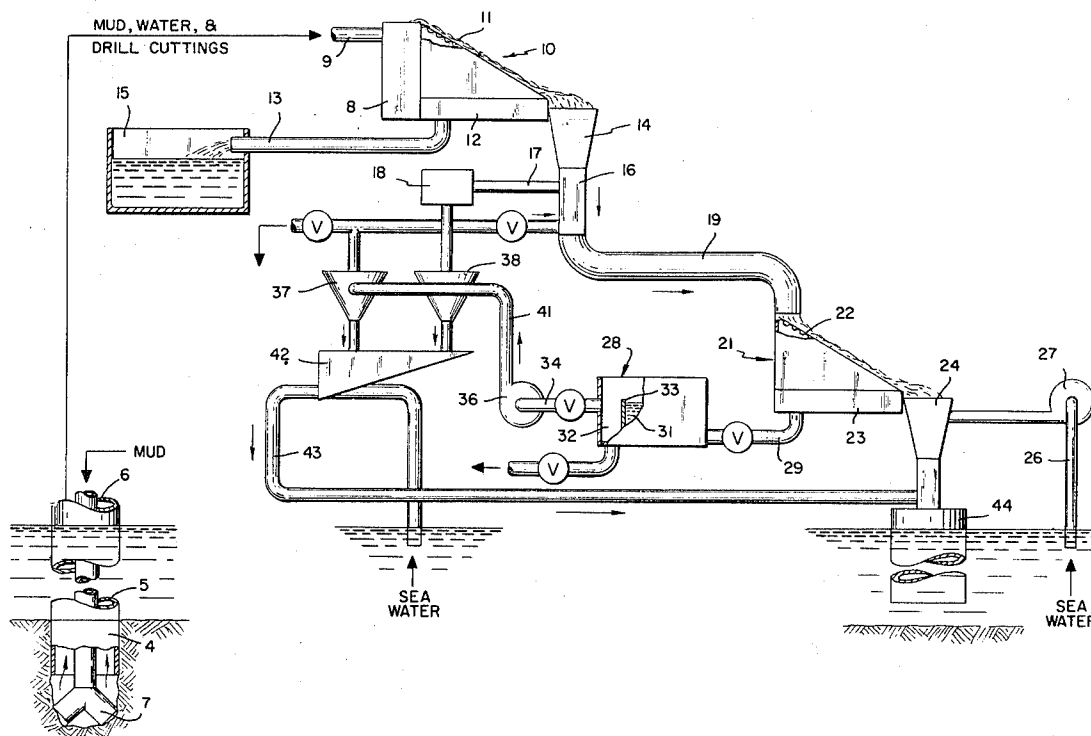
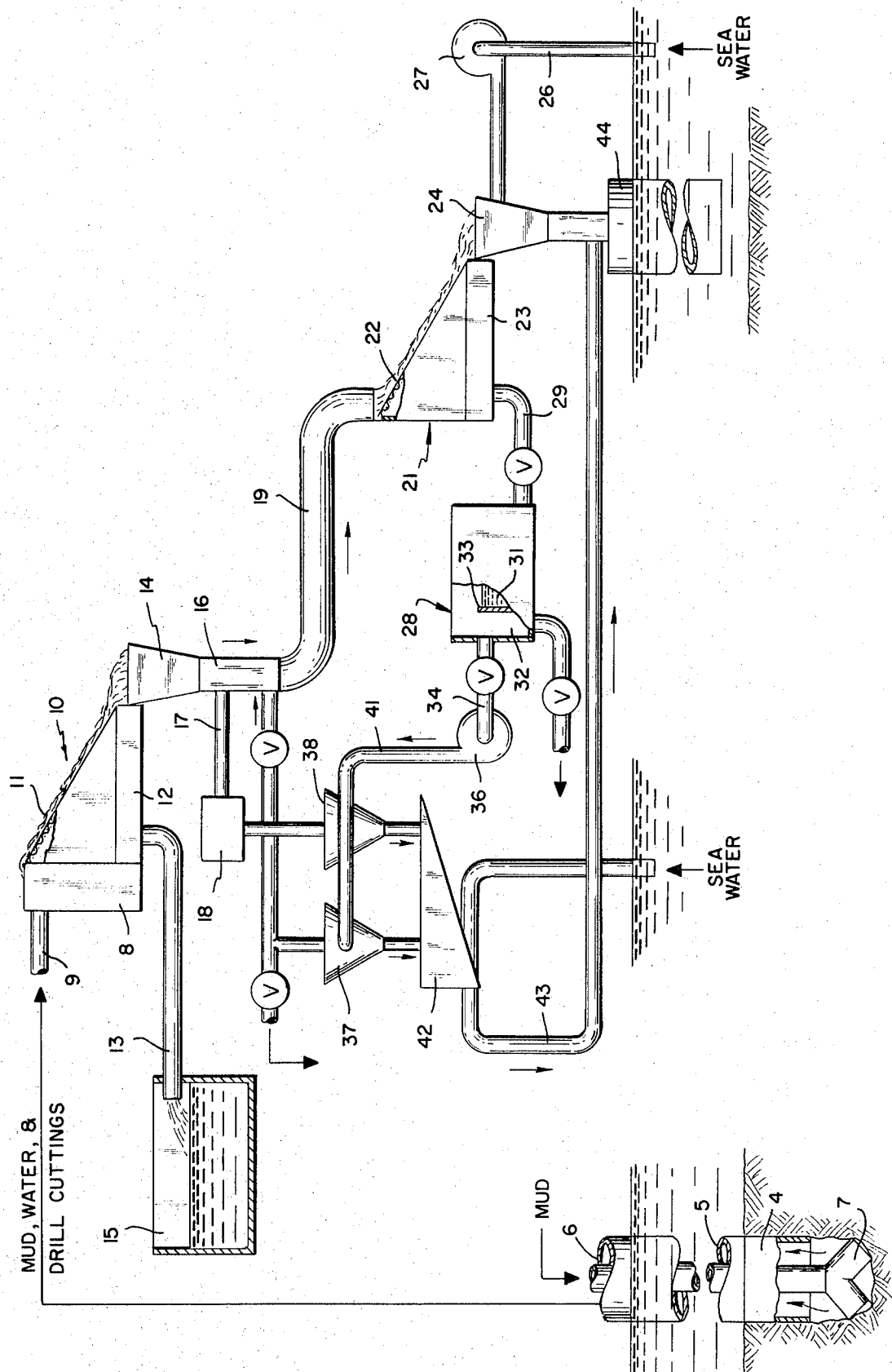






