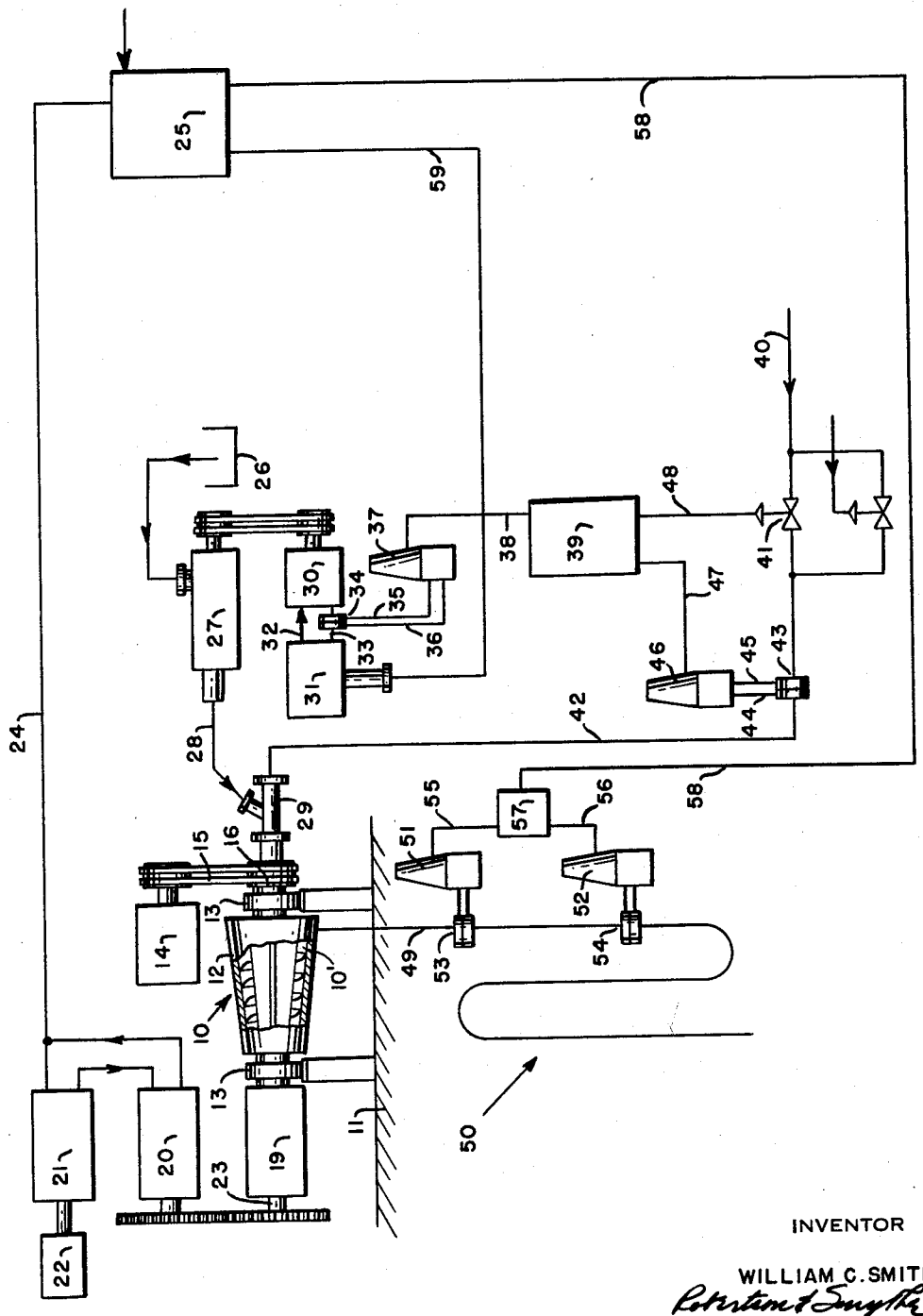
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SYSTEM FOR SEPARATING AND CLASSIFYING SOLIDS

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SYSTEM FOR SEPARATING AND CLASSIFYING SOLIDS

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This invention relates to apparatus for conditioning drilling mud or the like and particularly to a control system therefor.

