

June 20, 1967

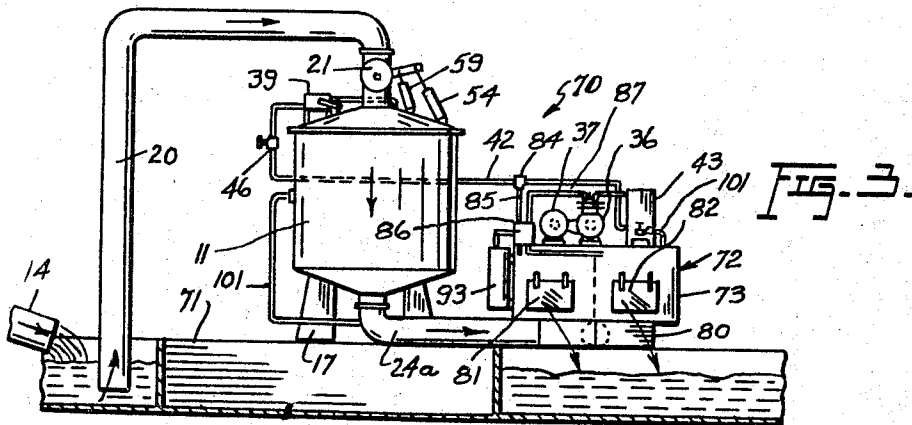
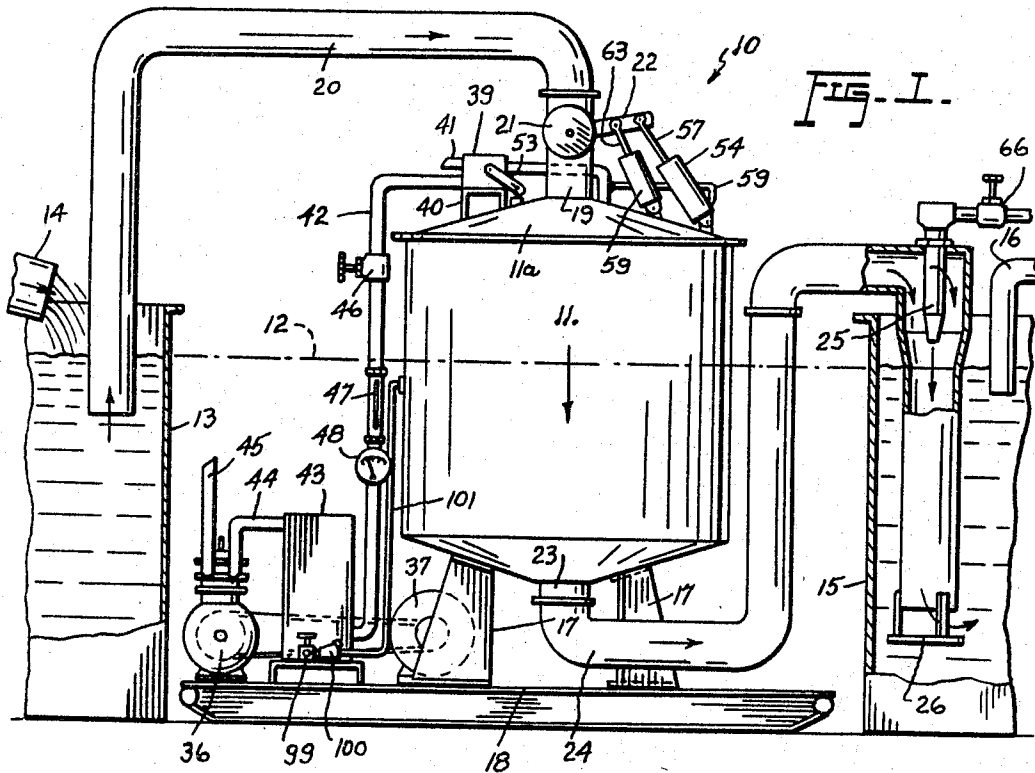
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3,325,974

