May 7, 1935. P. J. DUFFY 2,000,381

MEANS FOR EXTINGUISHING OIL WELL FIRES

Filed July 28, 1931 2 Sheets-Sheet 1

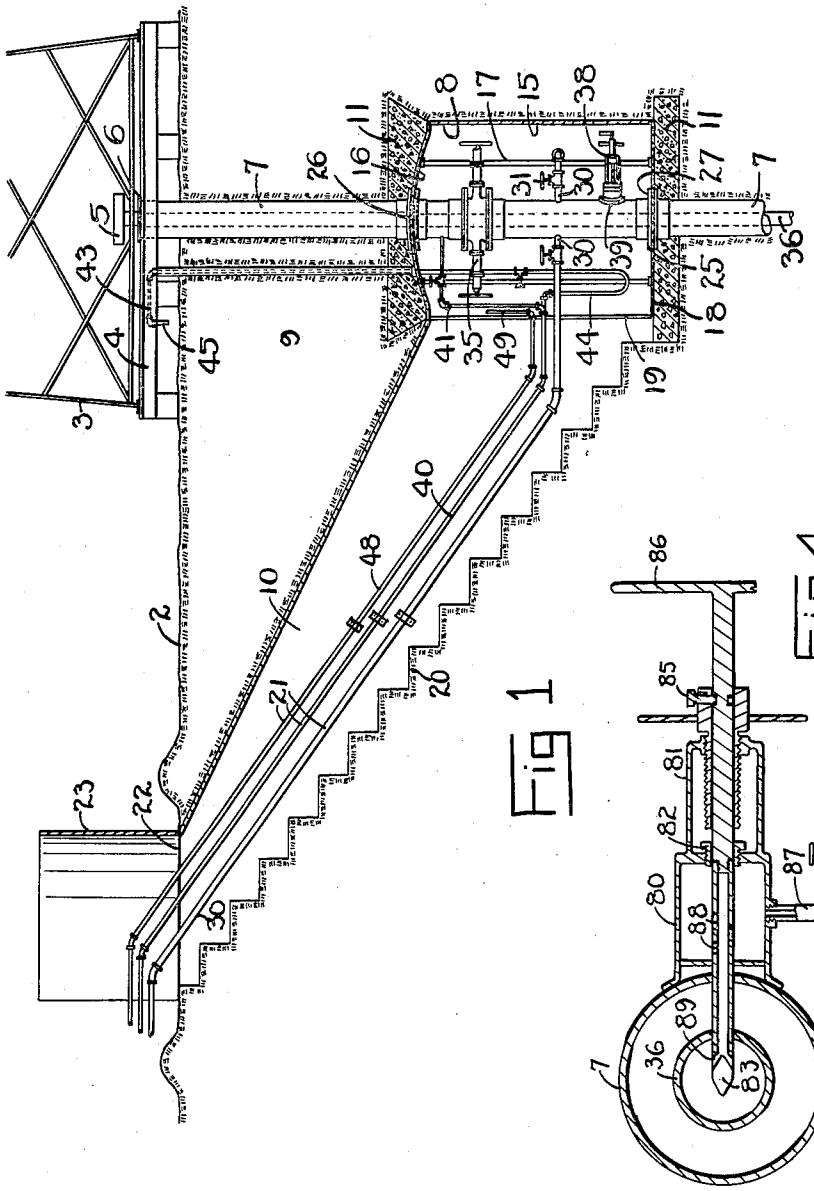

Fig 1

Fig 4

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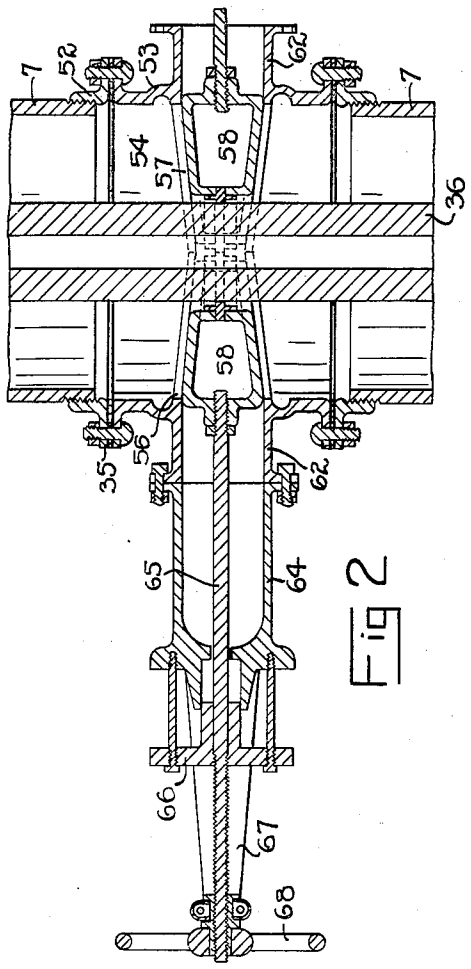

Fig 2

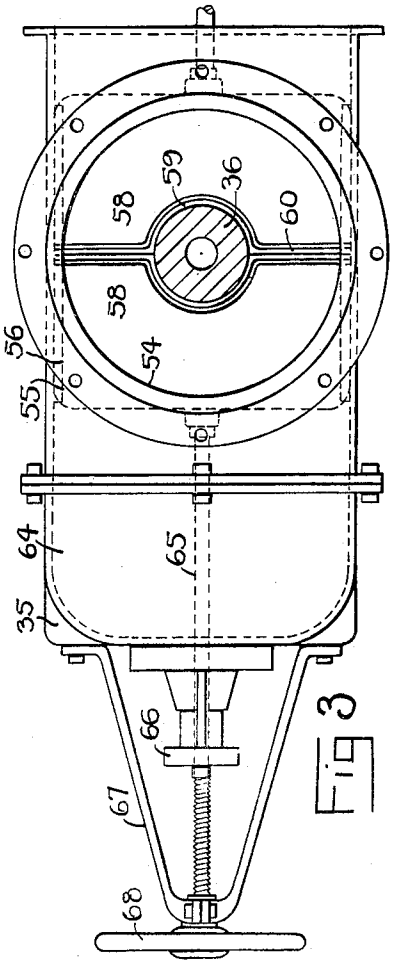

Fig 3

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MEANS FOR EXTINGUISHING OIL WELL FIRES

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16 Claims. (Cl. 169—4)

The invention relates to an improvement in a means for quenching fires in and about oil and gas wells, and particularly contemplates the provision of certain mechanisms so that complete control of the well may be had after it becomes ignited.

It has been the history of burning oil wells that they are very difficult to quench and that there is a great loss of property and in many instances loss of life due to this, the greatest hazard in well drilling. As a general rule when a well catches fire the flaming oil spreads for a distance about the derrick and ignites materials which are present. Also, the tremendous heat prohibits the approach of fire fighters and in many instances melts the metal machinery and mechanisms about the well head. Various devices have been conceived with a view of capping the well to extinguish the flame and various other expedients have been resorted to. The present invention, however, contemplates the provision of a cave or dugout which will be equipped with such devices that the operators may readily cope with any conditions which may arise in connection with the burning or ignition of the well.

It is one of the objects of the invention to provide a cave or dugout beneath the well head and to equip this dugout with devices to control the flow of fluid through the well.

Another object of the invention is to provide a cellar below the well head so that the fluid from the well may be drawn off at an elevation below the surface and in this manner reduce the fuel being fed to the surface.

Another object of the invention is to provide in combination with a well casing a closure member which is adapted to operate at an elevation below the head of the casing and at a point insulated from the casing head.

A still further object of the invention is to provide an excavation beneath the derrick and about the well casing so that the flow of fluid through the casing, or any member which might be therein, may be controlled.

A still further object of the invention is to provide in combination with an excavation beneath the casing head a plurality of fire fighting devices which would be available for use in extinguishing the fire.

Still another object of the invention is to provide a closure member in an excavation which is insulated from the casing head so that the well casing may be closed and a seal made about the drill stem or tubing which may be present in the well casing.

