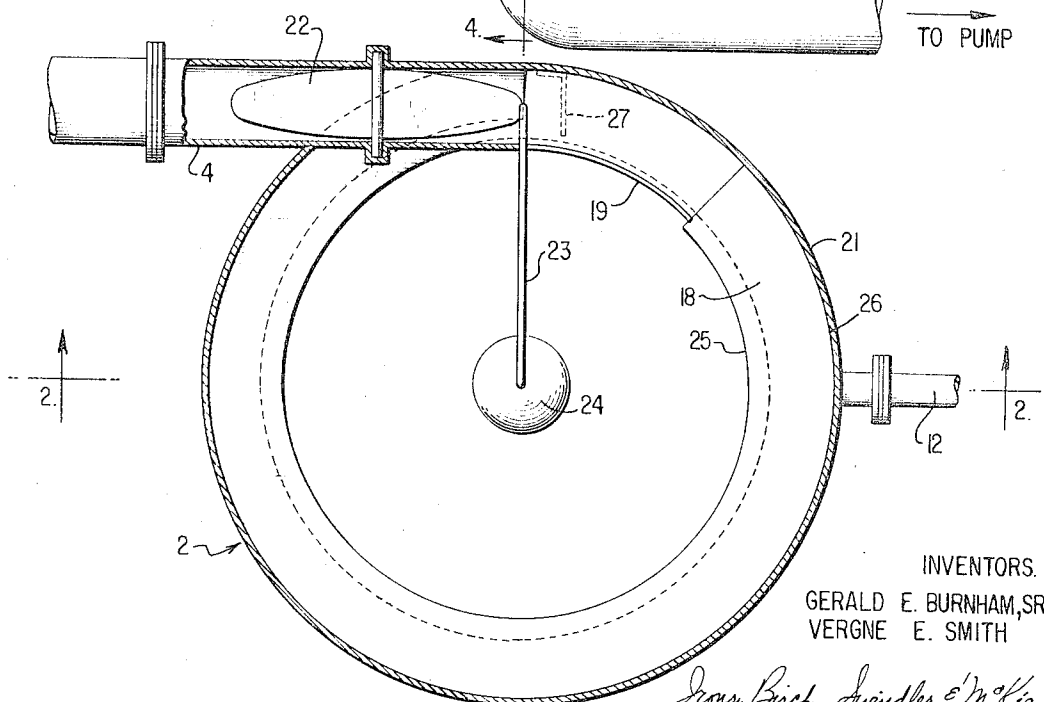


FIG. 3



INVENTORS.
GERALD E. BURNHAM, SR.
VERGNE E. SMITH

BY *Dons, Birch, Swindler, & McKee*
ATTORNEYS.

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APPARATUS FOR DEGASSING FLUIDS
Gerald E. Burnham, Sr., and Vergne E. Smith, Lafayette,
La., assignors to Fluid Control, Inc., Lafayette, La.,
a corporation of Louisiana

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ABSTRACT OF THE DISCLOSURE

Oil well drilling mud degassing apparatus with a tangential feed conduit for delivering mud through a float-controlled elliptical valve onto a helical shelf. The shelf grows progressively narrower as it follows its spiral, downward path around the inside wall of the vacuum tank to which it is affixed. The inside edge of the shelf is downwardly inclined at least 30° from horizontal to cause part of the mud to fall in a continuous curtain from said inside edge as the remainder of the mud progresses down the helical path to an upright, vortex-breaking, deflector plate. Separated gases pass through a mist eliminator to a vacuum pump for discharge to atmosphere.

This invention relates to apparatus for degassing fluids, and particularly to degassing apparatus which forms the fluid into a thin curtain which is subjected to a vacuum to remove the gas.

The problem of degassing fluids exists in many industries. For example, in the oil or gas well drilling industry, drilling mud frequently becomes contaminated in the well with natural gas or air. When the mud emerges from the well, the gas must be removed before the mud is recirculated into the well. Otherwise the gas decreases the weight and viscosity of the mud which will seriously diminish its effectiveness in preventing blowouts.

