

Aug. 26, 1969

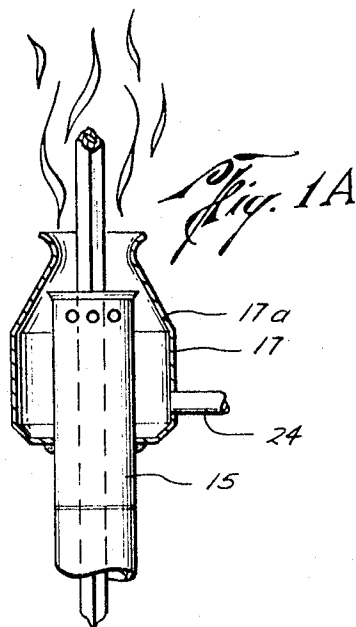
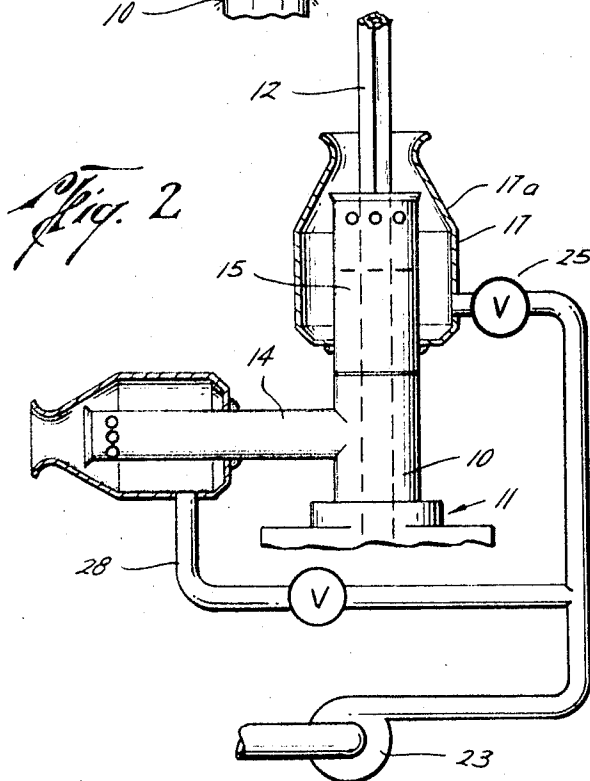
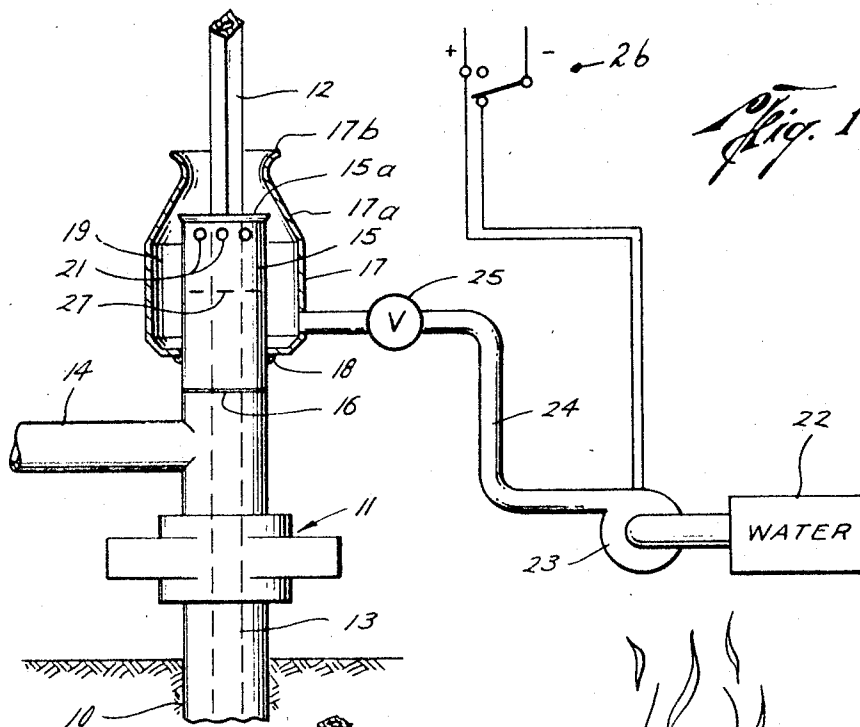
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3,463,227

