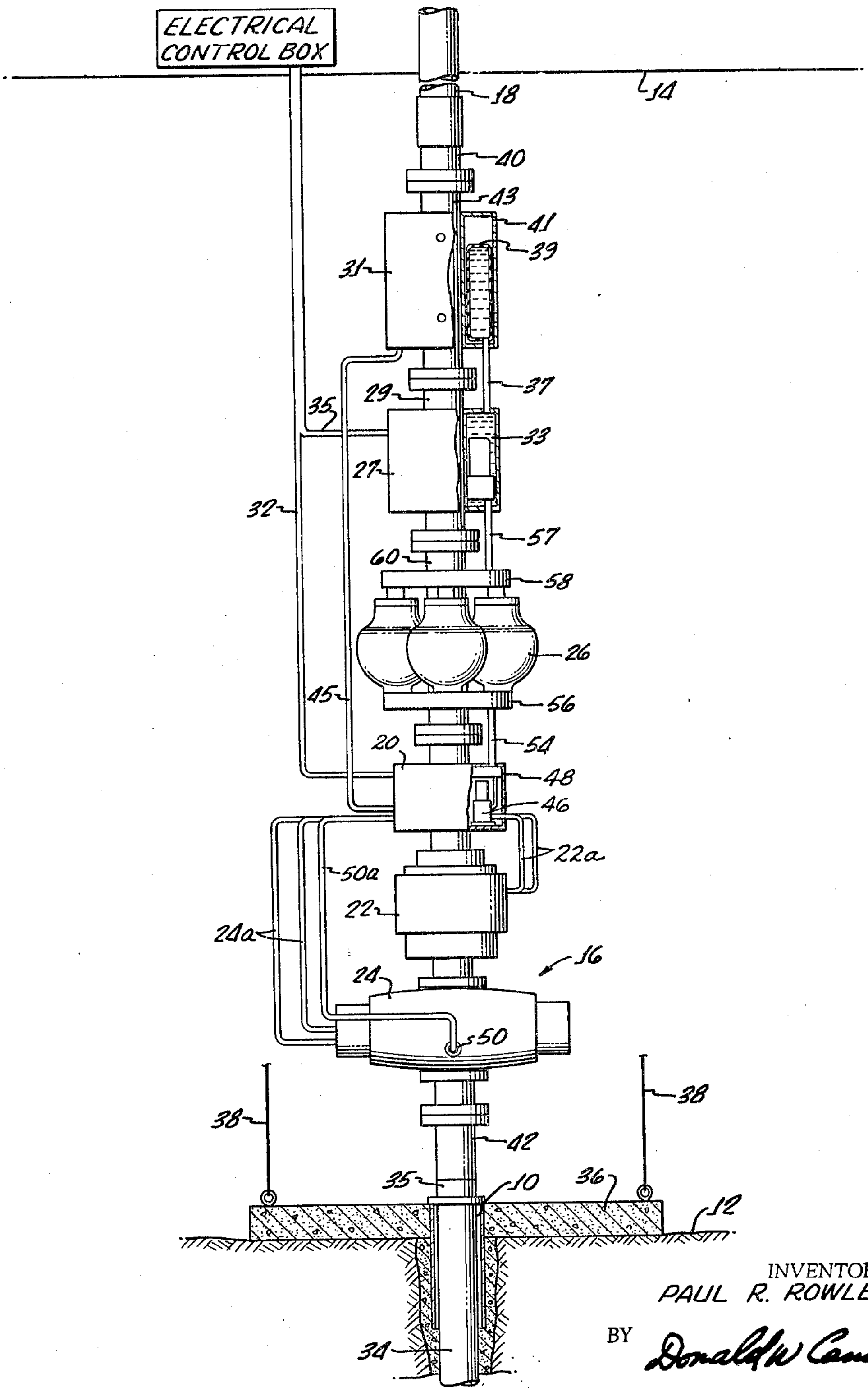
Feb. 24, 1970 P. R. ROWLEY 3,496,999

SELF-CONTAINED BENTHONIC BLOWOUT PREVENTION CONTROL APPARATUS AND METHOD

Filed Dec. 26, 1967



INVENTOR.
PAUL R. ROWLEY

BY Donald W Canady

ATTORNEY.