APPARATUS FOR AVOIDING WATER POLLUTION AT AN OFFSHORE DRILLING SITE

BACKGROUND OF THE INVENTION

In a normal well drilling operation at an offshore site, a pressurized stream of liquefied drilling mud is introduced down the drill string as the latter rotates. The drilling mud functions both as a lubricant and as a vehicle whereby to facilitate the cutting and removal of materials comprising the substratum. This rather heavy effluent stream carried from the well bore usually includes drilling mud, drilling cuttings, sea water and possibly oily constituents picked up from the substratum. As the drilling mud passes upwardly through the annulus defined by the rotating drill string and the bore hole, it acts as a vehicle for sand, clay, stone and other loosened solids which constitute the substratum.

These latter mentioned materials after being separated from the mud, as a matter of practicality, are normally returned to the water where they sink to the ocean floor. However, the cuttings are often coated with oily materials such as crude oil from the well bore, or other non-water soluble constituents which make up the drilling mud mixture.

The discharge into the surrounding water of such non-water soluble materials, can lead to a water polluting condition. Even the discharge of minor cutting amounts will tend to cause a visible discoloration at the water's surface.

Usually the drilling mud comprises essentially a water based, flowable composition of adequate weight and chemical quality to facilitate operation under a particular set of circumstances. However, the mud is frequently compounded with a lubricant material such as diesel, crude oil, or the non-water soluble petroleum base constituent, whereby to facilitate the mud's lubricating characteristics. In either event, the instant process is applicable toward the removal of petroleum base, water contaminating or polluting matter that would ordinarily adhere to the drilling cuttings and tend to float to the water's surface when the cuttings are discharged overboard.

Toward overcoming the above noted problems, and toward avoiding the possible pollution of the offshore environment, the present method and apparatus therefor comprises in brief the following. Ancillary to a well drilling operation, drilling cuttings are sequentially carried, together with drilling mud, through a first shaker. This device comprises in essence a screen separator of such a mesh that a major component of the fluid mud will pass through the screen. The more solid drilling cuttings remain on, and are carried to the screen discharge. The substantially mud free cuttings are then passed through a cleaning cycle where they were washed by contact with a liquid detergent.

The cuttings, together with used detergent, are again separated at a second shaker. The detergent passes through the shaker screen and is recycled for subsequent reuse. The substantially oil free cuttings are discharged from the shaker to a collector where they are subjected to a final bath comprising relatively clean water, which in the present instance can be sea water. The clean, and detergent free cuttings are then deposited beneath the water's surface where they gravitate to the ocean floor.