FIRE ARRESTER FOR A PETROLEUM WELL

Filed Aug. 4, 1967

2 Sheets-Sheet 1



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Fig. 4

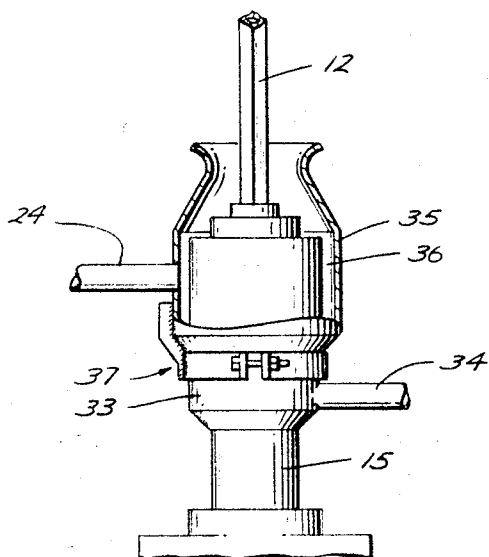
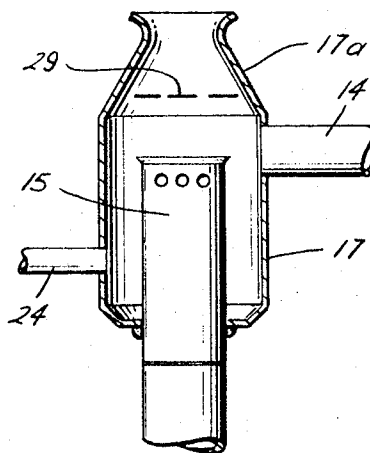


Fig. 3



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FIRE ARRESTER FOR A PETROLEUM WELL

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6 Claims

ABSTRACT OF THE DISCLOSURE

A fire arrester apparatus for introducing a fire extinguisher such as water into a housing surrounding a pipe from which gas passes at high velocity, with the housing forming with the end of the pipe a means for atomizing the fire extinguisher.

Background of the Invention

During the drilling of petroleum wells, conditions sometimes occur in which high-pressure gas cannot be controlled. Spectacular blowouts sometimes occur, resulting in tremendous fires and loss of equipment and even sometimes loss of the well. The wild well can be brought back under control by various expediences providing it does not catch fire, or the fire can be extinguished. In most instances the blowing gas and oil does catch fire due to broken wires, static electricity, engine exhaust blowing sparking rocks and sand against steel, etc.

Various types of blowout preventers, which are essentially valves which can be closed about the drill string, have been used for controlling the well by shutting off flow. In the event the blowout preventer for some reason cannot control the flow, there has been no practical means for preventing the escaping petroleum fluids from catching fire with resultant substantial loss in lives and property.

In the past it has been proposed that steam be introduced into the casing at a point several feet below the upper end of the pipe through which drilling is carried out. This is not practical as there is not an available supply of steam at the modern well site. It is impractical to supply a large volume of liquid fire extinguisher, such as water, at the substantial pressure required to overcome well pressures several feet below the point at which well fluids reach the atmosphere. Furthermore, fluctuations in pressure would cause slugs of water to be present and the lack of atomized water and uniform distribution would prevent complete blanketing of the gas stream to prevent combustion at the well head. See Pat. No. 1,640,839.

Summary of the Invention

By this invention there is provided an apparatus for loading the escaping fluid stream with a fire extinguisher under low pressure so that the resulting mixture will not support combustion. Thus, fires may be extinguished or prevented from occurring while remedial measures are being carried out to bring the well back under control.