It is also an object of the invention to provide an excavation equipped with various fluids to be used in extinguishing the well fire.

Another object is to provide a device for piercing the innermost of two concentric pipes and injecting fluid thru the same device to assist in extinguishing the fire.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation of a well equipped with the invention and showing certain of the parts in section.

Fig. 2 is a central vertical section through one type of closure member which may be used in combination with the means and method of the invention.

Fig. 3 is a top plan view of the closure member shown in Fig. 2 and showing the rams in closed position.

Fig. 4 is a sectional view of the pipe cutting device used in connection with the invention.

By having reference to Fig. 1, the earth's surface is indicated at 2, and 3 illustrates a common type of derrick used in the drilling of wells. This derrick is provided with a platform 4 which carries a rotary table 5 and the casing head 6. This casing head is usually attached to what is known as the surface casing indicated at 7. This casing extends a considerable distance into the earth and is cemented in position in order to serve as a support for the various parts of the well head equipment. It is usual to run the casing 7 directly into the earth but when a well is being equipped in accordance with this invention an excavation will be made below the surface 2 and of any desired size in order to accommodate the cage or frame 8. This cage or frame may be positioned in any manner desired such as by excavating a cavity of sufficient size to receive it and then replacing the earth, as at 9, over the top of the cage, or, if desired, the cage may be positioned by forming the tunnel or passage 10 and erecting the cage in the enlarged area at the end of the tunnel.

As seen in Fig. 1, a quantity of concrete 11 has been provided both above and below the cage or frame in order to insure its proper positioning and to properly support the load of the derrick about the cage. The manner of positioning this cage is immaterial as it may be positioned in any manner now well known in earth handling art.

As seen in Fig. 1, the cage 8 is preferably formed with panels 15 of metal or other substantial ma-

terial, or it may be formed of concrete or any fireproof material which will withstand the loads imposed upon it by the derrick and other equipment on the earth's surface. If panels are used they may be arranged in any desired manner and suitably reenforced or supported in order to serve the purposes in view. The roof or ceiling is indicated at 16 and is shown as being supported by the uprights 17. It is to be understood that other bracing may be provided in accordance with the loads to be imposed upon the cage.

The floor of the cage is indicated at 18 and may be of concrete or any suitable material. If desired, a door or other closure may be placed upon the opening 19 but preferably this area remains open to allow for the entrance and exit of the operators of the devices contained in the cage. Access to the cage is had through the tunnel 10, which is shown as being provided with steps 20 and also serves as a passage for pipe lines 21, a plurality of which have been shown. The entrance to the tunnel 10 is indicated at 22 and is provided with a shield or guard 23, which faces away from the derrick 3 to afford protection to those entering the tunnel and the cage. The cage 8 and all the parts therein are preferably of fireproof materials and so constructed that they will be removable, and may thus be erected on another well after the need of safety and protection on the first well has passed. The lining of the tunnel 10 and steps 20 will also be fireproof material and the entire assembly will be most likely constructed before the derrick is set up.

When an oil well ignites enormous heat is given off and in many instances the equipment and mechanism about the casing head will melt. It is intended that a sufficient thickness of earth or other material will be positioned above the cage 8 in order to completely insulate it from the heat contemplated. The cage may be buried the desired distance and it is intended that this cave will be constructed prior to or simultaneously with the setting up of the derrick and the placing of the surface casing 7. It is quite possible that when the cage of this invention is employed in the well set up that a lesser length of surface casing will be necessary due to the fact that the surface casing 7 is anchored to the cage floor 18, as at 25, and to the ceiling 16, as at 26. This casing may be anchored at these points by flanges 27 or by any other manner of fixing the casing to the cage. The cage thus acts as a dead man for the well casing. Inasmuch as the principal object of this surface casing is to provide an anchor for the well head equipment this cage assists in serving this purpose and it might be possible that the surface casing need only extend a minimum distance below the cage.

