

Aug. 4, 1953

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2,647,728

INSIDE BLOWOUT PREVENTER

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2 Sheets-Sheet 1

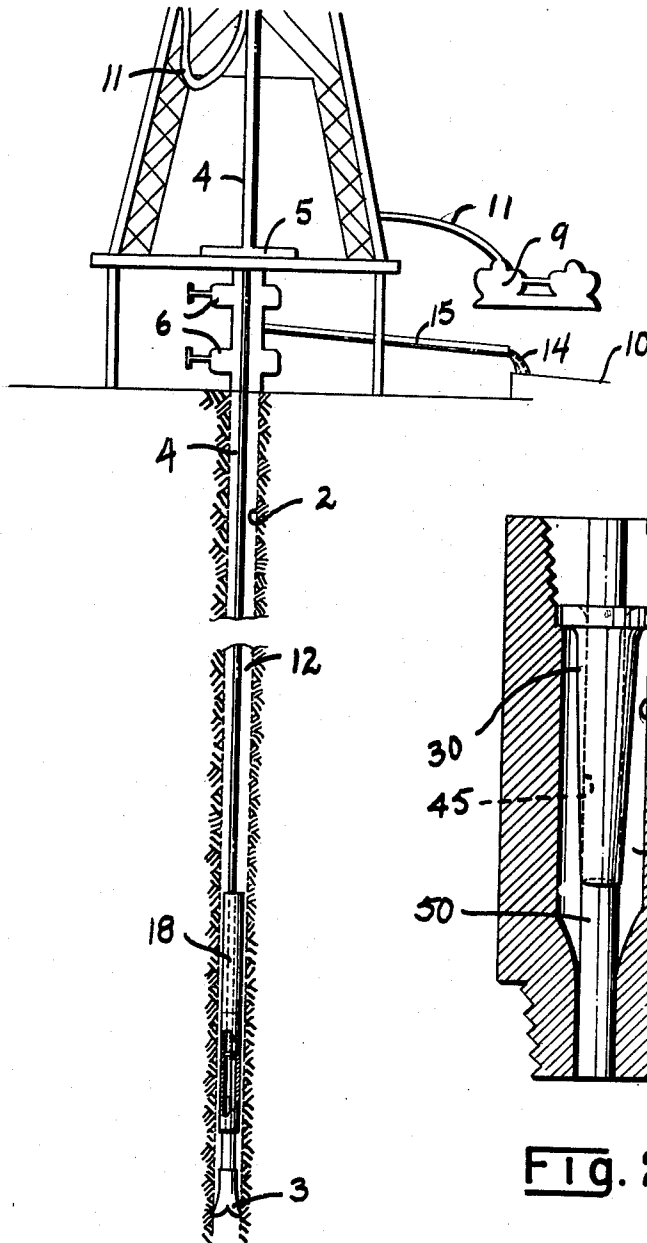


Fig. 1

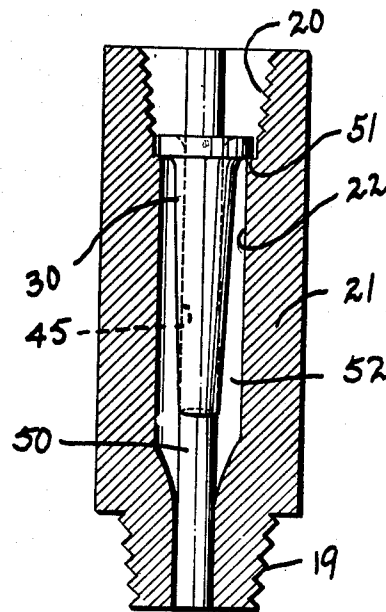


Fig. 2

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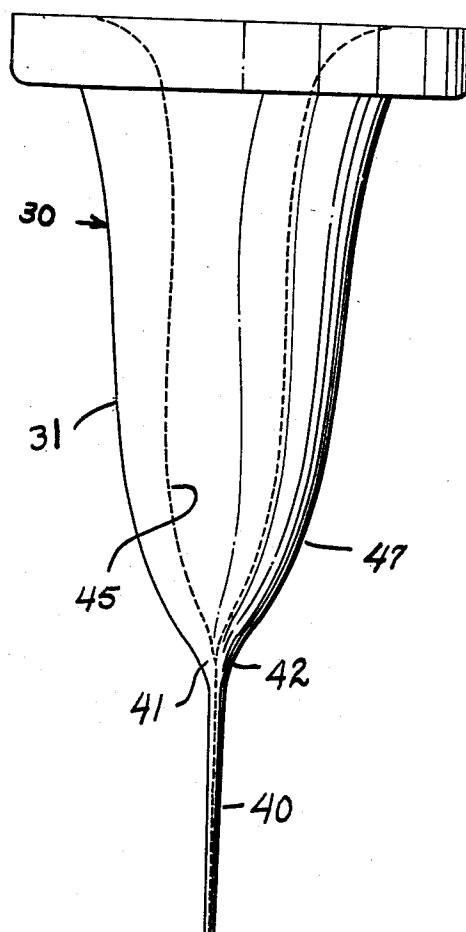
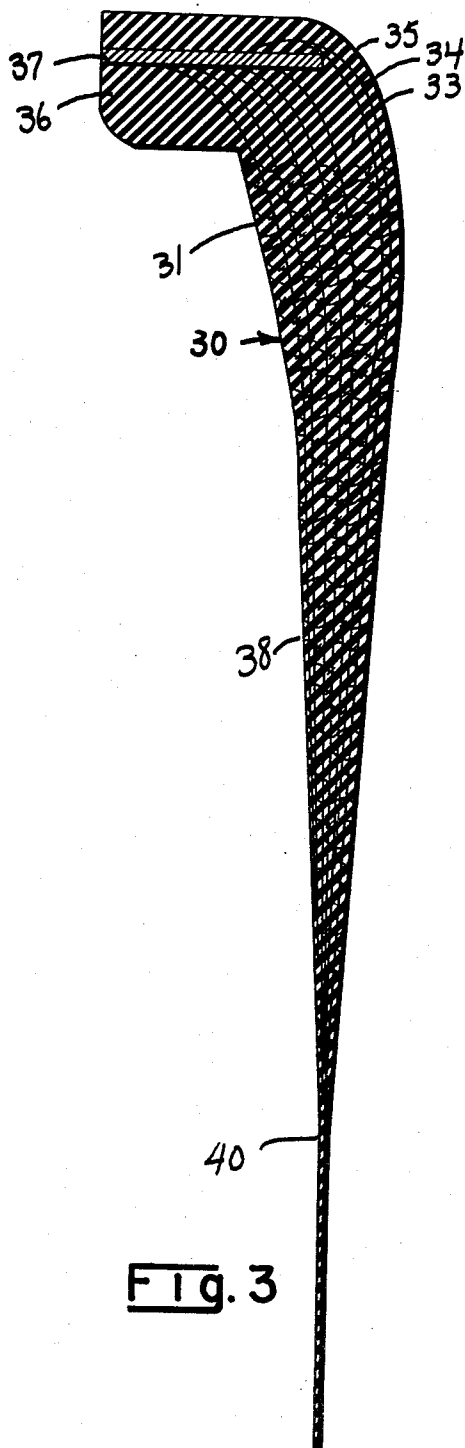
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UNITED STATES PATENT OFFICE

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INSIDE BLOWOUT PREVENTER

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3 Claims. (Cl. 255—28)

1.

The invention relates to a blowout preventer to be disposed inside of the drill stem or operating pipe used in the rotary method of drilling wells.

When a well is being drilled by the rotary method the drill bit is connected to the lower end of a piece of pipe and upon rotation the weight of the bit and the pipe causes the bit to cut into the earth formation. Additional lengths of pipe are added as the drilling progresses. In order to carry the cuttings away from the bit and to maintain the drill hole and to prevent caving of the walls of the drill hole and in addition to perform many other functions the practice has been developed of circulating a drilling mud or liquid downwardly through the drill stem to discharge from the bit and to flow upwardly in the well bore around the outside of the pipe.