More specifically, the apparatus of this invention has a housing surrounding a pipe through which gas may pass at high velocity. A liquid such as water is introduced into the housing at relatively low pressure but since the housing extends beyond the open end of the pipe, the housing forms with the pipe a means for atomizing the liquid fire extinguisher to extinguish any fire occurring in the gas being discharged from the pipe.

It is an object of this invention to provide a well fire arrester or preventer which is full-opening to permit drilling activities therethrough and which will introduce low-pressure fire extinguisher in atomized form into the petroleum stream.

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Another object of the invention is to introduce water into the blowing well petroleum stream to wet down sand and rock particles, to prevent sparking against the metal equipment and to prevent the forming of frictional static electricity in the blowing flow, which could set the well afire.

Another object of the invention is to provide a well fire arrester which thoroughly mixes a fire extinguisher, such as water, with an escaping petroleum stream at the time the petroleum stream is discharged to the atmosphere and thus is at low pressure.

Another object of the invention is to provide a well fire arrester which will atomize a low-pressure fire extinguisher with escaping petroleum fluids to prevent blow-out fires at wells while the drill pipe extends down through the arrester into the well.

Another object of the invention is to introduce a fire extinguisher uniformly around drill pipe in a well fire arrester at the mouth of the well to load the petroleum stream with atomized fire extinguisher so that no dead spots of petroleum stream can blow out of the arrester and ignite due to the lack of fire extinguisher.

Another object is to prevent a well fire by adding fire extinguisher, such as water, to a blowing petroleum stream as it leaves the mouth of the well to establish an extinguisher-petroleum ratio sufficient to prevent combustion.

Another object is to provide a nozzle opening above the blowout preventer assembly of a well being drilled where fire extinguisher and petroleum may be formed into a mixture and blown out of the nozzle in an atomized mixture of small particles for preventing fire.

Another object is to use in combination a well fire arrester to drill through for fire control and another well fire arrester on the end of the mud flow pipe for fire control at the end of the mud flow line.

Another object is to provide an apparatus for preventing well fires by mixing an atomized fire extinguisher with escaping well fluids just as they reach the atmosphere so that the well fluids will not support combustion.

Other objects, features and advantages of the invention will be apparent from the drawings, specification and claims.

In the drawings, wherein illustrative embodiments of this invention are shown, and wherein like numerals indicate like parts:

FIGURE 1 is a diagrammatic view showing parts of the system in elevation and parts of the system in cross-section;

FIGURE 1A is a fragmentary view partially in elevation and partially in cross-section showing the well on fire;

FIGURE 2 is a view similar to FIGURE 1 showing this invention also applied to the mud outlet or discharge line from a well;

FIGURE 3 is a fragmentary view partially in elevation and partially in vertical cross-section showing a slightly modified form of this invention; and,

FIGURE 4 is a view in elevation showing a still further modified form of this invention.

This invention is applied to a generally conventional drilling system. The well includes a casing 10 which will be cemented in place in the well bore in the conventional manner. Attached to the casing is a well head including blowout preventers as indicated generally at 11.

The kelly 12 extends down through the top of the well and engages the drill pipe shown in dotted lines at 13. Normal mud circulation is downwardly through the kelly and drill pipe and up through the casing annulus to the mud outlet pipe 14. Normally a bell housing extends upwardly above the mud outlet pipe 14 and a head of mud is pres-

ent in the bell housing. In this invention, the bell housing is replaced by the fire arrester.

In accordance with this invention, an atomized fire extinguisher is introduced into a fluid stream coming from the casing 10 before it reaches the atmosphere. Normally the fire extinguisher will not be present at the top of the casing and will only be delivered to the top of the casing at such time as there is an extreme danger of losing control of the well. If at any time it appears that control of the well is to be lost, or if control is suddenly lost, then the pump system is activated to deliver the fire extinguisher to the arrester system which replaces the bell housing. The fire extinguisher is delivered around the entire circumference of the casing 10 so that the entire stream from the casing will be blanketed, and the construction of the arrester is such that the fire extinguisher is drawn into the petroleum stream.