It is intended to equip the cage with various types of apparatus for use in extinguishing the well fire. In order that an understanding of the invention may be had, several such mechanisms have been illustrated, but it is intended that in the future development of the invention other devices may be added to the equipment contained in the cage in order to successfully extinguish the blazing well. Several devices have been illustrated in Fig. 1 as being contained within the cage and these devices will now be explained.

When a well is ignited one of the most efficient ways to extinguish the blaze is to cut off the flow of fluid through the well which is feeding the blaze and in order to do this the cage 8 has been equipped with the flow lines 30, one of which leads from each side of the casing 7. Each of these flow lines is provided with a valve 31 to control the flow of fluid through the line. Thus in event the well is ignited one of the first steps would be to open the valve 31 and allow a portion of the oil or gas coming through the casing to flow out through the line 30, which extends upwardly through the tunnel 10. In this manner a portion of the fuel feeding the fire could be bypassed and the size of the blaze considerably decreased. The fact that these flow lines are located in the protected area in the cave, and access to them may be had through the tunnel 10, makes them available after the well is ignited.

Another means of assisting in the extinguishing of the blaze is to close off the area inside of the casing 7. To accomplish this a closure member indicated generally at 35 has been provided. This closure member is seen in the detailed views of Figs. 2 and 3 and is adapted to close the area of the casing about any pipe or other member which is confined within the casing. When the well is being drilled, the drill stem is in the casing and in event the well is ignited the rams of this closure member will pass about the drill stem, as seen in Figs. 2 and 3, and close off the area about the drill stem. If tubing is in the well, the operation will be the same. However, if there is no pipe in the well, the type of rams carried by the closure member may be altered so that they will serve as a valve to completely close the casing area. The closure member, as seen in Fig. 2, and Fig. 3, will be later described.

In some instances the flow of fuel to the blaze passes not only through the casing 7, but also through the drill stem or tubing, such as 36, which is confined within the casing. In this event, it is necessary to either pierce or cut off the drill stem or tubing inside the casing so that any flow of fluid therethrough will be cut off if possible. To accomplish this, a pipe cutting device is indicated generally at 38 and is shown as being attached to the casing 7, as at 39. Devices of this general type are well known in the art and they form no part of the present invention except insofar as used in combination with the present improved means and method. Pipe cutting devices of this type are arranged to either drill or otherwise sever the interior of two concentric pipes. If this were accomplished, then the lower portion of the pipe would either drop down into the well or the upper portion would be blown out of the well or otherwise removed. However, if after severing of the inner pipe it could not be removed a material reduction in the fuel passing to the blaze would occur due to the fact that the flow of fluid through the inner pipe would then be reduced as it could flow into the casing 7 at the point where the pipe was severed.

In practising the invention, however, I may use a pipe cutting or piercing device such as seen in Fig. 4. This device is attached to the casing 7 in any desired manner by a housing 80 which carries a bearing 81 and stuffing box 82. A drill 83 is arranged to pass through the stuffing box and penetrate the casing 7 and pipe 36, a ratchet feed 85 and a hand wheel or other means 86 serve to advance and retract the drill 83. A pipe line 87 connects to the housing 80 and the drill 83 has perforations 88 and 89 therein so that a flow of fluid such as steam or other fire extinguishing material may be passed into either the casing 7 or pipe 36 after the drill has pierced the pipes.

In order to assist in extinguishing the blaze one of the pipe lines 21 leading into the cage is intended to convey a flow of steam or other fluid

into the well. This pipe is indicated at 40 and has a connection at 41 leading into the side of the casing 7. Thus when the valve in this line 41 is open a flow of steam or other fire-extinguishing material may thus be turned into the casing 7 to mingle with the fluid passing through the casing so that the blaze may be extinguished at the surface. Many oil well fires are extinguished by smothering the flames with an enormous flow of steam.

In connection with this line 40 is a surface connection 43. A flexible member 44 is shown as connecting the pipe 40 and the surface connection 43 and passing upwardly through the ceiling of the cage. This flexible connection 44 is provided so that the surface member 43 may be raised and rotated to such a position that the downwardly turned end 45 thereof may be directed into the casing 7 or the pipe 36 at the surface of the well. In this manner a flow of steam or other fluid may be directed downwardly into the mouth of the well and assist in extinguishing the blaze.