Drilling mud or fluid is commonly employed in rotary drilling operations, the mud having a number of functions to perform as is known in the art. These functions include lubrication of the rotary drill bit, removal of cuttings, overcoming formation pressures in the hole being drilled and depositing an impermeable wall cake. With the great increase in depth of wells and the problems of bottom hole temperature and pressure, drilling mud plays a large part in successful completion of a well, the cost of the mud being very high. Mud must be circulated in the system in the proper volume and must have the correct viscosity and weight to accomplish the aforementioned functions efficiently, and the amount of drilled solids in the mud must be properly regulated. Chemical treatment for control of the solids or addition of water has not been satisfactory. When clays are mixed with water, hydration results and an increase in viscosity occurs. Merely removing clay to reduce viscosity is insufficient because then it becomes necessary to add weighting materials for particular drilling operations. Barium sulphate or barite is commonly used as a weighting material and in some areas one of the principal considerations in treatment of mud is that of saving barium sulphate.

The principal object of this invention is to provide a separating and clarifying system in which a constant ratio of water and material to be treated is maintained substantially constant while the density of the effluent therefrom is maintained substantially constant.

Another object of this invention is to provide such a system that is automatically controlled.

Still another object of this invention is to provide such a system in which a measure of the torque required to drive the beach of a clarifier combines with a measure of the effluent density to control the feed of the material to be treated to the clarifier.

Still another object of the invention is to provide such a system in which the ratio of material to be treated and water entering the clarifier is maintained at a predetermined value by signals measuring the flow of mud and water to the clarifier.

A conventional solids-liquid separator or classifier of the centrifugal or decanting type may include a horizontally disposed, conical-shaped outer bowl or beach within which a conical-shaped screw conveyor may be located. The conical-shaped beach may be driven at a desired speed and the conveyor may be connected to the beach through a suitable differential or variable drive arrangement. The beach may be driven by one prime mover, while the input shaft of the differential gear may be driven by a hydraulic pump and motor system that is powered by a separate prime mover. The hydraulic system being a constant torque device, the pressure within said system is proportional to the torque or load on the conveyor.

In one aspect of the invention, the effluent leaving the classifier may be subjected to a density measuring device which may produce a signal that may be fed to a pneumatic controller along with a measure of the pressure within the hydraulic pump and motor system that drives the conveyor. The output from the controller may be

employed to vary the displacement of a hydraulic pump and motor system that operates a pump that feeds the material to be treated to the clarifier or separator.

In still another aspect of the invention, water or other liquid may be fed to the clarifier and mixed with the material to be treated prior to the admixture entering the clarifier. A predetermined substantially constant ratio of water and material to be treated may be fed to the separator by measuring the flow of water and the flow of liquid in the hydraulic system that drives the pump feeding the material to be treated to the separator. These two measurements may be combined within a ratio controller for operating a valve that controls the flow of water to the separator.

The above, other objects and novel features of the system and control will become apparent from the following specification and accompanying drawing which is merely exemplary.

In the drawing:

The figure is a schematic showing of apparatus to which the principles of the invention have been applied.

The invention will be described in conjunction with a conventional horizontal solids-liquid rotary separator or classifier.

Referring to the drawing, the separator or classifier **10** can be mounted on a suitable base **11**, the outer bowl or beach **12** being carried by bearings **13**, **13**, said beach being driven by a suitable motor **14** through belt **15** and pulley **16**. A conveyor **10'** within beach **12** can be driven by a shaft **23**, the speed thereof and the speed relative to beach **12** being controlled by a suitable differential drive arrangement **19**, which in turn is operated by a fluid motor system including a variable delivery fluid pump **21** driven by a motor **22**, and a constant displacement fluid motor **20**. The fluid motor drives the input shaft **23** of the differential unit **19**, variation of pump delivery, varying the fluid motor speed, and thus controlling the differential speed between the beach **12** and the conveyor.