The accompanying drawing comprises a diagrammatic illustration of the apparatus and flow path utilized in the practice of the present process.

Normally, the well bore cuttings treated according to the disclosed process, are carried from a well bore 4 during the drilling operation so long as the drilling mud flows. Thus, as drill string 6 is rotatably driven to urge the drill bit 7 downward, liquefied mud is forced under pressure through the drill string 6 to exit at the lower drill bit 7. The mud thereby lubricates the downhole operation, and in passing upwardly through the annulus 5 between drill string 6 and the well bore wall, carries with it various forms of drilling cuttings as heretofore mentioned.

Further in regard to the drilling mud, as is generally known, the composition of the mud is usually compounded to the particular drilling situation and condition. More specifically, the weight and the chemical makeup of the mud are initially determined and subsequently altered as needed and as the drilling progresses.

While not presently shown in great detail, the mud flow is urged under pressure from well bore 5, upwardly to the drilling deck of the offshore platform, and discharged as an effluent stream by way of line 9, into a tank 8 that is ancillary to shaker 10. From tank 8 the mud mixture overflows onto the perforated face 11 of shaker 10.

Shaker 10 as shown, comprises a vibratory or stationary type separator having a tilted screen working surface 11 upon which the mud mixture overflows from tank 8. The mesh of the screen utilized on shaker face 11 is variable, being contingent on the characteristics of the substratum being drilled and the type of drilling cuttings being carried by the mud flow.

In shaker 10, the liquefied mud vehicle will by and large traverse the screen openings and is received in an underpositioned pan 12. The latter is communicated by a conduit 13, with a mud storage tank 15. The remainder of the mixture deposited on shaker face 11, and which does not pass through the screen, will comprise essentially an aggregate of solids being of sufficient size to remain at the screen surface. Solid matter, through the screen's vibratory action or through gravity flow, advances along the screen face to be discharged at the lower side thereof.

A collector 14 communicated with shaker face 11 receives the stream of drilling cuttings which in essence comprises a conglomerate of solid matter as well as some liquid. This flowable mass further embodies the previously mentioned non-water soluble, oily base constituents which normally cling to the cuttings. A wash chamber 16 is communicated with the collector 14 discharge outlet to receive a stream of unprocessed drilling cuttings. Wash or spray chamber 16 includes a compartment adapted to receive the downwardly passing drilling cuttings, with means in the compartment to retain the cuttings sufficiently long to be brought into contact with the liquid detergent.

Said wash chamber 16, in the presently disclosed arrangement, a spray chamber, further includes a spray nozzle system 17 disposed thereabout and appropriately arranged to deliver detergent streams against the cuttings. Spray nozzle system 17 is communicated with a pressurized liquid detergent source represented by reservoir 18.

Toward cleaning or scouring the cuttings of oily matter, the cuttings as an alternative can be immersed in

a bath rather than being sprayed. The apparatus used in this latter step will be adapted in accordance with the consistency and the volume flow of cuttings as well as with other features of the drilling process.

Within spray chamber 16, detergent is brought into contact with the cuttings under sufficient pressure and/or turbulence to remove substantially all of the extraneous matter clinging thereto. An elongated conduit 19 directs a stream of liquid detergent and drilling cuttings from spray chamber 16 whereby to physically expose the cuttings to the cleaning and separating action.

For the present use, and toward achieving the necessary scouring and cleaning function, the detergent liquid can include any of a number of commercial solutions as for example, a bio-degradable phosphate-free detergent.

Conduit 19 is connected at the discharge end thereof to a second separator 21. The latter, as in the instance of shaker 10, is a vibratory unit having a screen-type face 22 across which the detergent and cuttings flow is directed. The mesh size or openings of said screen face 22 are usually smaller than the mesh of screen face 11, and of a sufficient size to pass the liquid detergent therethrough and into shaker reservoir 23. The remaining cuttings stream, substantially free of detergent and other liquid, falls from screen top 22 and into a discharge chamber 24.

Said chamber 24 includes a receptacle to receive and retain the flow of cleaned cuttings for further cleaning. Said receptacle 24 in the instant arrangement is communicated with sea water drawn from the immediate area by conduit 26 and pump 27, or from an alternate source of water. After further cleaning by contact with sea water, the cleaned cuttings are discharged into a downcomer 44. Said member comprises in its simplest form an elongated tubular conduit that extends downwardly beneath the water's surface terminating short of the sea floor. Cuttings deposited at the upper end thereby are directed toward the floor where they tend to settle without the concern of prompting a water polluting situation on the surface.