It is intended that any or all of the devices in the cage may be arranged for operation by remote control if desired. Such control may be accomplished by fluid pressure, manual means or by extended rods or connections. While a cage and its construction have been disclosed it is intended that the invention may be positioned in the cellar of the well or directly beneath the derrick floor if desired and that a tunnel such as shown may or may not be used in connection with the invention.

An additional line leads into the tunnel and is indicated at 48. This line is shown as terminating at 49 and may be a fresh air line in order to provide ventilation for the cage or cave 8. This line, however, may be a water line to pass a flow of water into the cage or into the casing 7 as desired. It is to be understood that any additional lines necessary in practicing the invention may be provided.

By having reference to Figs. 2 and 3, the closure member is indicated and is shown as being attached to the casing 7. It is to be understood that this closure may be attached by means of flanges such as 52 or it may be threaded directly to the casing. In either event a tight connection is made between the housing 53 of the closure member and the casing. This housing 53 is arranged with an internal cavity 54, which is of the same diameter as the casing 7 to which the closure is to be attached. This cavity 54, however, is provided with a cutaway area 55, which is divided by a flange or rim 56. This flange or rim is best seen in Fig. 3 and has been illustrated as tapered inwardly to form a seating face 57 for the rams or valve members 58. These valves or rams are arranged for horizontal sliding movement and have a semi-circular opening 59 in the forward face so that the two rams co-operate to close about the pipe or drill stem 36, which passes through the casing. It is intended that suitable packing 60 will be provided on the faces of the rams in order to obtain a seal.

The housing 53 is provided with extensions 62 on opposite sides thereof to accommodate the rams 58 when they are moved to retracted position. Attached to each of these extensions 62 is a bonnet 64 through which extends the stem 65 used in manipulation of the ram. This bonnet 64 is readily removable from the extension 62 so that the type or size of the ram may be altered when different sized pipe is being used in the well casing. The bonnet 64 carries a stuffing box indicated generally at 66 to form a seal about the stem 65 and also supports the bracket 67 which carries the hand wheel 68 for manipulation of the ram.

It is intended in practicing the invention that when the well is ignited any or all of the mechanism shown and described may be used independently or simultaneously in attempting to extinguish the blaze. Thus when the well first catches fire the valves 30 may be opened to reduce the flow of fluid, the valves 35 closed about the pipe 36 in the well and then if a flow of fluid is occurring through the pipe 36 the cutting device 38 will be manipulated and the pipe 36 either pierced or severed in order to additionally reduce the flow of fuel to the surface. Either or both of the pipes 40 and 43 may then be opened so that a flow of fire extinguishing material will be led into the casing to assist in smothering what flames remain. The nozzle 45 may be raised and positioned over the mouth of the well, if possible, and a flow of steam or other fluid passed into the well to assist in extinguishing the blaze. If, however, the heat is too intense and the nozzle 43 can not be moved to operative position a flow of steam or liquid may be passed into the casing 7 through the pipe 41 and in this manner the size of the blaze will be reduced. It is also intended to use the flow lines 30, the closure member 35, or the cutting device 38 in event of a blowout, regardless of whether the oil and gas becomes ignited.

In some instances it may be impossible to operate some one of the mechanisms due to existing conditions but it is contemplated that they will be constructed in as foolproof a fashion as possible so that they will always be available for use in extinguishing the fire.

Broadly the invention contemplates the provision of a fire-fighting mechanism at a point below the surface of the earth so that it will be insulated from the heat of the flames and ready access can be had into the well casing in order to extinguish the blaze by attacking the same at a protected point below the earth's surface.

What I claim as new is:

1. In combination with a well, a cage disposed below the earth's surface and about the casing of the well, a pipe line leading to said cage and connected to the casing to inject fire extinguishing material into the casing below the point of ignition of the oil, and an additional connection on said pipe line leading from said cage to the surface constructed and arranged to direct fire extinguishing material from said line directly into the casing head.