Referring specifically to the structure shown in FIGURE 1, the fire arrester includes a pipe 15 which is welded to the casing as at 16 and provides a continuation thereof. Preferably, the pipe 15 has the same internal diameter as the casing 10. The upper end 15a of the pipe 15 is chamfered outwardly to prevent well tools hanging up on the pipe as they are introduced into the pipe.

A fluid distribution means for distributing the fire extinguisher circumferentially about the pipe 15 is provided by an annular housing 17 about pipe 15 which has a fluid-tight seal within pipe 15 at its lower end as by the weld 18.

The housing 17 is spaced radially from pipe 15 to provide a distribution chamber 19 therebetween. The housing 17 extends upwardly above the upper end of pipe 15 to provide for fluid communication between the chamber and the upper end of pipe 15 about its entire circumference. It will be noted that a plurality of circumferentially spaced holes 21 are provided adjacent the upper end of pipe 15. These holes provide for loading of the interior section of the fluid stream escaping from the pipe.

The arrester is so constructed that the fire extinguisher is thoroughly atomized. In addition to extending above the pipe 15, the upper section of housing 17 is necked inwardly at 17a in an upwardly and inwardly extending frusto-conical manner. The smallest diameter of the necked-in portion is approximately the same as the inner diameter of the pipe 15. The necked portion is then chamfered outwardly at 17b to avoid tools hanging up on the housing. This construction will result in the petroleum gas stream from the well picking up the fire extinguisher and the fire extinguisher will be thoroughly atomized.

Any suitable fire extinguisher may be used which when mixed with a petroleum gas stream will prevent the stream from supporting combustion. Water is preferred, as it has been found that only a minute quantity of water is necessary to snuff out a fire. A source of water such as tank 22 may be connected to the chamber 19 through pump 23, line 24 and control valve 25. The pump may be operated electrically as shown and controlled by the switch indicated generally at 26.

In the normal drilling of the well, the presence of the fire arrester system is ignored. The pipe 15 acts as the bell nipple and the mud level rises therein to the level indicated by dashed line 27. The pipe 15, as well as the necked portion of the housing 17a, have a diameter equal to the inner diameter of the casing, and therefore there is no interference or obstruction to normal drilling operations. In other words, during normal drilling the fire arrester functions as a bell housing.

In the event control of the well is lost, or it appears that control may be lost, pump 23 is energized and valve 25 is opened so that fire extinguisher, such as water from tank 22, is delivered to chamber 19. The fire extinguisher will flow about the chamber and rise therein about the entire circumference of pipe 15.

Fire extinguisher will pass through holes 21 into the interior of pipe 15 to mix with the stream. In the form of arrester shown, water introduced through these holes

will tend to load the inner portion of an escaping petroleum stream. The water rising to the top of pipe 15 will mix with the petroleum stream from pipe 15 about its entire circumference. The expanding gas will pick up and atomize the water and thoroughly mix the water and gas. The water will wet down sand and rock particles to prevent sparking against the metal equipment and prevent forming of static electricity in the blowing stream.

In a recent demonstration, a 2-inch line was tapped into a pipeline under pressure of 640 to 680 pounds per square inch. The 2-inch line had a capacity of five to six million feet per day under these circumstances. A 100-gallon tank was partially filled with water and placed under pressure of 80 pounds. The water tank was approximately 250 feet away from the outlet of the 2-inch line, but the 250-foot line was full of water to the 2-inch line. The 2-inch line was opened and the escaping gas was ignited. The valve controlling the water line to a nozzle on top of the 2-inch line, of the design shown in FIGURE 1, was opened. Surprisingly, it was found that only about a gallon of water was required to extinguish the flame. In experimentation it was found that with the escaping gas ignited, the water valve when cracked and gradually opened would result in the bottom of the fire rising in response to increasing the flow through the water line. As the volume of water was increased, the flame was gradually snuffed out. Thus, if a well be on fire, as shown in FIGURE 1A, the introduction of water through the line 24 would result in extinguishing of the blaze.

