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[54] **DEVICE FOR PUTTING OUT OIL WELL FIRES**
15 Claims, 6 Drawing Figs.

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A62c 37/04, F21b 35/00

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64, 65, 75, 90, .5; 169/2, 4, 11, 16; 175/9

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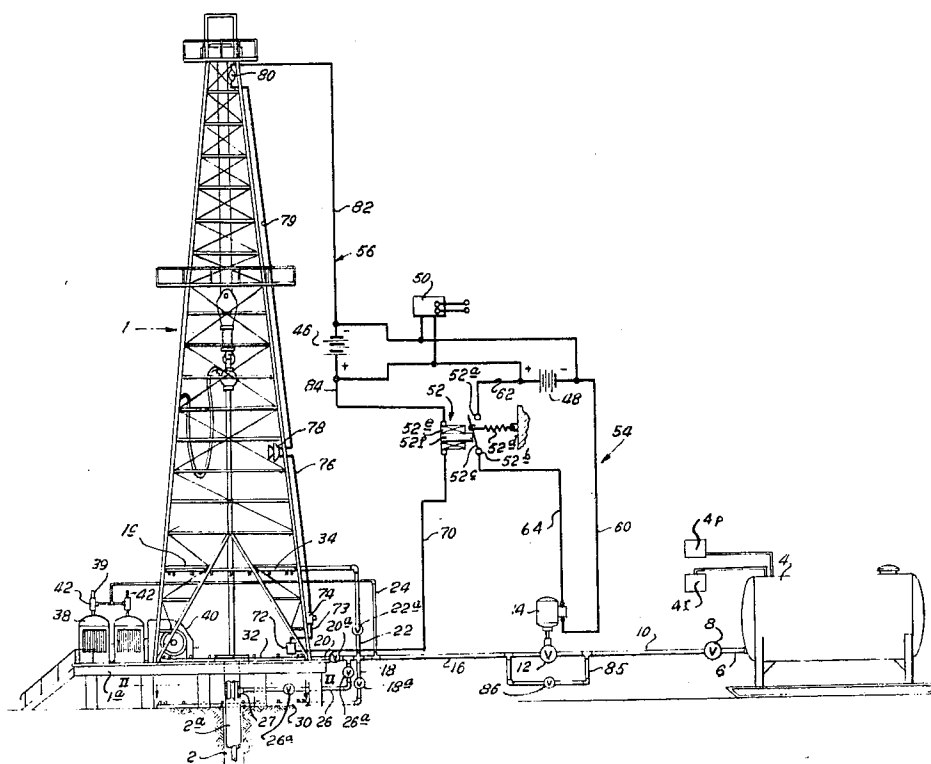
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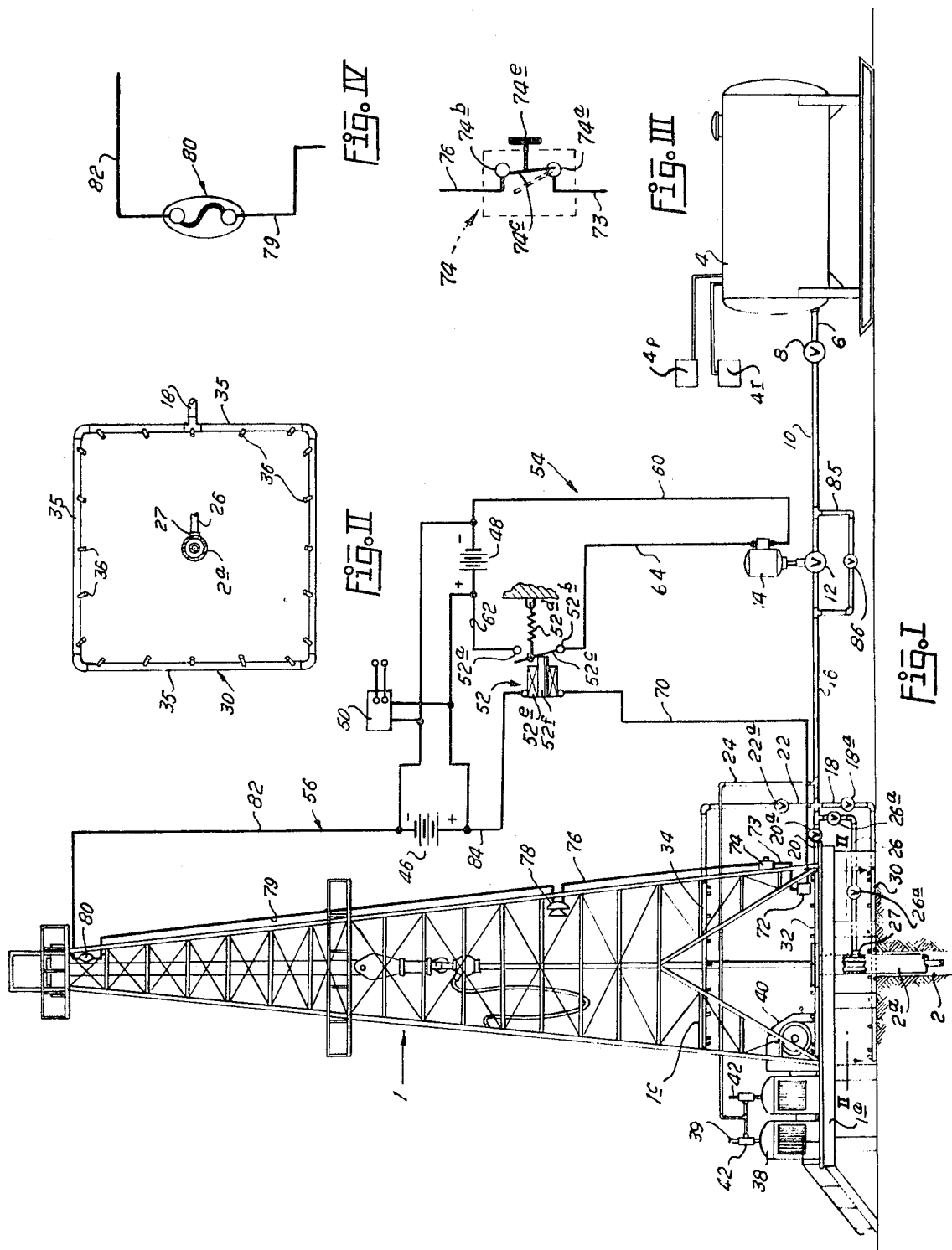
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ABSTRACT: An extinguishing manifold around the opening of an oil well and a control circuit actuated by heat, air pressure or manually to open a valve to cause carbon dioxide to be dispensed from the manifold to prevent or extinguish an oil well fire. The carbon dioxide may also be injected into the well casing, and used to cool the exhaust pipes of engines at the well site. On an offshore rig, the carbon dioxide container is attached to a leg of the platform, below water.