DRILLING MUD DEGASSERS FOR OIL WELLS

Original Filed Sept. 11, 1963

4 Sheets-Sheet 1



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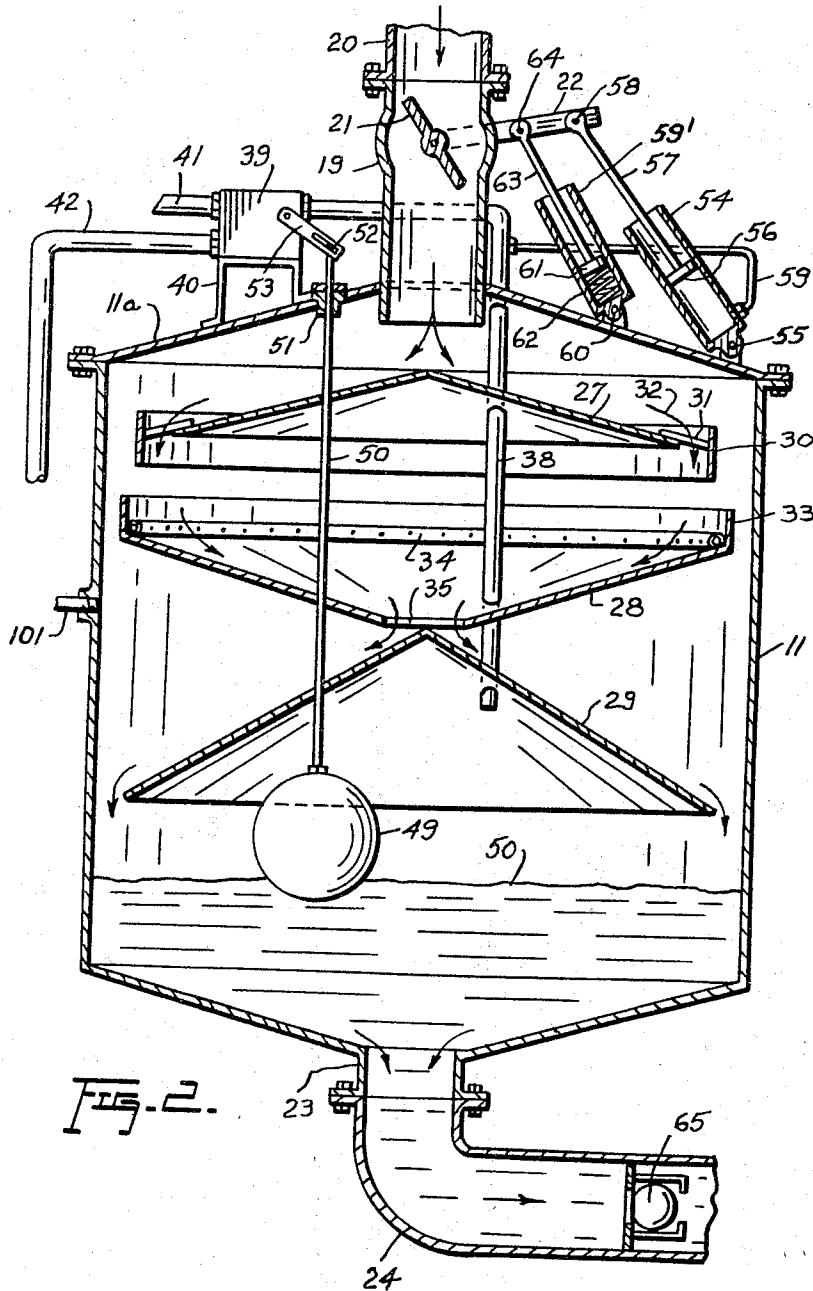
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

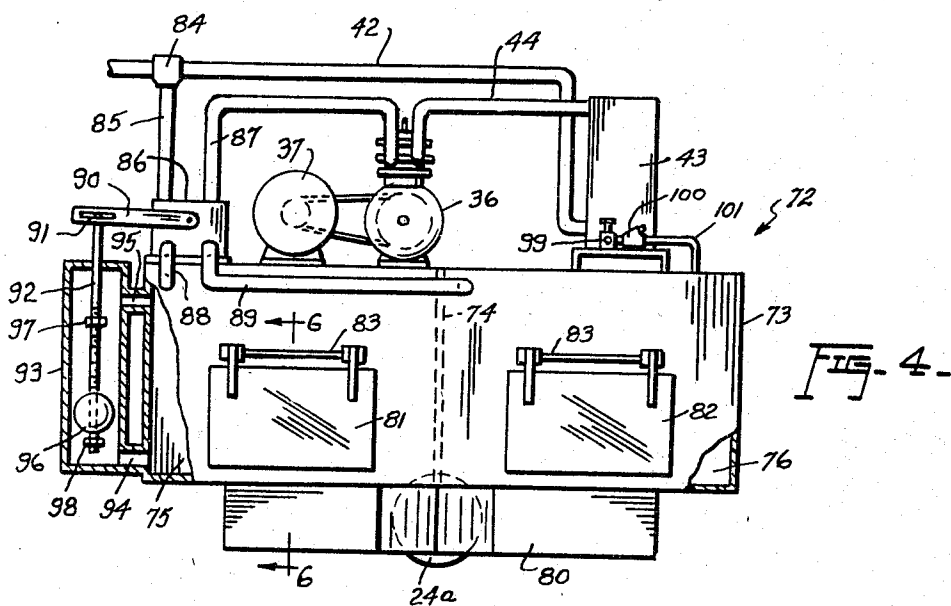


FIG. 4.

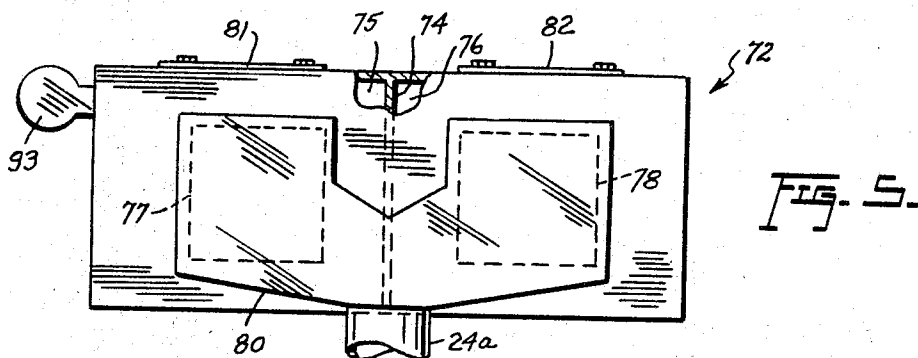


FIG. 5.