Since the fluid drive will have constant torque characteristics, the torque of the drive will be that required for conveying solids along the beach and will be directly proportional to the pressure in the fluid system. This pressure is connected through line **24** to a pneumatic controller **25** for a purpose to be described later. Pneumatic controller **25**, for example, can be similar to that shown in Patent No. 2,770,247, although other types of controller can be used.

Mud to be treated may be supplied from a tank **26** to a pump **27**, the outlet **28** therefrom being connected to a T-fitting **29** leading to the separator **10**. The pump **27** may be driven by a hydraulic constant displacement motor **30** that is driven by a variable displacement hydraulic pump **31** which latter may be driven by a suitable prime mover (not shown). Pump **31** and motor **30** are connected together by hydraulic lines **32** and **33**. In the return line **33**, an orifice **34** may be located for measuring the flow of oil through the pump **31** and motor **30**. Pressure lines **35** and **36** from the orifice **34** may lead to a differential pressure cell **37**, such, for example, as those manufactured by The Foxboro Company of Foxboro, Massachusetts, and known as their Model 13A. The output signal **38** from the cell **37** may lead to a ratio controller **39** for a purpose presently to be described.

Water is adapted to be introduced into the separator **10** from a supply line **40** that includes a control valve **41** therein which may be pneumatically operated. The water may flow through a line **42** leading to the T-fitting **29** which latter is spaced sufficiently from the separator to ensure proper mixing of the water and mud before it enters separator **10**.

An orifice device **43** may be located in line **42** for

measuring the water flow therethrough, and it may be connected through lines 44 and 45 to another differential pressure cell 46, the output signal 47 therefrom leading to the ratio controller 39. The ratio controller 39 may be of the type manufactured by The Foxboro Company and known as their Model M/40. It may be preset to maintain a predetermined fixed ratio of mud to water entering the separator 10 and its signal 48 may control the operation of the pneumatic valve 41 to maintain such ratio constant.

While a predetermined ratio of mud to water may be maintained constant in passing into the separator 10, the effluent leaving the separator may vary in density depending upon the duration of time the mixture remains in the separator. In order to maintain the density of the effluent substantially constant, it is caused to pass out from the separator 10 through a line 49 leading to a U-tube arrangement 50 similar to a manometer.

In the line 49, forming one leg of the U-tube arrangement 50, may be located in spaced relation two differential pressure cells 51 and 52 of a particular design. They may be of the type manufactured by The Foxboro Company and known as their Model 13A. They present to the effluent in line 49 diaphragms 53 and 54. The signals 55 and 56 from the cells 51 and 52 are fed to a subtraction relay 57, the output signal 58 from which leads to the load controller 25.

As previously explained, load controller 25 also receives a signal from line 24, and the output signal 59 therefrom controls the variable displacement pump 31 to control the amount of mud being fed by the mud pump 27 to the separator 10. At the same time, the ratio of mud to water is maintained substantially constant to thereby produce an effluent of substantially constant density.

Although the various features of the new and improved

separating system and control therefor have been described in detail to fully disclose one embodiment of the invention, it will be evident that changes may be made in such details and certain features may be used without others without departing from the principles of the invention.

What is claimed is:

A system for separating and classifying solids, comprising in combination a separator including a rotatable beach and a rotatable conveyor therein; means for driving said beach; a hydraulic pump and motor system for driving said conveyor in a predetermined relation relative to said beach; a pump for feeding material to be treated to said separator; a hydraulic variable displacement pump and motor system for driving said feeding material pump; means for measuring the density of the effluent discharging from said separator; a controller responsive to the pressure of liquid in said conveyor driving system and the density of said effluent for varying the displacement of said variable displacement pump and thereby the amount of separation; and adjustable means responsive to the flow of liquid in said variable displacement pump and motor system and the flow of liquid to said separator for maintaining substantially constant a predetermined ratio of liquid to material to be treated being fed to said separator.

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