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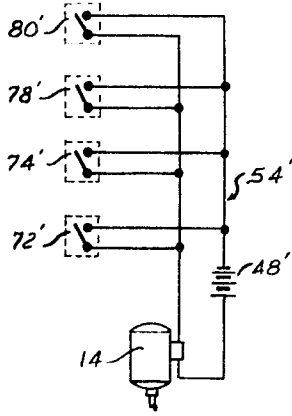


Fig. V

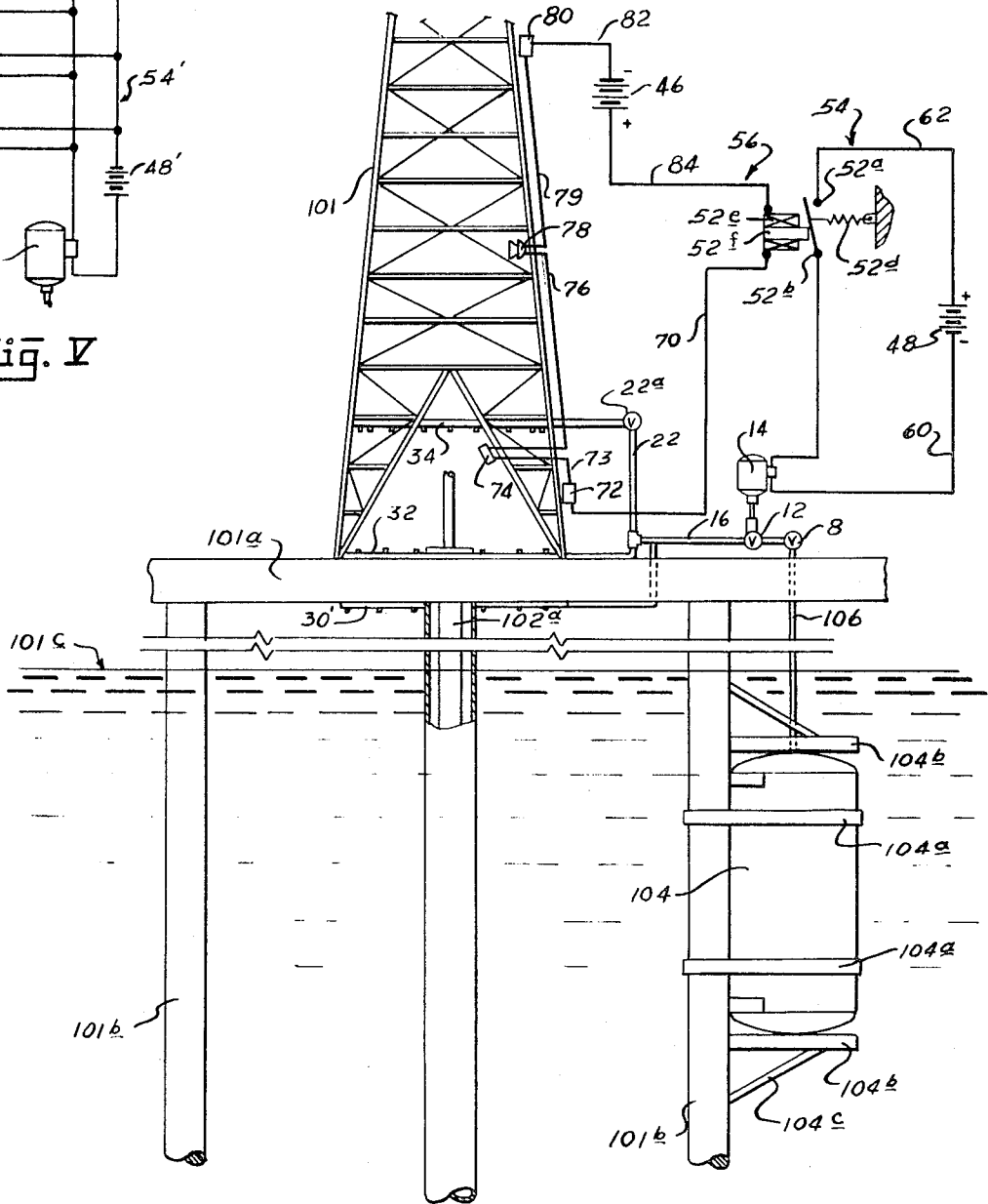


Fig. VI

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DEVICE FOR PUTTING OUT OIL WELL FIRES

BACKGROUND OF THE INVENTION

The possibility of blowout is an ever-present danger to personnel and equipment on drilling rigs. Large sums of money are spent for equipment and in training personnel in an effort to prevent blowouts. However, a shortage of trained and experienced workmen, unexpected occurrences and widely varying working conditions together with nonstandardized procedures and equipment results in blowouts accompanied by fire.

A well fire is very dangerous to personnel and is extremely costly because valuable equipment is usually damaged beyond repair and large quantities of oil and gas are wasted.

A well fire usually requires the services of highly skilled technicians for bringing the fire under control. These technicians are usually retained on a standby basis at great expense to the driller.

In view of the extent of damages normally accompanying a blowout and fire, most drillers expend large amounts of money for insurance premiums to cover liabilities and to cover damages which will be incurred in case of a blowout. This expense is passed on to the consumer in increased prices of gasoline and other petroleum products.

SUMMARY OF INVENTION

I have developed apparatus including an extinguishing manifold which may be positioned around an oil well opening connected to a source of extinguishing fluid, preferably carbon dioxide, wherein the fluid may be dispensed through the manifold when a blowout, leakage or fire occurs at the well-head. A valve in a line between the manifold and the source of extinguishing fluid may be opened by manipulating any one of a series of switches which are responsive to one or more preestablished occurrences. For example, the valve may be opened manually to prevent fire when leakage is detected or a blowout is suspected. The valve may be opened automatically by a thermostat control or by air pressure sensitive means if leakage or blowout is not detected in time to prevent a fire.