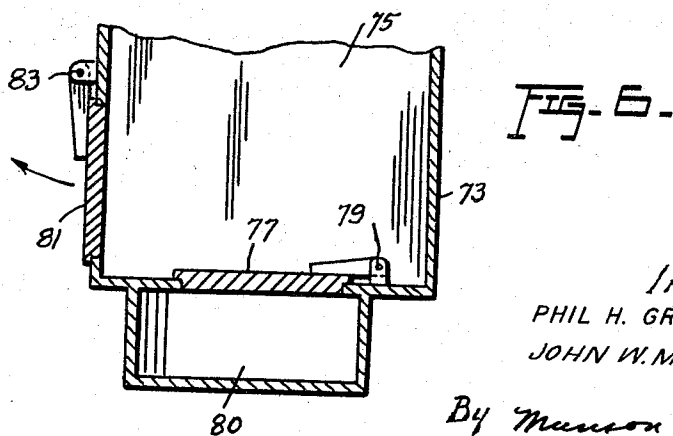


FIG. 6.

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4 Sheets-Sheet 4

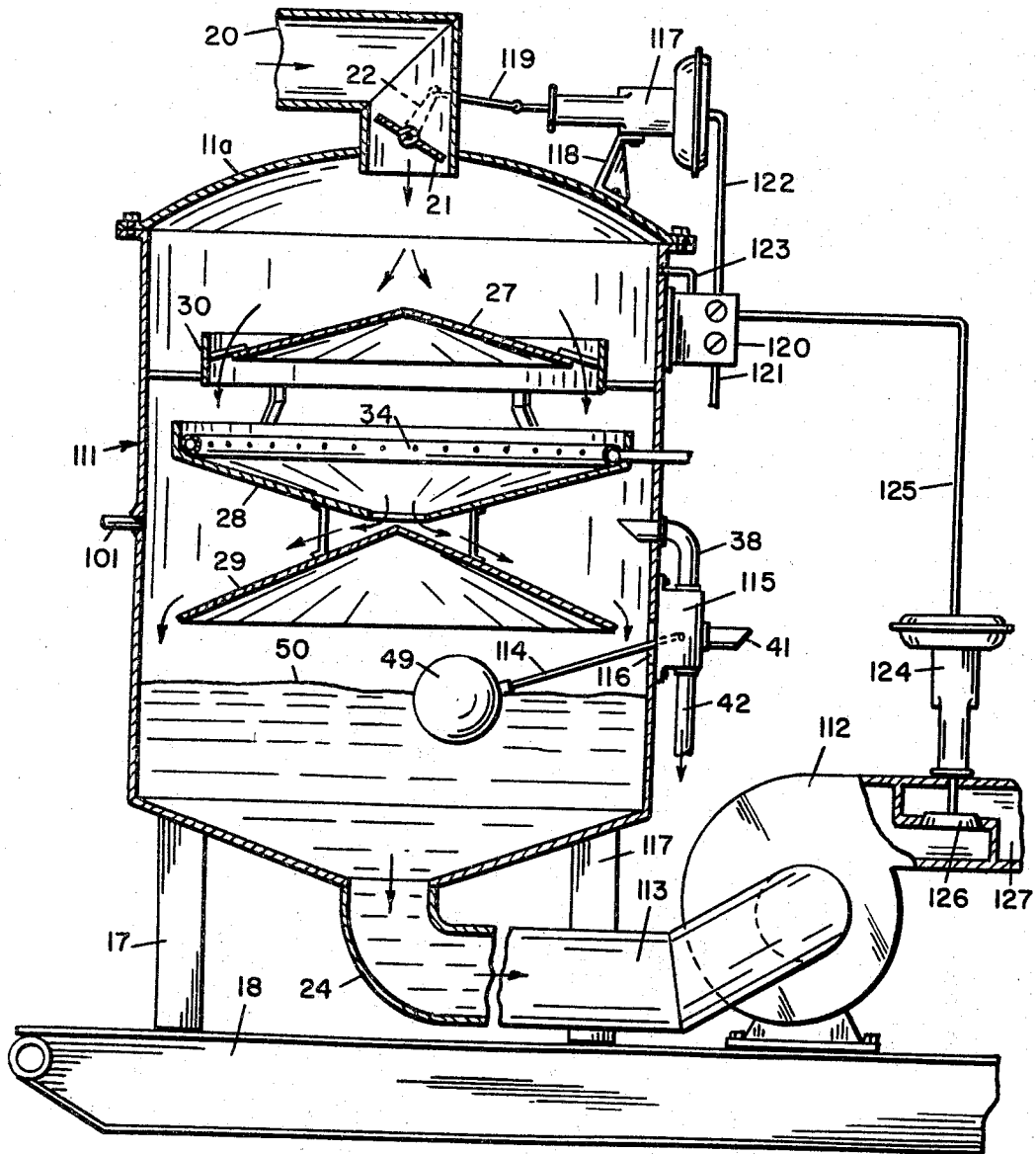


FIG. 7.