United States Patent Office

3,496,999
Patented Feb. 24, 1970

1

3,496,999

SELF-CONTAINED BENTHONIC BLOWOUT PREVENTION CONTROL APPARATUS AND METHOD

Paul Robert Rowley, Long Beach, Calif., assignor to Atlantic Richfield Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Dec. 26, 1967, Ser. No. 699,001
Int. Cl. E21b *7/12*
U.S. Cl. 166—.5 **4 Claims**

ABSTRACT OF THE DISCLOSURE

This application relates to the control of fluid operated equipment on the ocean floor during drilling operations conducted from a floating vessel through a riser extending between the ocean floor and the vessel. Hydraulic fluid is stored in a benthos reservoir, from which it is pumped to a group of accumulators by a motor pump assembly. From the accumulators, the pressurized hydraulic fluid is piped through a valve and manifold assembly to the individual components of the blowout preventer stack. The valve and manifold assembly consists of a series of electrically actuated valves which control the fluid applied to the individual blowout preventer units, and which are electrically controlled from the vessel to provide means for controlling the blowout preventers from the vessel. The reservoir, accumulators, and motor pump assembly are each arranged annularly around the lower end of the riser adjacent the blowout preventer stack.

Ocean floor drilling equipment, such as blowout preventers, latching mechanisms, etc., are normally controlled by fluid pressure applied through hoses extending between the vessel and the individual blowout preventer units. Such hoses are shown, for example, in U.S. Patent No. 3,236,308 to Leake. Relatively high fluid pressure is normally maintained in these hoses and they frequently fail under working and flexure conditions at such pressures. Replacement of the hoses to the individual blowout preventers is costly in that it is time consuming and requires the use of divers, or in deep water installations may require retrieval of the blowout prevention equipment to the vessel for replacement of the hoses. Having a multiplicity of hoses running from the vessel to the ocean floor increases the incidence of failure and also gives rise to hose entangling which often requires the services of a diver for untanglement. The elimination of all high pressure hydraulic hoses from the vessel to the ocean floor equipment is desirable to avoid the aforementioned complications. Accordingly, it is considered desirable to provide a system for controlling benthos blowout prevention equipment by supplying only electrical energy to the benthos well head equipment.

It is an object of my present invention to provide a system for drilling from a floating vessel with the blowout prevention equipment positioned on the ocean floor without the need for high pressure, hydraulic control lines extending between the vessel and the benthos equipment.

It is also an object of my present invention to provide a system for drilling a benthos well from a floating vessel with the blowout prevention hydraulic control equipment located on the ocean floor, but operated remotely from the vessel.

It is a further object of my present invention to provide a system for drilling an underwater well from a floating drilling vessel, with the hydraulic control fluid stored and distributed to the individual blowout preventers from equipment positioned on the lower end of the riser pipe proximate the ocean floor.

2

Other objects and a more complete understanding of my present invention will be appreciated by reference to the drawing wherein an offshore drilling arrangement is shown diagrammatically with the floating drilling vessel arranged over the benthos well.

Referring more particularly to the drawings, a well **10** is drilled in a water covered formation **12** from a floating drilling vessel **14** in the conventional manner and a blowout preventer stack **16** installed at the ocean bottom on the lower end of a riser **18** which extends from the vessel to the well opening. The blowout prevention equipment, referred to generally as **16**, is conventional equipment which may be fluid or hydraulically operated through control hoses extending from a valve and manifold assembly **20** to the individual blowout preventers **22** and **24**. The valve and manifold assembly receives hydraulic fluid from a series of annularly spaced accumulators **26** which are manifolded together and receive pressurized hydraulic fluid from motor-pump assembly **27** which is arranged annularly around sub **29**. The blowout preventers **22** and **24** are individually controlled by an electrical cable **32** extending between the valve and manifold assembly and the vessel **14** and containing sufficient wires to serve each of the blowout preventer units. In addition to the blowout preventers, the valve and manifold assembly may also be used to regulate the hydraulic control fluid to other benthos well head equipment, e.g. kill line valve **50**.