The primary object of the invention is to provide apparatus which may be installed and used with conventional drilling equipment to prevent or put out oil well fires.

A further object of the invention is to provide apparatus for preventing and putting out oil well fires which may be operated manually or automatically by unskilled workmen.

A further object of the invention is to provide apparatus for preventing and putting out oil well fires which minimizes danger to personnel and equipment on the rig.

A further object of the invention is to provide apparatus for preventing and putting out oil well fires having a plurality of means for dispensing extinguishing fluid whereby the malfunction of a single dispensing means will not result in failure of the apparatus.

A still further object of the invention is to provide apparatus for preventing and extinguishing oil well fires wherein extinguishing fluid is injected into the well casing to be mixed with gas and oil as they are being blown from the well.

A still further object of the invention is to provide apparatus for preventing oil well fires including means for cooling the exhaust pipes of engines employed for driving the draw works, pumps and the like as soon as a blowout is detected to prevent ignition of combustible gases and oil which might contact the exhaust pipes.

Other and further objects of the invention will become apparent from the following detailed description and by reference to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

The enclosed drawings of the preferred embodiment of the invention are provided so that the invention may be better and more fully understood, in which:

FIG. I is a diagrammatic view of structure embodying the present invention mounted in relation to a conventional oil derrick;

FIG. II is a cross-sectional view taken along lines II—II of FIG. I illustrating details of construction of an extinguishing manifold;

FIG. III is an enlarged diagrammatic view of a manually operated switch;

FIG. IV is a diagrammatic view of a fusible link;

FIG. V is a schematic diagram of a modified form of the invention; and

FIG. VI illustrates a third form of the invention.

Numeral references are employed to designate like parts throughout the various figures of the drawing.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. I of the drawing, oil derrick 1 has suitable dispensing means positioned about borehole 2 for dispensing extinguishing fluid from container 4 to prevent or to put out oil well fires.

Natural gas and fuel oil are combustible, but a large amount of oxygen is required before combustion can be accomplished. Carbon dioxide gas is very effective for extinguishing fires because it displaces oxygen, preventing combustion. However, heretofore the use of carbon dioxide gas was not feasible for extinguishing oil well fires because of the large quantities required to do so.

While any suitable extinguishing fluid may be utilized, the following description will be limited to the use of carbon dioxide gas.

Container 4 and the contents thereof may be maintained at any desired temperature and pressure by suitable pressurization and refrigeration means 4p and 4r.

The critical temperature (the temperature just above which no pressure, no matter how great, can liquefy gas) of carbon dioxide is 88° F. The critical pressure (the pressure which just suffices to liquefy the gas at the critical temperature) of carbon dioxide is 1,073 pounds per square inch. As temperature is reduced, the pressure required to maintain the carbon dioxide in the liquid state is decreased.

Carbon dioxide is in the liquid state when maintained at 0° F. under 300 pounds per square inch pressure, limits which may be achieved in the field. Under normal operating conditions container 4 should be refrigerated and pressurized to assure that the carbon dioxide is maintained in the liquid phase which facilitates pumping at high velocity through conduits or allows the carbon dioxide to be simply released into the atmosphere.

One end of conduit 6 communicates with the inside of container 4 and the other end thereof is connected to shutoff valve 8.

Shutoff valve 8 is of conventional construction having a passage extending therethrough which may be opened or closed as desired by manipulating suitable closure means therein.

Valve 8 is connected by conduit 10 to valve 12 which may be opened and closed by suitable actuating means such as a solenoid or motor 14 controlled by a suitable electrical circuit as will be hereinafter more fully explained.

Valve 12 is connected through line 16 to branch lines 18, 20, 22, 24 and 26 for controlling the flow of liquid carbon dioxide to suitable dispensing means which may be positioned in any desired location around the well opening.

In the particular embodiment illustrated in the drawings, lines 18, 20 and 22 are connected through a suitable coupling to conduit 16 and the other ends thereof are connected to manifolds 30, 32 and 34 respectively.

Manifold 30 is anchored to the ground underneath the floor 1a of oil derrick 1. Manifold 32 is anchored to the upper side of the derrick floor. Manifold 34 is positioned in the derrick 1 above the floor, preferably around the first girth 1c of the derrick.