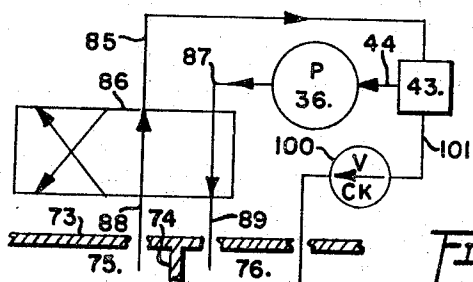


FIG. 8.

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3,325,974

DRILLING MUD DEGASSERS FOR OIL WELLS

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Original application Sept. 11, 1963, Ser. No. 308,314, now Patent No. 3,241,295, dated Mar. 22, 1966. Divided and this application Sept. 7, 1965, Ser. No. 485,173

10 Claims. (Cl. 55-167)

The present application is a division of our application Ser. No. 308,314, now Patent No. 3,241,295, filed Sept. 11, 1963, which in turn is a continuation-in-part of our earlier applications Ser. No. 37,685, filed June 21, 1960, and Ser. No. 299,317, filed Aug. 1, 1963, both now abandoned.

This invention relates to new and useful improvements in drilling mud degassers for oil wells of the general type disclosed, for example, in U.S. Patents No. 2,784,884 dated June 5, 1956, and No. 2,869,673 dated Jan. 20, 1959, to R. W. Erwin.

The degassers disclosed in those patents are mounted above the level of mud in the mud trough, and an object of the present invention is to facilitate positioning of the degasser either beside or below as well as above the mud level, as is best suited for particular operating conditions.

A feature of the invention resides in the provision of means comprising an automatically controlled and actuated inlet valve for controlling the level of mud in the degasser tank, so that even if the tank is disposed at or below the level of mud in the trough, it is positively safeguarded against flooding. This feature is covered by our Patent No. 3,241,295 referred to above.

Another feature of the invention involves a novel structural arrangement of the degasser tank per se, the same being vertically rather than horizontally disposed and containing a set of vertically spaced baffles over which the mud flows in a cascading manner to facilitate and expedite degassing thereof. This feature may be used independently of the other features herein set forth.

Another feature of the present invention, contemplated by a modified embodiment thereof, resides in the provision of mechanical vacuum actuated pump means of a novel construction, for causing the flow of mud through the degasser tank, as distinguished from the jet type propelling means disclosed in the aforementioned patents.

Another feature of the invention, contemplated by another modified embodiment, make possible the use of a mechanical pump means for causing the flow of mud through the degasser tank, by the provision of suitably controlled valve means in the degasser outlet pipe for effectively controlling the mud flow in relation to the mud level in the tank, to protect the pump and prevent the same from becoming air or gas locked.

With the foregoing object and features in view and such other objects and features as may become apparent as this specification proceeds, the invention will be understood from the following description taken in conjunction with the accompanying drawings, wherein like characters of reference are used to designate like parts, and wherein:

FIG. 1 is an elevational view of the degasser apparatus, with certain portions thereof shown in section;

FIG. 2 is a vertical sectional view of the degasser tank;

FIG. 3 is an elevational view, similar to that shown in FIG. 1 but on a reduced scale and showing a modified embodiment of the invention;

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FIG. 4 is an elevational view, partly in section, of the pump used in the embodiment of FIG. 3;

FIG. 5 is a bottom plan view of the pump;

FIG. 6 is a fragmentary sectional view on an enlarged scale, taken substantially in the plane of the line 6-6 in FIG. 4;

FIG. 7 is a view, partly in vertical section and partly in elevation, showing another modified embodiment; and

FIG. 8 is a diagrammatic view showing connections of a valve used in the embodiments of FIGS. 4-6.

Referring now to the accompanying drawings in detail, more particularly to FIGS. 1 and 2, the mud degasser apparatus in accordance with the invention is designated generally by the reference numeral 10 and, principally, embodies in its construction a degasser tank 11 which may be positioned above, below, or, as shown, at the level 12 of mud in a tank 13 into which the mud is discharged from the well through a pipe 14, the same mud level 12 also existing in a tank 15 from which degassed mud is subsequently pumped or otherwise delivered through a pipe 16 back to the well.

The degasser tank 11 comprises a cylindrical, vertically disposed body mounted by suitable supporting brackets 17 on a platform or skid 18 and provided with a removable cover 11a to facilitate access to the interior thereof for purposes of inspection or repair. A tubular adapter 19 extends into the tank through the cover 11a and is connected to an inlet pipe 20 which communicates with the tank 13 as shown. A butterfly valve 21 is provided in the adapter 19 for actuation by an arm 22 as will be hereinafter described, the purpose of this valve being to regulate the volume of mud passing into the degasser tank 11 from the tank 13, whereby to prevent the degasser tank from flooding, as set forth in the claims of our Patent No. 3,241,295.

The lower end of the tank is provided with an adapter 23 connected to a discharge pipe 24 which communicates with the tank 15, the pipe 24 being shown as provided, as in the aforementioned Erwin patents, with a jet 25 for propelling the degassed mud therethrough and simultaneously causing mud to be drawn into the trough and from the tank 13 through the inlet pipe 20 into the tank 11, as set forth in the aforesaid Erwin patents. The lower end of the pipe 24 may be equipped with a wear plate 26.