The present day drilling muds are compounded from various ingredients and chemicals with a view of accomplishing various results, one of which is to maintain a predominant pressure upon the earth formations which are being cut and which have been penetrated by the drill bit. Various finely ground powdered materials are added to the mud to increase the specific gravity thereof and obtain more suitable drilling mud.

In many instances and quite frequently due to various causes the pressures in the earth formations may exert a predominant pressure against the column of drilling mud in the well bore. For instance, if gas enters the well bore and dilutes the mud naturally the pressure against the formation due to the column of mud is reduced. In some instances as such predominant pressure from the formation moves upwardly in the well bore or inside of the drill pipe it may expel the mud from the well and the pipe as well.

Various types of drill valves and outside blowout preventers have been devised to grip and seal the outer periphery of the drill pipe so as to confine the mud in the well outside of the drill pipe. It is much more difficult however to provide a closure or blowout preventer for the inside of the drill pipe due to the fact that the abrasive and solids-laden drilling mud is being pumped downwardly through the inside of such drill pipe and any valves, such as back pressure valves or other control members will of necessity be subjected to wear and abrasion which soon decreases the efficiency and satisfactory operation thereof.

With the foregoing difficulties in mind the present invention contemplates an inside blowout preventer which will automatically close the inside of the drill stem or other pipe in which it is positioned when there is a reverse or upward flow of fluid in the drill pipe.

2.