Manifolds 30, 32 and 34 are of identical construction. A plan view of manifold 30, illustrated in FIG. II, consists of tubular members 35 having nozzles 36 disposed on the inner side thereof directed radially toward the well bore 2. Tubular

members 35 of manifold 30 are connected through a suitable connector to line 18 which is in turn connected through a connector to conduit 16.

It should be readily apparent that carbon dioxide will be dispensed from nozzles 36 of manifolds 30, 32 and 34 when valve 12 is opened.

Valves 18a, 20a and 22a, disposed in lines 18, 20 and 22 respectively, will normally be in the open position. However, it if is desired that carbon dioxide not be dispensed from one or more of the manifolds, the valves may be manipulated as desired.

One end of line 26 communicates with conductor 16 through a suitable connector and the other end thereof is connected to the inside of surface casing 2a in the borehole 2, forming a venturi 27. A check valve 26a is provided in line 26 to prevent backflow through line 26 when the well pressure exceeds the pressure in conduit 16.

In case of blowout high-velocity fluids will be flowing through surface casing 2a. When valve 12 is opened, carbon dioxide will be drawn through line 26 and mixed with the fluids in casing 2a as a result of the well-known principles commonly referred to as venturi effect.

A blowout may not ignite if the gas and oil is not exposed to open flame, sparks or hot objects. The exhaust pipes on engines 38 which provide power to drawworks 40 reach very high temperatures and may ignite oil which blows from the well.

Line 24 is connected to pipes 42 which extend around a portion of exhaust pipe 39 of each engine 38 whereby opening valve 12 will cause carbon dioxide to be dispensed through conduit 16 and line 24 into pipes 42 around each exhaust pipe 39 to chill same instantaneously. If valve 12 is opened before a fire is started, cooling exhaust pipes 39 may prevent combustion.

An electrical circuit comprises blowout condition sensing and detecting means for automatically monitoring conditions adjacent to the exterior of the casing has heat-sensing means 72 and 80; is capable of being energized manually; and is electrically connected to motor 14. In the particular embodiment illustrated in the drawing, direct current power supplies 46 and 48 are utilized for energizing circuits 56 and 54 because electricity is usually turned off as soon as a blowout is detected to prevent fire. A conventional trickle charger 50 may be employed to assure that batteries 46 and 48 are fully charged at all times.

An electromagnetically operated single-pole relay 52 or other current-responsive switching means is utilized to close an energizing circuit 54 when the sensing circuit 56 is broken manually or by sensing means 72, 78, 80 as will be hereinafter more fully explained.

The energizing circuit consists of a line 60 having one end thereof connected to the windings of motor 14 and the other end thereof connected to the negative terminal of battery 48. The positive terminal of battery 48 is connected through line 62 to contact 52a of relay 52. Contact 52b of relay 52 is connected through line 64 to the opposite side of the windings of motor 14 thereby completing a loop forming the energizing circuit 54.

Pole 52c of relay 52 is urged toward contact 52a as by spring 52d causing energizing circuit 54 to be completed.

A coil 52e of relay 52 is disposed in a sensing circuit 56.

One end of coil 52e is connected through line 70 to suitable heat-sensing means such as thermostatically controlled switch 72. Switch 72 may be of any conventional design for example, a bimetallic strip positioned to open the contacts of the switch when the temperature reaches a predetermined value. Thermostatically controlled switch 72 may be positioned at any desired location for sensing excessive temperature at or near the opening of borehole 2.

Thermostatically controlled switch 72 is connected in series with pushbutton switch 74, best illustrated in FIG. III, through a line 73. Switch 74 is a conventional single-pole, single-throw switch and consists of fixed contacts 74a and 74b which are

normally connected by movable pole 74c. When button 74e is pressed, pole 74c is moved away from contact 74b to break the sensing circuit. Switch 74 may consist of any suitable switching medium.

Contact 74b of switch 74 is connected through line 76 to a suitable pressure-actuated switch 78. The pressure-actuated switch 78 is of conventional construction and is of the type normally employed to break a circuit when air pressure or sound at a predetermined level is detected. Switch 78 will be opened by sound waves or air pressure if an exceptionally loud noise, such as an explosion, is sensed. However, switch 78 will not be opened by noises normally accompanying drilling operations such as dropping of tools and the like.