Many prior art degassing devices utilize vacuum tanks containing various structures for spreading out or breaking up the mud or other fluid to increase the exposure to the vacuum. In general, these structures have not been entirely satisfactory. Some have been complicated with a number of moving parts which are subject to mechanical failure and clogging. Many of the prior art devices must be cleaned by auxiliary equipment when they are shut down for any appreciable time. If the degassing tank is not immediately cleaned after shutdown, the mud becomes hard requiring a major operation to remove it. Because of these cleaning problems, expensive special cleaning jets and apparatus are usually built into the tank adding greatly to both initial and operating expense.

To overcome prior art shortcomings, it is a primary object of this invention to provide a highly effective self-cleaning degassing device which is simple and inexpensive and contains a minimum of moving parts.

It is a further object of this invention to provide such a device which is particularly effective in degassing oil or gas well drilling mud.

These objects and others hereinafter appearing are attained by the present invention which generally relates to a degassing system for fluids which comprises in combination a vacuum tank, means for connecting said tank to a source of vacuum, an elongated guideway within said tank having sides and extending along a line, said line being inclined from the horizontal such that the fluid to be degassed will flow down the guideway by gravity, said guideway being inclined transversely of said line such that a portion of the fluid flowing down the guideway will flow in a thin curtain off one of said sides of said guideway allowing the vacuum in the tank to remove the gas from the falling fluid.

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In a preferred embodiment of the invention, the fluid is introduced into the tank by a tangential flume and is discharged onto the guideway which is in the form of a helical shelf affixed to the inner side of the wall of the vacuum tank. Where the helical guideway has more than one turn, it preferably becomes progressively narrower from top to bottom to prevent interference between fluid falling off of successive turns.

The invention having been generally described, a specific embodiment will be set forth in the accompanying drawings in which:

FIGURE 1 is an isometric view of the novel degassing system mounted in operating condition relative to a pair of mud tanks;

FIGURE 2 is a cross-section taken through the vacuum tank;

FIGURE 3 is a horizontal section taken substantially on line 3—3 of FIGURE 2;

FIGURE 4 is a vertical section taken substantially on line 4—4 of FIGURE 2; and

FIGURE 5 is a detailed horizontal section taken substantially on line 5—5 of FIGURE 4.

FIGURE 1 shows a degasification system 10 which includes a fluid tight vacuum tank 2 connected by a conduit having an inlet 3 in a first mud tank 1 which is a part of the mud system of a standard drilling rig. In the vacuum tank, the mud is degassed in a manner described in detail hereinafter. The vacuum is maintained in the tank 2 by vacuum pump 5 driven by motor 6 which may be an electric or internal combustion engine. Preferably, the motor 6 is independent of the prime mover of the drilling rig. The vacuum pump 5 is connected to the vacuum tank 2 by line 7, mist eliminator 8 and outlet line 9. The mist eliminator 8 is conventional and its purpose is to condense any stray liquid that is entrained by the gas removed from the mud in vacuum tank 2. Condensate from the mist eliminator 8 is returned by line 12 to the bottom of vacuum tank 2. There may be a check valve in line 12 to allow flow only from mist eliminator 8 to the tank 2 and preventing flow in the opposite direction. The degassed mud after passing through the vacuum tank 2 is pumped by mud pump 13 also driven by motor 6 through output line 15 into a second mud tank 14. The first mud tank 1 and second mud tank 14 are connected independently of the degasification system by mud trough 16 in the conventional manner. The entire degasification system 10 is mounted on skid 17 so as to be readily movable.

The specific construction of the degassing tank 2 is best seen in FIGURES 2 through 5. The vacuum tank 2 is in the shape of a vertical cylinder and is sealed against inflow or outflow of fluids except through desired passages. The mud from mud tank 1 is introduced into vacuum tank 2 through circular inlet conduit 4. The mud to be degassed is deposited by tangential flume 19 on the top of a guideway 18, which lies along a curved longitudinal line which line is in the general form of a helix. The flow of mud through the conduit 4 is controlled by elliptical valve 22, best seen in FIGURE 3. The elliptical valve 22 is pivotally mounted in the conduit 4 and is rigidly connected by arm 23 to float 24. Float 24 moves in response to changes in the liquid level at the bottom of the tank 2. The float therefore limits the mud inflow through conduit 4 according to the rate at which mud is removed from the tank. With the control valve located in the mud inlet line, rather than in the vacuum line, the mud flow may be cut off while vacuum is still applied inside the tank.