The accumulators **26** receive pressurized hydraulic fluid from water pump assembly **27**. The motor-pump assembly **27**, shown in cutaway view, may contain several vertically oriented motors and pumps and a pressure switch in an oil-filled annular space between the riser sub **29** and an outer casing **33**. The pumps within the motor-pump assembly **27** are small but relatively high pressure pumps driven by electrical motors which receive electrical energy through the electrical cable **35** which extends to the vessel with electrical cable **32**. The motor pump assembly has two lines, one line **37** to the reservoir **31**, and line **57** leading to the oil side of the accumulators. The annular reservoir **31** may be of any suitable design such as a sleeve-type bladder **39** within the annular space between reservoir casing **41** and the riser sub **43**. A line **45** provides fluid communication between the valve and manifold assembly **20** and the reservoir **31** to release the hydraulic pressure from the blowout preventer units.

As a typical manner of installing and operating the system of the present invention, the surface pipe **34** may first be run and cemented in any conventional manner. Normally a base **36** is lowered on the drill string (not shown) and set on the ocean bottom **12** and the well drilled sufficiently to receive the surface pipe **34**. The surface pipe is then guided into the hole on the guidelines **38** with a bit guide (not shown) and hung with a landing mandrel **35** attached to the upper end of the surface pipe, either on the base **38** or a conductor pipe, and the surface pipe is then cemented to the formation **12**. The surface pipe may be run into the hole on a conventional safety release joint **42** which preferably is internally actuatable.

The blowout preventer stack **16** is attached to the lower end of the riser **18** with a conventional safety release joint

40 and run until the lower end of the blowout preventer stack is latched to the upper end of the surface casing mandrel **35** with safety release joint tool **42**. Drilling is conducted by operating through the riser **18**, a drill pipe (not shown) having a bit on its lower end. Conventional rotary equipment (not shown) is positioned on the vessel for rotating the drill pipe.

The blowout preventer stack **16** as shown includes a double Shaffer gate **24** and a Hydril bag-type blowout preventer **22**. Each of the units **22** and **24** are hydraulically controlled through their control hoses **22a** and **24a**, respectively, which interconnect these units with the valve and manifold assembly **20**.

A kill line valve **50** is shown on the casing of the blowout preventer **24** for injection of weighting mud through a kill line for killing the well in the event of a high pressure condition below.

The valve and manifold assembly **20** consists of a group of remotely actuable valves **46** which control the flow of hydraulic pressure from the accumulators **26** to the hydraulically controlled units **22** and **24**. Hence when it is desired to close the blowout preventer **22** to seal around the drill pipe, a valve **46** which is shown in the cutaway portion of valve and manifold assembly **20**, is actuated from the vessel through electrical conductors in cable **32**, to admit, for example, hydraulic pressure from the accumulators **26** to the Hydril unit **22** to close the Hydril rubber seal element (not shown) around the drill pipe in the conventional manner. The valve and manifold assembly **20** contains sufficient valves **46** to control each of the hydraulically operated units in the blowout preventer stack **16**. Preferably the valves are positioned in an oil-filled annular space within the external protective casing or cylinder **48**. In the embodiment shown, the valve and manifold assembly **20** has eight hydraulic lines or hoses connected thereto, two each for the operation of units **22** and **24** and the kill line **50a** and one line connected to hydraulic fluid reservoir, and a line **54** interconnecting the valve and manifold assembly with the annular accumulator manifold **56**.

The accumulator assembly comprises sufficient accumulators **26** necessary to store the amount of energy required. An accumulator may be a conventional accumulator which is essentially a high-pressure vessel with a diaphragm inside which separates hydraulic fluid from a high pressure gas, the purpose of the accumulator being merely to store energy in a compressed gas. The expansion of the gas forces hydraulic fluid through the control lines when the switch valves **46** in the valve and manifold assembly **20** are opened. As shown in the drawing, three accumulators are symmetrically spaced around a riser sub and manifolded together at the outlet **56** and inlet manifold **58**. The annular manifolds may serve as connecting means which are affixed to the riser pipe sub **60** in any convenient manner, as with a bracket on a frame supporting the annular manifold. The line **54** between the accumulators and the valve and manifold assembly may be a solid pipe. A flexible charging line **57** conveys a high pressure fluid from the motor pump assembly to the manifolded accumulators **26**.