Switch 78 is connected in series through line 79 with fusible link 80, best illustrated in FIG. IV of the drawing.

Fusible link 80 is of conventional construction and has a wire therein which will melt at a predetermined temperature level thereby opening the circuit.

The other side of fusible link 80 is connected through line 82 to the negative terminal of battery 46. The loop of the sensing circuit is completed by line 84 which connects the positive terminal of battery 46 with the coil 52e of relay 52.

When current is flowing through sensing circuit 56 coil 52e of relay 52 is energized and armature 52f causes pole 52c to disengage contact 52a holding energizing circuit 54 open.

From the foregoing, it should be readily apparent that motor 14 is inoperative as long as energizing circuit 54 is broken by current flowing in the sensing circuit 56 through coil 52e of relay 52. However, since thermostatically controlled switch 72, manually operated switch 74, sound-detecting switch 78 and fusible link 80 are connected in series in the sensing circuit 56, opening any one of these switches will break the sensing circuit 56, causing pole 52c of relay 52 to move into engagement with contact 52a, thereby closing energizing circuit 54. When energizing circuit 54 is closed, motor 14 will open valve 12, causing carbon dioxide to flow from container 4 through line 16 to the various dispensing devices as hereinbefore described.

DESCRIPTION OF A SECOND EMBODIMENT

A modified arrangement of the electrical circuit 54' for energizing motor 14 is illustrated in FIG. V. The modified circuit includes thermostatically controlled switches 72' and 80', manually operated switch 74' and pressure-responsive switch 78' connected in parallel, each being normally open. Closing any one of the switches 72', 74', 78' or 80' completes a circuit from battery 48' through the closed switch to motor 14 causing valve 12 to be opened.

It should be noted, that breaking a wire, as by an explosion, in the modified circuit shown in FIG. V opens the circuit deenergizing motor 14. In the first embodiment, FIG. I, the energizing circuit 54 may be located a safe distance from the well and breaking a line in the sensing circuit 56 will not deenergize the motor 14.

A bypass line 85 connects conduit 10 with conduit 16 routing carbon dioxide around valve 12. A manually controlled valve 86, which is normally closed, may be opened as an alternative means for releasing carbon dioxide gas. It should be readily apparent that a malfunction of the electrical system employed for opening valve 12 will not effect the operation of manually operated valve 86.

DESCRIPTION OF A THIRD EMBODIMENT

Oil well fires on offshore rigs create a particularly hazardous condition because large numbers of workmen are concentrated in a small area on a platform above the surface of water. The primary consideration of workmen when it is discovered that a blowout is imminent is to clear the platform as quickly as possible. Workmen load into boats or "survival capsules" to escape the danger of the fire. Most survival capsules are fire resistant and completely enclosed to prevent suffocation of workmen.

The preferred embodiment of the present invention shown in FIGS. I-IV and the second embodiment shown in FIG. V are adaptable for use on an offshore rig as shown in FIG. VI of the drawing. Oil derrick 101 is mounted in conventional manner on a platform 101a which is secured to support legs 101b which extends downwardly from the said platform having lower ends anchored in the earth on the ocean floor.

Since space on the surface of platform 101a is limited and very expensive to construct, container 104 having extinguishing fluid therein is mounted on one of the legs 101b of the platform. Positioning container 104 on a support leg 101b below water line 101c allows installation of the invention hereinbefore described on the offshore rig without interfering with normal operating procedures because said container does not occupy any space upon the surface of drilling platform 101a. It should also be noted that container 104 may be submerged to a depth so as not to interfere with watercraft which are operated below platform 101a. The weight and buoyancy of container 104 may be substantially equalized if it is deemed expedient to do so. Any suitable attachment means may be employed for securing container 104 to support leg 101b, such as bands 104a, retainer ledges 104b and braces 104c.

Conduit 106 communicates with the inside of container 104 and the other end thereof is connected to shutoff valve 8. Manifolds 30, 32 and 34 are positioned adjacent casing 102a as hereinbefore described in the description of the preferred embodiment of the invention. However, manifold 30' may be secured to the lower surface of platform 101a.