Solution, including detergent separated from the drilling cuttings within separator 21, is received in reservoir 23. The latter includes an outlet communicated with the inlet of skimmer tank 28 by a valved connecting line 29. Skimmer tank 28 embodies a first compartment 31 into which the detergent is fed and into which additional detergent can be added if such addition is required for reconstituting said material.

A second compartment 32 is communicated with the first compartment across a transverse panel 33. Compartment 32 is provided with an outlet to receive detergent in valved line 34, which in turn is communicated with the suction of detergent pump 36. The discharge of said pump 36 is communicated with one or more hydrocyclone units 37 and 38 or similar fluid separating units, by way of line 41. The function of said units 37 and 38 is to provide a final separation of detergent from any remaining materials in the flow stream.

Hydrocyclone units 37 and 38 function to centrifuge detergent from any remaining mud, water, and/or other fluidized or particulated components. The separated and cleaned fine solids pass upwardly into manifold 42 and are carried by line 43 into conduit 44. The detergent material, essentially free now of solids, discharges into wash chamber 16 to again contact the incoming mud and cuttings flow.

Open ended downcomer conduit 44, as noted herein is disposed in the body of water, normally depending from the offshore drilling platform. Said conduit 44 preferably is positioned with its lower open end spaced from the floor at the offshore location, or provided in the alternate with openings formed about said lower end. The conduit or caisson upper end is open to the atmosphere and disposed in alignment with the discharge opening of cuttings collector 24. Thus, in the course of the present process, substantially clean cuttings are fed into the caisson upper end. The clean cuttings thus enter the water and flow downwardly by gravity through the caisson, to be deposited at the ocean floor.

Use of the presently disclosed method for treating drilling cuttings results in a cleaner operation as well as a more economical one. The method serves to maintain a non-polluting condition at the offshore production or drilling site and also permits maximum recovery of both drilling mud and washing detergent for the subsequent reuse of both items.

Obviously many modifications and variations of the invention, as hereinafter set forth, may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. Apparatus for purging well drilling cuttings of water polluting materials subsequent to removal of said cuttings from a subterranean well within a circulating drilling mud flow, which apparatus includes;

first separating means communicated with said subterranean well for receiving and initially separating a major portion of the drilling mud from said drilling mud flow to provide a substantially mud free, drilling cuttings stream,

washing means communicated with said first separating means to contact said drilling cuttings stream with a washing detergent,

second separating means communicated with said washing means to receive a mixture of detergent and drilling cuttings, and to segregate the latter therefrom free of said water polluting materials, and

return conduit means communicated with said second separating means to receive detergent from the latter and for recirculating the same for introduction to said washing means.

2. An apparatus as defined in claim 1, including; rinsing means (27) communicated with said second separating means to introduce water to the latter whereby to contact cuttings contained therein subsequent to being contacted with detergent.

3. Apparatus for purging well drilling cuttings of water polluting materials at an offshore site in a body of said water subsequent to removal of said cuttings from a subterranean well, the cuttings being carried within a drilling mud flow, which apparatus includes;

first separating means (10) communicated with said well for receiving and initially separating the major portion of the drilling mud from said drilling mud flow to provide a substantially mud free drilling cuttings stream,

washing means (16, 17, 18) communicated with said first separating means (10) to contact said drilling cuttings stream with a washing detergent,

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second separating means (21, 22, 24) communicated with said washing means (16, 17, 18) to receive a mixture of detergent and cuttings, and to segregate the latter therefrom free of said water polluting materials, and

rinsing means (24, 27) communicated with said second separating means to introduce a stream of water to the latter whereby to contact cuttings therein.

4. An apparatus as defined in claim 3, wherein rinsing means communicated with said second separating means to introduce a stream of water to the latter is communicated with said body of water whereby to contact cuttings with said stream of water.

5. An apparatus as defined in claim 1, wherein said return conduit means includes; a liquid separating tank communicated with said second separating means or receiving water and detergent from the latter, and for segregating said respective water and detergent compo-

nents into discrete liquid segments.

6. An apparatus as defined in claim 1, wherein said return conduit includes; a liquid separator communicated with said second separating means and being operable to centrifugally segregate mud residing from liquid detergent therein.

7. An apparatus as defined in claim 1, wherein said return conduit means includes; a liquid separating tank having an inlet connected with said separating means for receiving a mixture of water and detergent from the latter. and an overflow compartment in said tank to form discrete segments of liquid received therein.

8. An apparatus as defined in claim 1, wherein said washing means includes; a spray chamber adapted to receive said cutting stream, and a spray system connected with a source of liquid detergent whereby to spray the latter into contact with said cuttings.

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