The accumulator assembly, the motor pump assembly **27**, the reservoir **31**, and each of the blowout preventer elements **22** and **24** may be considered part of the riser in that they have a central opening which is contiguous with the central opening of the riser pipe **18**. These units are arranged on special subs, for example, the accumulator sub **60** which is flanged at **64** and **66** above and below, respectively.

Hence, it can be readily seen by my invention that only electrical energy is provided to the ocean floor drilling equipment, thus eliminating hydraulic connections between the vessel and the ocean floor and eliminating a source of diver expense.

Electrical controls on the boat permit remote operation of the valves and valve and manifold assembly **20** and the motor pump assembly **27** to permit remote control of the various hydraulically controlled units **22**, **24**, and kill line valve **50**.

While my invention is described with reference to an electrical device which would normally utilize a solenoid to actuate the valves **46** in the assembly **20**, it is also within the scope of my present invention to employ electronic equipment which would eliminate the need for the electrical cable **32**.

While my present invention has been described herein with respect to certain specific apparatus, it is to be understood that various modifications in my invention may be made by substitution of equivalent components without departing from the spirit of my invention, and hence my invention should be afforded the full scope of the appended claims.

I claim:

1. A system for controlling blowout prevention equipment affixed to the lower end of a riser extending between a formation underlying a body of water and a structure proximate the surface of said water, comprising in combination:

(a) an accumulator assembly including a plurality of accumulators manifolded together proximate said blowout prevention equipment,

(b) a hydraulic motor-pump assembly positioned proximate said accumulator assembly with a line interconnecting said accumulator assembly with said motor-pump assembly,

(c) a hydraulic fluid reservoir in fluid communication with said motor-pump assembly,

(d) a valve and manifold assembly proximate said blowout prevention equipment arranged and constructed to control the flow of hydraulic fluid from said accumulators to said blowout prevention equipment through hydraulic control valves, said valve and manifold assembly being in fluid communication with said accumulators and said reservoir, and

(e) means for actuating said valves remotely to control said blowout prevention equipment from said structure.

2. The apparatus of claim **1** wherein said motor-pump assembly, said reservoir, said accumulator assembly, and said valve and manifold assembly are arranged annularly around each riser.

3. The apparatus of claim **1** wherein said valve and manifold assembly is connected to said blowout prevention equipment to provide for discharge of hydraulic fluid from said blowout prevention equipment.

4. A system for controlling blowout prevention equipment affixed to the lower end of a riser extending between a formation underlying a body of water and a structure proximate the surface of said water, comprising in combination:

(a) a motor-pump assembly positioned proximate said blowout prevention equipment,

(b) means for supplying electrical energy to said motor-pump assembly from said structure,

(c) a hydraulic fluid reservoir annularly arranged around said riser proximate with said motor-pump assembly and in fluid communication therewith,

(d) a series of accumulators arranged proximate said motor-pump assembly and in fluid communication therewith whereby said motor-pump assembly pumps hydraulic fluid from said reservoir to said accumulators,

(e) means for distributing pressurized hydraulic fluid from said accumulators to said blowout prevention equipment, and

(f) means for remotely actuating said blowout prevention equipment from said structure.

(References on following page)

References Cited

UNITED STATES PATENTS

3,064,735	11/1962	Bauer et al.	166—.6
3,163,224	12/1964	Haeber et al.	166—.6
3,186,486	6/1965	Rhodes et al.	175—7 X
3,199,595	8/1965	Lafitte et al.	166—.6
3,211,223	10/1965	Hoch	166—.6
3,219,118	11/1965	Lewis	166—.6
3,338,302	8/1967	Hubby	166—.5
3,339,632	9/1967	Lewis	166—.6
3,405,387	10/1968	Koomey et al.	166—.5 X

CHARLES E. O'CONNELL, Primary Examiner

RICHARD E. FAVREAU, Assistant Examiner