From the foregoing detailed description of suitable embodiments of my invention, it should be readily apparent that very simple structure is employed for carrying out the objects of my invention. No training is necessary to use the device and it may be employed before a blowout occurs to prevent a fire or after a fire has started to extinguish the fire. Carbon dioxide gas may be turned off by merely closing manually operated valve 8.

In addition to the advantages hereinbefore set out, it should be readily appreciated that the carbon dioxide gas dispensed from manifolds 30, 32 and 34 and venturi 27 will be blown by the wind in the same direction that the oil and gas is being blown. This will cause carbon dioxide gas to encompass and smother the flame even though the wind is blowing. It should also be readily apparent that the cold carbon dioxide gas will tend to cool metal objects on the derrick to prevent reignition of oil and gas coming in contact therewith. It should also be noted that the heat-sensing means, thermostat control switch 72 and fusible link 80, are positioned at various locations in the derrick to assure that the sensing circuit 56 will be broken in case of fire.

Releasing the carbon dioxide gas at various levels below and above the opening of the well casing will assure that the carbon dioxide gas will be drawn into and encompass a fire and will mix with the oil as a result of convection currents and venturi effect. The carbon dioxide gas does not burn, nor does it support combustion, and being heavier than air, it forms a blanket around the well opening.

Having described my invention, I claim:

1. In apparatus for preventing and extinguishing oil well fires around a well casing; a source of refrigerated, pressurized liquid carbon dioxide; at least one manifold positioned around the exterior of the well casing said manifold having a plurality of inwardly directed openings spaced from said well to direct carbon dioxide toward a stream of fluid flowing out of the well; a conduit extending between the source of carbon dioxide and the manifold; and a first valve in the conduit for controlling the flow of liquid carbon dioxide therethrough.

2. The combination called in claim 1 with the addition of a bypass conduit communicating with the first-named conduit and connected thereto on opposite sides of the first valve; and a second valve in the bypass conduit for regulating the flow of carbon dioxide therethrough.

3. In apparatus for preventing and extinguishing oil well fires around a well casing, a source of refrigerated, pressurized

carbon dioxide; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of carbon dioxide and the nozzle; a valve in the conduit for controlling the flow of carbon dioxide therethrough; and means coupling the conduit with the exhaust pipes of engines adjacent to the well casing for dispensing carbon dioxide thereon when the valve is opened.

4. In apparatus for preventing and extinguishing oil well fires around a well casing, a source of refrigerated, pressurized carbon dioxide; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of carbon dioxide and the nozzle; a valve in the conduit for controlling the flow of carbon dioxide therethrough; a motor connected in driving relation with the valve; an energizing circuit connected to the motor; a source of electricity in the energizing circuit; current-responsive switching means in the energizing circuit; a closed sensing circuit connected to the electrically responsive switching means adapted to cause the switching means to hold the energizing circuit open as long as current is flowing in the sensing circuit; a source of electricity in the sensing circuit; and at least one switch in the sensing circuit whereby opening the switch in the sensing circuit causes the current-responsive switching means to close the energizing circuit to open the valve.

5. The combination called for in claim 4 with the addition of heat-responsive means outside the well for opening the switch in the sensing circuit at a predetermined temperature level.

6. The combination called for in claim 4 wherein the switch is a fusible link.

7. The combination called for in claim 4 wherein the well casing is secured relative to an offshore drilling platform; and with the addition of means for securing the source of carbon dioxide to a leg of the offshore drilling platform below water surface.

8. In apparatus for extinguishing combustion of fluids blown out of a well casing head, dispensing means adjacent said head; a conduit connected to the dispensing means; a valve in the conduit; means communicating with the conduit for forcing carbon dioxide through the conduit when the valve is opened; and actuating means arranged to open the valve by any of the following: change of temperature to a predetermined level at the wellhead; or change of air pressure to a predetermined level at the wellhead.

9. In apparatus for preventing and extinguishing oil well fires around a well casing on an offshore drilling platform, a source of refrigerated, pressurized carbon dioxide; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of carbon dioxide and the nozzle; a valve in the conduit for controlling the flow of carbon dioxide therethrough; and means for securing the source of carbon dioxide to the leg of the offshore drilling platform below water surface.