2. In a buried cage for use in extinguishing oil well fires, a closure member for the well casing, flow lines connected to the casing below said closure member to lead off the fluid from the well, said closure member including a housing, rams slidable in said housing and adapted to close about a pipe in the casing, and means also in said cage and below said closure member to sever a pipe within the casing to reduce the flow of fuel to the fire at the well head.

3. A device of the character described including in combination a well casing, means to close said casing below the well head, means to pierce the casing below and independent of said closure means, and means to bleed fluid from or inject fluid into said casing through the opening made by said second means.

4. A device of the character described including in combination a well casing, a pipe within

said casing, means to close said casing below the well head, means to pierce the casing below said closure means and to also pierce a pipe in the casing, and means to withdraw fluid through said piercing means from the pipe within said casing.

5. A device of the character described including in combination a well casing, a pipe within said casing, means to close said casing below the well head, means to pierce the casing below said closure means, and to also pierce the pipe within said casing, said means being hollow whereby fluid may be bled from or injected into said pipe through said means.

6. In a fire prevention hook up for wells having a casing, means to close the casing about a pipe therein, means to pierce the casing and pipe therein, means whereby fluid may be injected into or withdrawn from the pipe through said second means, and additional means to withdraw fluid from said casing all of said means being insulated from the well head.

7. An apparatus for use in extinguishing well fires including a cage disposed about a well head, means connected to the casing to pierce the casing and the pipe therein through which fire extinguishing material may be injected into such pipe, and means in said cage to cut off the flow of fluid through the casing to the well head.

8. A fire prevention mechanism for wells having a casing with a pipe therein including a blowout preventer on said casing to close the casing, and means independent of such preventer to inject fire extinguishing material through the casing and into the pipe therein, whereby the flow of fluid will be cut off through the casing and the fluid flowing upwardly through said pipe made noninflammable.

9. In a fire prevention hook-up for wells having a casing, means to close the casing about a pipe therein, means to pierce the casing and pipe therein, and means whereby fluid may be injected into or withdrawn from the pipe through said second means, said last means including a drill, a housing about the rear of said drill, and perforations in said drill for the passage of fluid to or from said housing.

10. In combination with a well casing, a subterranean cage, means in said cage to control the flow of fluid through the casing, means to withdraw fluid from the casing, means to pierce a pipe within said casing and to then feed fire-extinguishing material into the casing through said piercing means.

11. In combination with a well having a casing, means to extinguish a fire including a subterranean cage disposed about the well casing at an elevation below the earth's surface whereby the cage is insulated from the heat of the fire at the well head, said means also including a cutoff for the well casing, a fluid inlet to the casing for fire-extinguishing material, and means to pierce a pipe within the casing and inject or withdraw fluid from the pierced pipe.

12. In a well casing protective device to extinguish fires, a blowout preventer on the casing to close about a pipe therein, a flow line leading from the casing below said closure, and a pipe line connected to the casing above said closure to inject fire extinguishing material into the casing above the closure.

13. In a well casing protective device to extinguish fires, a blowout preventer on the casing to close about a pipe therein, a flow line leading from the casing below said closure, and a pipe line connected to the casing above said closure to inject fire extinguishing material into the casing above the closure, said device being buried and insulated from the top of the well head.

14. In a well casing protective device to extinguish fires, a casing closure on the casing to close about a pipe therein, a flow line leading from the casing below said closure, a pipe line connected to the casing above said closure to inject fire extinguishing material into the casing above the closure, and means below said flow line to pierce the casing and any pipe therein and to inject fire extinguishing material into the casing below the closure.

15. In a well casing protective device to extinguish fires, a casing closure on the casing to close about a pipe therein, a flow line leading from the casing below said closure, a pipe line connected to the casing above said closure to inject fire extinguishing material into the casing above the closure, and means below said flow line to pierce the casing and any pipe therein and to inject fire extinguishing material into the pipe below the closure.

16. An apparatus for use in extinguishing well fires including a cage disposed about the well casing and insulated from the well head, and means in said cage to feed fire extinguishing material into the well casing, said means including a connection to the casing in the cage, and means adjustable from within the cage, adapted to be positioned to discharge into the top of the casing.

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