The interior of the degasser tank 11 is shown as provided with a set of vertically spaced baffles, namely, a conical upper baffle 27, an inverted frusto-conical intermediate baffle 28, and a conical lower baffle 29. The upper baffle 27 is equipped with an annular rim 30 which is spaced outwardly from the marginal edge of the baffle by a set of supporting straps 31, so that mud flowing downwardly through the adapter 19 may, after becoming deposited on and evenly distributed over the baffle 27, cascade downwardly as indicated at 32 onto the marginal edge portion of the baffle 28.

The marginal edge of the baffle 28 is provided with an upstanding flange or rim 33, within which there is provided an apertured pipe or conduit 34 whereby water under pressure may be discharged onto the baffle 28 for purposes of washing the interior of the tank, or whereby suitable chemicals may be introduced for mixing with the mud, if so desired. The water or chemicals are delivered to the conduit 34 from a suitable source exteriorly of the tank by a suitable pipe (not shown). The baffle 28 is provided with a central opening 35 whereby mud may flow onto

the lower baffle 29, for subsequent accumulation in the bottom of the tank.

It is to be noted that the slope of the intermediate baffle 28 is greater than that of the upper baffle 27 and that the slope of the lower baffle 29 is also greater than that of the baffle 28. Thus, in flowing downwardly from the adapter 19, the mud first is evenly spread over the upper baffle 27, then re-directed toward the center of the tank by the intermediate baffle 28, and then again spread evenly over the lower baffle 29, until it drops to the bottom of the tank. The tank bottom also of inverted conical form, safeguards against sediment dropping out of the mud, and the different slopes of the several baffles, as above noted, accelerate the flow of mud during its cascading over the baffles, whereby a self-cleaning action of the baffles is produced. The purpose of the baffles is to assist in releasing the gas or air from the mud and in this respect cooperates with the vacuum producing means to be described herein-after but the particular baffle arrangement is not necessarily associated with the particular valve control arrangement herein disclosed and more particularly the baffle arrangement is not necessarily confined to an association with the inlet valve control system of FIG. 1 but can be used in assemblies having other valve control systems such as that shown in FIG. 7 wherein a control valve in the outlet pipe of the mud degasser is disclosed, the valve being actuated by changes in the liquid level in the degasser tank or by changes in pressure. The baffle arrangement may also be used where no valve control systems are employed.

The pressure within the degasser tank 11 is normally maintained at less than atmospheric pressure in order that gas bubbles entrained in the mud passing through the tank will expand and break away from the mud, this being assisted by the cascading action of the baffles above described. The sub-atmospheric pressure within the tank is produced not only by the jet discharge 25 of the mud from the tank, but also and, mainly, by a suitable vacuum or air pump 36, mounted on the platform or skid 18, and driven by a suitable motor 37. The gases released from the mud in the tank 11 enter the open, lower end of a tube 38 which extends from the underside of the baffle 29, through the baffles 29, 28, 27 and through the tank cover 11a to a conventional three-way valve 39 mounted by a bracket 40 on top of the cover 11a. The valve 39 also has a port 41 communicating with the atmosphere and a suction line or pipe 42 extending to a conventional float-actuated liquid trap 43 mounted on the skid 18. The trap 43 communicates through a pipe 44 with the pump 36, while the exhaust of the pump to the atmosphere is indicated at 45. If desired, a shut-off valve 46, a sight glass 47 and a pressure gauge 48 may be provided in the line 42, as shown.

Sub-atmospheric pressure within the tank 11 is regulated by the valve 39 in response to raising and falling of a float 49 on the mud level 50 in the bottom of the tank 11. The float 49 is secured to the lower end of a rod 50' which extends slidably through the baffles 29, 28, 27 and through a packing gland 51 in the tank cover 11a, being operatively connected at its upper end as at 52 to an actuating arm 53 of the valve 39. As the mud level 50 in the tank rises, the float 49 causes the three-way valve 39 to open the port 41 to the atmosphere while at the same time cutting off communication through the line 42 to the pump 36, thus allowing atmospheric pressure to enter the tank and reduce the vacuum therein.

On the other hand, when the mud level falls, the valve port 41 is closed, and a greater sub-atmospheric pressure is produced in the tank by suction of the pump 36 through the lines 44, 42 and 38.

The aforementioned butterfly valve 21 in the adapter 19 is opened and closed automatically in response to

air pressure within the tank 11, that is, in response to variations in pressure of air within the tank, this being effected by the provision of a vacuum cylinder 54 which is pivotally mounted as at 55 on the tank cover 11a and includes a piston 56 with a piston rod 57 pivoted as at 58 to the valve actuating arm 22. The cylinder 54 is connected by a vacuum line 59 to the tube 38 and as the pressure within the tube 38 and tank 11 decreases, the piston 56 is retracted into the cylinder 54 and causes the valve 21 to open, thus permitting more mud to enter the tank. On the other hand, when pressure within the tank increases, outward sliding of the piston 56 in the cylinder 54 causes the valve 21 to close, thus restricting the flow of mud into the tank accordingly.

Means are provided for biasing the valve 21 to its closed position, such means comprising a cylinder 59', pivotally mounted as at 60 on the tank cover 11a adjacent the cylinder 54, and having a reciprocable piston 61, spring-biased by a compression spring 62, with a piston rod 63 extending from the piston 61 and pivoted to the arm 22 as at 64.