The helical guideway 18 preferably is a flat shelf having an inner edge 25 and an outer edge 26. The outer edge 26 is affixed to the side wall 21 of the vacuum tank 2 by welding or any other appropriate connection. The guide-

way 18 is inclined both longitudinally (circumferentially) and transverse to its longitudinal path (radially) so that the mud flowing down the guideway will fall in a continuous thin curtain off the inner edge 25. In the particular embodiment shown, the guideway has a pitch of twelve inches per turn with a tank five feet in diameter. The radial inclination of the guideway is at least 30° from the horizontal. It has been found that these inclinations are satisfactory in the degassing of most drilling muds. It will be understood that these specific inclinations may vary depending upon many factors such as the viscosity of the fluid being degassed and the velocity at which it is introduced onto the guideway.

The inclination of the helical guideway 18 transverse to its longitudinal (circumferential) dimension must be selected so as to counteract the action of centrifugal force tending to move the mud flowing down the guideway against the outer wall 21 of the vacuum tank 2. In addition, the inclination must be sufficiently greater than the inclination necessary to balance the centrifugal force so that some of the mud will fall as a continuous curtain from the inner side 25.

As the mud falls in a continuous curtain off the inner edge 25 of the helical guideway 18, the vacuum maintained in the tank through line 9 will remove gas trapped in the mud. In order to prevent interference between fluid falling off of successive turns of the helical guideway 18, the guideway is made progressively narrower from top to bottom. Thus, the inside diameter of the helical shelf becomes progressively greater. Preferably, all of the mud will have been discharged from the helical guideway at about the time the flow of mud reaches the bottom of the guideway. However, any mud which is discharged longitudinally from the bottom of the guideway will strike upright deflector plate 27 and fall directly to the bottom of the tank. The deflector plate 27 is aligned with the end of the guideway 26 and prevents formation of a vortex by mud leaving the end of the guideway.

The mud collected in the bottom of the tank is removed from the tank through outlet pipe 28 by the pump 13. The gas removed from the mud is ejected through outlet 9 and is passed through mist eliminator 8 as described previously.

Mist eliminator 8 is of standard construction and is therefore not shown in detail. Mist eliminator 8 is placed at the level of the top of the vacuum tank 2 so that the condensate from the mist eliminator may flow by gravity back into the vacuum tank 2 through condensate line 12. Preferably, a check valve is located in the condensate line 12 to limit flow to the direction toward the tank 2.

In operation, mud is forced from mud tank 1 through line 4 by the differential pressure of the atmosphere acting on the surface of the mud in tank 1 and the vacuum in the vacuum tank 2. The mud passes through the elliptical control valve 22 and flume 19 and is discharged onto the helical guideway 18. A portion of the mud falls in a continuous curtain off the inner edge 25 as the mud moves down the guideway. The gas is removed from the falling curtain of mud by the vacuum produced in the tank by the vacuum pump 5 acting through line 9. The removed gas passes out of the tank through line 9, through the mist eliminator 8, and is exhausted to the atmosphere or otherwise disposed of by vacuum pump 5. The degasified mud is drawn from the bottom of the tank 2 through outlet 28 by pump 13 and pumped into the second mud tank 14. If the degasification system for any reason should be shutdown, the mud in the tank will continue to flow down the guideway and out the outlet 28, thus making the tank self-cleaning.

It should be noted that inside the tank 2 there are no moving parts other than the simple valve 22. The degasification is highly efficient since the application of vacuum to the thin falling curtain of mud lowers the pressure of the mud and will enable all or nearly all of the gas to escape.

It is of course possible to make the guideway 18 in a configuration other than a true helix. For example, it would be possible to vary the pitch of the helix from one turn to the next, and to vary the inclination of the guideway 18 to match the pitch.

Moreover, while the invention has been described with reference to a preferred specific embodiment, many other modifications may be made by persons skilled in the art without departing from the scope of the invention which is defined solely by the appended claims.