10. In apparatus for preventing and extinguishing oil well fires around a well casing head, a container; carbon dioxide in the container; means communicating with the inside of the container to maintain the carbon dioxide under pressure; means communicating with the inside of the container to maintain the carbon dioxide under refrigeration; dispensing means for carbon dioxide adjacent the exterior of the casing head; a conduit extending between the container and the dispensing means; a valve for controlling the flow of carbon dioxide through the conduit; current-responsive actuating means constructed and arranged to open the valve when current is supplied thereto; an energizing circuit connected to the current-responsive actuating means; a source of electrical current in the energizing circuit; a current-responsive relay having contacts in the energizing circuit between the source of current and the actuating means; a coil in the relay; a core in the relay arranged to maintain the contacts open when current is supplied to the coil; a sensing circuit connected to opposite sides of the coil; a second source of electrical current in the sensing circuit; and heat-responsive switching means in the sensing circuit positioned near the casing head for opening the

sensing circuit thereby closing the energizing circuit to open the valve when the temperature at the casing head reaches a predetermined value.

11. In apparatus for preventing and extinguishing oil well fires around a well casing, a source of extinguishing fluid; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of extinguishing fluid and the nozzle; a first valve in the conduit for controlling the flow of extinguishing fluid therethrough; a motor connected in driving relation with the first valve; an energizing circuit connected to the motor; a source of electricity in the energizing circuit; current-responsive switching means in the energizing circuit; a closed sensing circuit connected to the electrically responsive switching means adapted to cause the switching means to hold the energizing circuit open as long as current is flowing in the sensing circuit; a source of electricity in the sensing circuit; at least one switch in the sensing circuit positioned such that opening the switch in the sensing circuit causes the current-responsive switching means to close the energizing circuit to open the valve; and pressure-responsive means for opening the switch in the sensing circuit at a predetermined pressure.

12. In apparatus for preventing and extinguishing oil well fires around a well casing, a source of extinguishing fluid; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of extinguishing fluid and the nozzle; a first valve in the conduit for controlling the flow of extinguishing fluid therethrough; a motor connected in driving relation with the first valve; an energizing circuit connected to the motor; a source of electricity in the energizing circuit; current-responsive switching means in the energizing circuit; a closed sensing circuit connected to the electrically responsive switching means adapted to cause the switching means to hold the energizing circuit open as long as current is flowing in the sensing circuit; a plurality of switches connected in series in the sensing circuit; heat-responsive means for opening at least one of the switches at a predetermined temperature level; and pressure-responsive means for opening at least one of the switches at a predetermined pressure level.

13. In apparatus for extinguishing combustible fluids adjacent a wellhead, pressure-sensing means adjacent the exterior of the wellhead adapted to generate a signal when air pressure reaches a predetermined level; and dispensing means in communication with the inside of the well adapted to dispense noncombustible fluid into the well responsive to a signal generated by the sensing means.

14. In apparatus for extinguishing combustion of fluid issuing from a well, a manifold around the exterior of the casing, said manifold having at least one opening therein to direct carbon dioxide toward the stream of fluid flowing from the well; dispensing means communicating with the inside of the well casing positioned to form a venturi to mix carbon with the fluid in the casing; and means to release liquified carbon dioxide through the opening in the manifold and through the dispensing means such that carbon dioxide will be drawn into and encompass a fire and will mix with fluid before issuing from the well.

15. In apparatus for preventing and extinguishing oil well fires around a well casing, a source of refrigerated, pressurized carbon dioxide; at least one nozzle positioned adjacent the exterior of the well casing; a conduit extending between the source of carbon dioxide and the nozzle, a first valve in the conduit for controlling the flow of carbon dioxide therethrough; a branch line extending between the conduit and the inside of the well casing; a check valve in the branch line; the directional flow through the branch line being toward the well casing; a bypass conduit communicating with said conduit and connected thereto on opposite sides of the first valve; a second valve in the bypass conduit for regulating the flow of carbon dioxide therethrough; electrically operated means for opening the first valve; an energizing circuit connected to the electrically operated means; a source of electricity in the energizing circuit; switching means in the energizing circuit adapted to energize the electrically operated means to open the first valve causing carbon dioxide to be dispensed through the nozzle; and heat-responsive means positioned adjacent the exterior of the well casing for manipulating the switching means when the temperature adjacent the exterior of the casing reaches a predetermined value.

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