In order to prevent degassed mud from flowing back to the tank 11, a suitable check valve 65 is provided in the discharge pipe 24 between the adapter 23 and the jet 25.

When the apparatus is in operation, the rate of flow of mud therethrough is controlled by the action of the jet 25, regulated by a suitable valve 66, whereby the rate of mud flow out of the tank and the mud level in the bottom of the tank are maintained substantially constant. However, if the inflow of mud should become greater than the outflow, rising of the mud level in the tank will cause the float 49 to vent the valve 39 to the atmosphere, and the resultingly increased pressure of air in the tank and in the lines 38, 59 will cause the piston 56 in the cylinder 54 to close the valve 21, thus reducing or shutting off the inflow of mud through the adapter 19. Conversely, with the inlet of mud reduced or stopped, lowering of the mud level 50 in the tank will produce a greater vacuum in the tank, thus causing the cylinder 54 to open the valve 21 to permit a greater inflow of mud into the tank. As a combined result of these automatic operations, both the mud level and sub-atmospheric pressure within the tank will be maintained substantially constant. Such control of the inflow fluid is covered by the claims or our Patent No. 3,241,295.

The purpose of the trap 43 is to prevent liquids from entering the vacuum pump 36, the trap fulfilling this function by collecting and storing the undesired liquid which may be occasionally drained from the trap through a drain valve 99. The latter is manually operated and instances may arise when draining of the trap is overlooked, in which event an excessive amount of liquid accumulated in the trap will cause the float in the trap to close a valve on the line 42, thus preventing further vacuum to form in the degasser tank 11. In order to eliminate this difficulty and to provide for automatic draining of the trap 43, a check valve 100 is connected to the trap 43 so that it communicates with the trap even when the drain valve 99 is closed, and a line 101 extends from the check valve 100 to the interior of the degasser tank, as shown. The valve 100 permits liquid to flow from the trap 43 to the tank 11 only. When the pump 36 is stopped, the vacuum in the line 42 will leak off more rapidly than the vacuum in the tank 11 and when this condition arises, the liquid accumulated in the trap will flow through the check valve 100 and line 101 into the tank 11, thus automatically draining the trap.

Referring now to FIGS. 3-6 which show a modified embodiment of the invention denoted generally by the reference numeral 70, the same is adapted to be mounted above the level of mud in a mud trough 71 having inlet and outlet tanks or sumps at opposite ends thereof corresponding to the tanks 13 and 15 of FIG. 1, with the

degasser tank 11 being arranged substantially as described in connection with the embodiment 10.

However, in place of the jet 25 for propelling the mud through the degasser tank, mechanical vacuum pump means designated generally by the numeral 72 is employed. This pump is mounted above the mud through 71 adjacent the tank 11 and comprises a suitable housing 73 having a partition 74 there in which separates the interior of the housing into a pair of chambers 75, 76, these being referred to respectively as first and second mud displacement chambers or first and second pump chambers. The bottom of the housing 73 is provided with a pair of door openings having a pair of doors 77, 78 in communication with the respective first and second pump chambers 75, 76, the doors 77, 78 being hingedly mounted as indicated at 79 so that they are normally urged by gravity to their closed position. A manifold 80 is provided at the underside of the housing 73 in communication with the doors 77, 78 and is connected by a duct or pipe 24a to the mud outlet of the degasser tank 11.

The housing 73 also has a front wall provided with openings for a pair of doors 81, 82 in communication with the respective pump chambers 75, 76, these doors being hingedly mounted as at 83 so that they are normally urged by gravity to their closed position.

In this embodiment, the aforementioned motor 37, the vacuum pump 36 and the liquid trap 43 are mounted on top of the housing 73 and the suction line 42 which extends between the valve 39 on the tank 11 and the liquid trap 43 is provided with a T 84 having a branch suction line 85 connected thereto. The suction line 85 communicates with one port of a four-way valve 86, also mounted on top of the housing 73, while the exhaust line 87 of the pump 36 communicates with another port of this valve. The two remaining ports of the four-way valve 86 have conduits 88, 89 connected thereto for communication with the respective pump chambers 75, 76, it being understood that in one position of the valve 86, air may be withdrawn from the chamber 75 through the conduit 88 and lines 85, 42, 44 while air under pressure from the pump 36 is delivered into the chamber 76 through the lines 87 and 89. Conversely, in a second position of the valve 86, air may be withdrawn from the chamber 76 and delivered under pressure into the chamber 75.

The valve 86 is actuated by an arm 90 which has operatively connected thereto as at 91 the upper end of a rod 92 which extends into a cylinder 93. The latter is provided at the outside of the housing 73 and communicates with the chamber 75 by a pair of connecting passages 94, 95. A mud level responsive float 96 is slidable in the cylinder 93 on the rod 92 and when the float rises sufficiently high in the cylinder, it comes in abutment with an adjustable stop 97 on the rod 92, whereupon further upward movement of the float causes the rod 92 to slide upwardly to actuate the valve 86 through the medium of the arm 90.