FIGURE 2 is identical in all respects with FIGURE 1, with the exception of the mud outlet or discharge line 14. The mud outlet line 14 has been provided with a flame arrester identical to the flame arrester of FIGURE 1, except that it is smaller in size and that it is lying on its side. Water or other fire extinguisher introduced through line 28 will be under sufficient pressure that it will swirl about the entire chamber 19 and, while the greater amount of water would flow into the fluid stream escaping from the mud line 14 from the bottom, at least some of the water would mix with the top of the stream.

In FIGURE 3, the mud or discharge line 14 has been moved upwardly into the side of housing 17 approximately at a level equal to the top of the pipe 15. During normal drilling the mud level would be as indicated at 29. This form of the invention would be used where space is at a premium, as the arrester can be placed closer to the blowout preventer.

In FIGURE 4 there is shown a form of the invention for use with air drilling. In air drilling the casing 15 has attached to the top thereof a housing 33 which contains the rotary seal between the housing and the kelly 12. Return air is through the conduit 34. The fire arrester housing 35 is identical with fire arrester housing 17 (FIG. 1) except that it is sized to fit about the rotary seal housing 33 and to be slightly larger than housing 33 to provide the distribution chamber 36. A split clamp indicated generally at 37, or any other desired means, may be utilized to fasten the fire arrester housing 35 to the rotary seal housing 33. A suitable seal (not shown) provides a fluid-tight seal between the two housings. In this instance, fire extinguisher delivered through pipe 24 passes into the chamber 36 and up to the top of housing 33. Thus, the fire extinguisher is available to mix with a petroleum gas stream in the well in the event of a blowout or other malfunction of the rotary packer assembly.

From the above it will be seen that all of the objectives of this invention have been attained. While the necked-in outer housing is preferred to provide a means of atomizing the liquid fire extinguisher, it will be appreciated that any form of arrester that will atomize the liquid fire extinguisher may be used.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof and various changes in the apparatus and method, as well as in

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the details of the illustrated construction, may be made without departing from the spirit of the invention.

What is claimed is:

1. In a fire arrester apparatus for a petroleum well having a casing therein the improvement which comprises;

a pipe through which drilling operations are carried out,

said pipe forming an extension of the upper end of the casing,

a housing surrounding said pipe and forming therewith a fluid distribution means;

means for introducing a fire extinguisher into said fluid distribution means below the upper end of said pipe; and

said housing extending upwardly above the upper end of said pipe to form with the pipe a means for atomizing the fire extinguisher with gas passing through the pipe at high velocity.

2. The arrester of claim 1 wherein a discharge line is connected to the casing and means are provided for introducing an atomized fire extinguisher into the fluid stream leaving said discharge line to prevent fire in said fluid stream.

3. In a fire arrester apparatus for a petroleum well having a casing therein the improvement which comprises,

a pipe through which drilling operations are carried out,

said pipe forming an extension of the upper end of the casing,

a housing extending circumferentially about said pipe, means forming a fluid-tight connection between the bottom of the housing and said pipe,

said housing spaced radially from said pipe to form a distribution chamber therebetween and extending upwardly above the upper end of said pipe to provide fluid communication between said chamber and the upper end of said pipe about its entire circumference,

said housing forming with said pipe a means for atomiz-

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ing liquid from the distribution chamber upon gas passing through the pipe at high velocity, and means for introducing a fire extinguisher into said housing below the upper end of said pipe.

4. The arrester of claim 3 wherein a plurality of holes extend through the wall of said pipe and are spaced circumferentially about the pipe adjacent its upper end.

5. The arrester of claim 3 wherein the upper end of the housing necks down to approximately the inner diameter of the pipe.

6. Fire arrester apparatus for a petroleum well having a casing therein, comprising:

a discharge line connected to and extending laterally relative to the casing through which mud or other fluid may be discharged from the well;

a housing surrounding said discharge line and forming therewith a fluid distribution means;

means for introducing a fire extinguisher into said fluid distribution means inwardly of the outer end of said discharge line; and

said housing extending outwardly beyond the outer end of said discharge line to form with the line a means for atomizing the fire extinguisher with gas passing through said discharge line at high velocity.

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