What is claimed is:

1. In a degasification system for fluids, the combination which comprises:

a vacuum tank,

means for connecting said tank to a source of vacuum, a single, continuous guideway within said tank having sides and extending along a line,

said line being generally in the shape of an upright helix,

the pitch of said helix being such that the fluid to be degassed will flow down the guideway by gravity,

said guideway being inclined transverse to said line toward the axis of said helix such that a portion of the fluid flowing down the guideway will flow in a thin curtain off the inner side of said helix, and wherein said helix extends longer than one complete turn, and the width of the guideway at any point below the uppermost turn is less than the width of the guideway vertically above that point on the preceding turn of the helix so that the discharge from each turn above the lowermost turn will not interfere with that portion of the fluid being discharged from the next lower turn.

2. The combination of claim 1 wherein the width of said guideway is gradually decreased from its top to its bottom.

3. The combination of claim 2 further comprising an upright deflector plate mounted in the path of the fluid being discharged from the bottom of said guideway.

4. A combination of claim 2 wherein said tank has a gas discharge conduit and a mist eliminator connected to said conduit, said mist eliminator having a condensate return connection to said tank, said mist eliminator being positioned above the level of the liquid in said tank so that the condensate will return to the tank by gravity.

5. In a drilling mud degassing system the combination which comprises:

a cylindrical tank having a vertical axis,

means to connect said tank to a vacuum pump,

a continuous helical mud guideway mounted in said tank with its outer edge engaging the interior of the wall of said tank,

means for introducing said drilling mud into said tank and depositing the mud onto the top of said guideway,

said means for introducing including a circular inlet conduit and an elliptical valve in said conduit controlled by a float within the vacuum tank,

means rigidly connecting said float to said valve, and said guideway having an inner edge sufficiently lower than said outer edge so that a portion of the drilling mud flowing down the guideway will freely fall from said inner edge toward the bottom of said tank so that exposure of said falling curtain of mud to the vacuum will effect removal of gas from the mud.

6. In a degasification system for well bore fluids and the like, the combination comprising:

(a) a vertically positioned tank;

(b) said tank having openings at its upper and lower ends for receiving and discharging well bore fluids;

(c) vacuum means mounted with said tank;

(d) said opening at the upper end of said tank being positioned tangentially relative to said tank;

(e) a single, continuous spiral shelf having two edges, said first edge being secured with the inner surface

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- of said tank, and said second edge being positioned below said first edge;
- (f) said shelf extending from adjacent said opening at the upper end of said tank to adjacent said opening in the lower end of said tank wherein fluids enter tangentially into and relative to said tank to thereby follow the path of said spiral shelf until gravity urges the fluid over said second edge of said shelf to thereby cause the fluid to fall to the bottom of said tank whereby the fluids are removed through said opening in the lower end of said tank and vapors are released from the falling fluid to be removed by said vacuum means; and
- (g) said spiral shelf decreases in width from adjacent said opening in the upper end of said tank to adjacent said opening in the lower end of said tank.
7. The structure as set forth in claim 6 including:
- (a) a float member positioned in said tank and floating on the fluid in said tank;
- (b) an elliptical closure member pivotally mounted in said tangential opening in the upper end of said tank; and
- (c) an arm mounted between said float member and said elliptical closure member wherein a rise in fluid level in said tank thereby causes said float member to rise which causes said elliptical closure member to close said opening in the upper end of said tank and wherein said vacuum means is unaffected by rising fluid level in said tank.
8. In a drilling mud degassing system, the combination which comprises:
- (a) a cylindrical tank having a vertical axis;
- (b) means to connect said tank to a vacuum pump;
- (c) a continuous helical mud guideway mounted in said tank with its outer edge engaging the interior of the wall of said tank;

- (d) said helical guideway extending further than a single turn, wherein successive portions of said guideway below the uppermost turn are narrower than the respective portions of the guideway located vertically above each said successive portion to prevent interference between portions of the fluid being discharged from successive turns;
- (e) means for introducing said drilling mud into said tank and depositing the mud onto the top of said guideway; and
- (f) said guideway having an inner edge sufficiently lower than said outer edge so that a portion of the drilling mud flowing down the guideway will freely fall from said inner edge toward the bottom of said tank so that exposure of said falling curtain of mud to the vacuum will effect removal of gas from the mud.

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SAMIH N. ZAHARNA, *Primary Examiner*.REUBEN FRIEDMAN, *Examiner*.R. BURKS, *Assistant Examiner*.