In operation, mud under sub-atmospheric pressure discharged from the degasser tank 11 stands in the pipe 24a and manifold 80, while the pump 36 exhausts air from the chamber 75 through the valve 86 and conduit 88. When the vacuum in the first pump chamber 75 is greater than that in the manifold 80, the door 77 is caused to open, with the result that the mud enters through the open door into the chamber 75. With the rising of the mud in the chamber 75 and in the cylinder 93 communicating therewith, upward movement of the float 96 eventually reverses the valve 86, so that air under pressure from the air pump 36 is delivered into that chamber. As this occurs, the door 77 is automatically closed and the mud in the chamber 75 flows by gravity through the door 81 into the discharge sump of the mud trough 71. With the discharge of mud from the chamber 75 and cylinder 93, lowering of the float 96 causes the same to engage

another stop 98 on the lower portion of the rod 92, thus sliding the rod downwardly and returning the valve 86 to its position where suction is again applied to the chamber 75 for the next cycle of operation.

The pumping operation in the second pump chamber 76 is reverse to that in the chamber 75, that is, while mud is being discharged from the chamber 75 through the door 81, mud is being drawn into the chamber 76 through the door 78, and conversely, when mud is drawn into the chamber 75 through the door 77, mud is discharged from the chamber 76 through the door 82. As a result, the flow of mud through the pump 72 is substantially continuous by virtue of the two, reversely acting first and second pump chambers 75 and 76.

Referring now to FIG. 7, the same illustrates another modified embodiment of the invention including a degasser tank 111 through which mud is propelled by a centrifugal pump 112 connected to the mud outlet 24 of the tank, as by a pipe or conduit 113. To the extent that construction and arrangement of the tank 111 is similar to the degasser tank 11, corresponding reference numerals are used in the illustration of FIG. 7.

The float 49 on the mud level 50 in the tank 11 is carried by a vertically swingable arm 114 which operates the three-way valve 115 mounted exteriorly on the side of the tank. The arm 114 extends from the valve into the tank through an opening 116 in the tank wall, such opening being covered by the valve 115 to prevent leakage of air therethrough. The valve 115 is connected to the suction pump by a suction line 42, has a port 41 vented to the atmosphere, and a suction pipe 38 which communicates with the interior of the degasser tank. The operation of the float-controlled valve 115 is the same as that of the aforementioned valve 39, but it is to be noted that since the valve 115 is mounted at the side of the tank rather than on top of the tank cover 11a, it is not necessary to pass the float arm 114 and the suction pipe 38 through the various baffles 27, 28, 29, as in the embodiment of the tank 11.

A pressure-responsive governor 117 of a conventional, commercial type is mounted as by a bracket 118 on the tank cover 11a and is operatively connected as by linkage 119 to the arm 22 of the mud inlet valve 21 at the top of the tank. The governor 117 has a pilot control 120 mounted at the side of the tank 111 and connected by a line 121 to the vacuum pump or to the line 42, as desired. The connection between the governor 117 and the control 120 is by a line 122, and a vacuum line 123 extends from the control 120 to the interior of the tank.

When the mud level in the tank falls and the air pressure in the tank is decreased by the valve 115, the air pressure change is sensed by the pilot control 120 through the line 123 and the control responds by communicating the line 122 with the suction line 121 so that the governor 117 opens the valve 21 and admits more mud into the tank. Conversely, when the mud level in the tank rises, the governor closes the valve 21 to decrease or stop the inflow of mud into the tank.

A similar governor 124, connected by a line 125 to the control 120, may be used to operate a valve 126 in the discharge 127 of the pump 112 by which the mud is drawn through the tank 111 and delivered to the mud sump. The arrangement is such that when the mud level in the degasser tank falls, the regulator 124 closes the discharge valve 126, thus permitting the mud in the tank to rise to a higher level while the mud inlet valve 21 is opened by the regulator 117. On the other hand, if the mud level rises, the regulator 124 will open the discharge valve 126, thus permitting excess mud to be withdrawn from the tank by the pump 112 while the inflow of mud into the tank is decreased or shut off by closing of the valve 21 by the regulator 117.

The mud valve 126 may be located downstream from the pump 112 as shown, or between the pump 112 and the tank outlet 24, or in a by-pass around the pump, as

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disclosed in the aforementioned application Ser. No. 299,317, filed Aug. 1, 1963.

While in the foregoing there have been shown and described the preferred embodiments of the invention, various modifications may become apparent to those skilled in the art to which the invention relates. Accordingly, it is not desired to limit the invention to this disclosure and various modifications and equivalents may be resorted to, falling within the spirit and scope of the invention as claimed.

We claim:

1. In a mud degasser apparatus, the combination of a degasser vacuum tank having a mud inlet and mud outlet, a mechanical vacuum-actuated mud pump means connected to said mud outlet for drawing mud from said inlet through said tank, an air pump having an intake communicating with said tank for maintaining the interior thereof at sub-atmospheric pressure, and means for respectively decreasing and increasing said pressure in response to lowering and rising of mud level in the tank, said mechanical vacuum-actuated mud pump means also being connected to the intake of said air pump, so that the mud pump means is actuated only when said pressure in the tank is higher than that in the mud pump means, for maintaining the mud level and pressure in the tank substantially constant.

2. The apparatus as defined in claim 1 together with inlet flow control valve means provided in said mud inlet of said tank, and means responsive to decreasing and increasing of pressure in the tank for respectively opening and closing said inlet flow control valve means.

3. In a mud degasser apparatus, the combination of a degasser vacuum tank having a mud inlet and a mud outlet, a vacuum and pressure-actuated mud pump connected to said mud outlet for drawing mud from said inlet through said tank, an air pump having a suction side and a pressure side, the suction side of said air pump being connected to said tank for maintaining sub-atmospheric pressure therein, and means for respectively decreasing and increasing said tank pressure in response to lowering and rising of mud level in the tank, said mud pump having a mud displacement chamber communicable alternately with the suction side and with the pressure side of said air pump so that mud may be drawn from said mud outlet into said chamber by suction only when said pressure in said tank is higher than that in said chamber, whereby to maintain the mud level and pressure in the tank substantially constant.

4. The apparatus as defined in claim 3 together with inlet flow control valve means provided in said mud inlet of said tank, and means responsive to decreasing and increasing of pressure in the tank for respectively opening and closing said inlet flow control valve means.

5. The apparatus as defined in claim 4 together with means responsive to variations in the level of mud in said mud pump chamber for alternately communicating said chamber with the suction side and pressure side of said air pump.

6. In a mud degasser apparatus, the combination of a degasser vacuum tank having a mud inlet and a mud outlet, a vacuum and pressure actuated double acting mud pump connected to said mud outlet for drawing mud from said inlet through said tank, an air pump having a suction side and a pressure side, the suction side of said air pump being connected to said tank for maintaining the interior thereof at subatmospheric pressure, and means for respectively decreasing and increasing said tank pressure in response to lowering and rising of mud level in the tank, said mud pump comprising a housing having first and second mud displacement chambers therein, a mud inlet door and a mud outlet door provided on each of said chambers, each door being biased to a closed position by gravity, a two-position four-way air valve having a first position wherein it communicates the suction side of said air pump with said first chamber and the

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pressure side thereof with said second chamber whereby mud may be drawn from said outlet of said tank into said first chamber through the inlet door thereof and whereby mud may simultaneously be discharged from the second chamber through the outlet door thereof, said air valve also having a second position wherein it communicates the suction side of said air pump with said second chamber and the pressure side thereof with said first chamber whereby mud may be drawn from the tank outlet into the second chamber through the inlet door thereof and whereby mud may simultaneously be discharged from the first chamber through the outlet door thereof, and means connected to said valve and responsive to variations of mud level in one of said chambers for moving said air valve alternately between its first and second positions, said mud pump being operative to draw mud from said tank outlet into said chambers only when pressure in the chambers under suction of said air pump is lower than the pressure in said degasser tank, whereby to maintain the mud level and pressure in the tank substantially constant.

7. The apparatus as defined in claim 6 with inlet flow control valve means provided in said mud inlet of said tank, and means responsive to decreasing and increasing of pressure in the tank for respectively opening and closing said inlet flow control valve means.

8. In a mud degasser apparatus, the combination of a degasser vacuum tank having a mud inlet and a mud outlet, a mechanical vacuum-actuated mud pump connected to said mud outlet for drawing mud from said inlet through said tank, and an air pump connected to said mud pump for actuating the same and also connected to said tank for maintaining the interior thereof at sub-atmospheric pressure variable in coordination with the level of mud in the tank, and means to actuate said mud pump only when the pressure in the tank is higher than that in the mud pump, so as to maintain the mud level and pressure in the tank substantially constant.

9. In a mud degasser apparatus, a double-acting pump adapted to be connected to a degasser tank for continuously propelling mud therethrough, said pump comprising a housing having first and second pump chambers therein, a mud inlet door and a mud outlet door provided on each of said chambers, each door being biased to a closed position by gravity, an air pump having an air inlet and an air outlet, a two-position four-way valve having a first position in which it communicates the air inlet of said air pump with the first chamber and the air outlet with the second chamber so as to draw mud into the first chamber through the inlet door thereof and simultaneously discharge mud from the second chamber through the outlet door thereof, said valve also having a second position in which it communicates the air inlet of said air pump with the second chamber and the air outlet with the first chamber whereby to draw mud into the second chamber through the inlet door thereof and simultaneously discharge mud from the first chamber through the outlet door thereof, and means connected to said valve and responsive to raising and lowering of mud level in one of said chambers for moving said valve alternately to its first and second positions so as to produce a continuous flow of mud through the double-acting pump.

10. In a mud degasser apparatus, the combination of a mud degasser vacuum tank having a mud inlet and a mud outlet, and a double-acting pump connected to said mud outlet of said tank for continuously propelling mud therethrough, said mud pump comprising a housing having first and second pump chambers therein, a mud inlet door and a mud outlet door provided on each of said chambers, each door being biased to a closed position by gravity, an air pump having an air inlet and an air outlet, a two-position four-way valve having a first position in which it communicates the air inlet of said air pump with the first chamber and the air outlet with the second chamber whereby to draw mud from the outlet of said tank into

the first chamber through the inlet door thereof and simultaneously discharge mud from the second chamber through the outlet door thereof, said valve also having a second position in which it communicates the air inlet of said air pump with the second chamber and the air outlet with the first chamber whereby to draw mud from the outlet of said tank into the second chamber through the inlet door thereof and simultaneously discharge mud from the first chamber through its outlet door, and means connected to said valve and responsive to raising and lowering of mud level in one of said chambers for moving said valve alternately to its first and second positions whereby to produce a continuous flow of mud from said tank through said double-acting pump.

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