It is therefore one of the objects of the invention to provide an automatically operable flexible inside blowout preventer.

Another object of the invention is to provide an inside blowout preventer which may be deposited within the drill pipe and permit a downflow of liquids through the pipe while automatically sealing itself and the pipe against any return or upward flow of fluid or pressure.

Another object of the invention is to provide a collapsible inside blowout preventer having a flexible portion thereon which will readily collapse to close the passage through the pipe when there is a predominant pressure exerted thereagainst from beneath.

A still further object of the invention is to provide a hollow tube or sleeve-like blowout preventer adapted to be positioned in the drill pipe, possibly adjacent the drill bit, so that any pressure exerted thereon from below will tend to collapse the sleeve and close the passage through the drill pipe.

Another object of the invention is to provide a flexible hollow sleeve-like inside blowout preventer having an anchor flange adjacent one end thereof with the other end of such sleeve being constructed of relatively thin flexible material so that the sleeve will collapse automatically upon pressure being exerted against the outer surface of the sleeve.

A still further object of the invention is to provide a method of automatically closing a drill pipe upon the exertion of an upward flow or force due to fluid within the pipe.

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 drill assembly in which the means and method of the invention have been illustrated.

Fig. 2 is a vertical sectional view of a length of pipe or sub in which the blowout preventer may be supported and retained within the drill pipe, which view illustrates a core barrel or other member extending downwardly through the blowout preventer.

Fig. 3 is a vertical sectional view through one half of the flexible blowout preventer sleeve on an enlarged scale.

Fig. 4 is a side elevation of the blowout preventer sleeve in collapsed position.

In Fig. 1 the well bore 2 has been drilled by the rotation of the bit 3 due to the turning of the drill pipe 4 by means of the rotary table 5.

The casing in the well may be closed by one

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or more outside blowout preventers 6 which are shown diagrammatically and are arranged to close about the drill pipe 4.

The pumps 9 pick up the drilling mud from the slush pit 10 and force it through the rotary hose 11, the upper end of which is not shown but which hose is connected to the upper end of the drill pipe 4.

The drilling mud moving upwardly in the annular space 12 in the well bore around the outside of the pipe 4 will discharge as at 14 from the return pipe 15.

In order to obtain as straight a well bore as possible it is usual to place a considerable length of heavy pipe or drill collar 13 above the bit 3 and to which the lower end of the drill pipe 4 will be connected, as best seen in Fig. 1.

Both the pipe 4 and the collars 13 are made up of lengths of pipe which are usually provided with a threaded pin 19 on the lower end and a threaded box 20 on the upper end as illustrated in the length of pipe or sub 21 seen in Fig. 2.

The sub 21 as well as the rest of the pipe and the drill collars are hollow so as to provide a passage such as 22 through which the drilling mud is forced downwardly by the pumps. As an illustration it is not uncommon to circulate four or five hundred gallons of drilling mud per minute downwardly through the pipe at pressures which may exceed a thousand or fifteen hundred pounds per square inch. It will thus be appreciated that a tremendous abrasive problem is present. It is impractical to close the passage 22 to any substantial extent because any restrictions in such passage tend to increase the power required to circulate the drilling mud downwardly on the one hand and also interfere with the volume which can be pumped on the other hand. Flat or butterfly valves supported upon cross shafts spanning the passage 22 have been found to be impractical because of the corrosive and abrasive action of the flowing stream of mud.

It is desirable that, in event of emergency or reversal of pressure in the lower end of the drill pipe, the passage 22 be instantly and automatically closed. Speed in closing is of the essence because if a high pressure gas or other formation is encountered such pressure immediately enters the drill bit and reverses the direction of flow of the fluid in the drill pipe. Of course the resistance to upward flow of mud inside of the drill pipe is primarily due to the pressure of the pumps and also to the weight of the column of liquid in the pipe. If the predominant pressure in the bottom of the well begins to lift the column of mud in the pipe the resisting pressure or load of mud is materially reduced as the mud is expelled from the drill pipe. Oftentimes the rotary hose 11 may be disconnected during procedural operations and the drilling mud may begin to flow out of the top of the drill pipe which is open. Due to the lessening of the weight of the mud in the pipe the rate of discharge increases geometrically to such an extent that in a few seconds or minutes at most the well may blow out causing tremendous damage and injury so that it is imperative that the inside of the drill stem be closed off instantly and as automatically as possible.

The present invention directs itself to a sleeve-like blowout preventer member 30, seen in position in Fig. 2, in half section in Fig. 3, and in side elevation in Fig. 4.

This blowout preventer 30 is made up of an annular body 31 which is a composite member

made up of resilient material such as natural or artificial rubber or a similar composition 33 which may have the fabric or reinforced material 34 arranged therein as seen in Fig. 3 so as to provide a rounded internal tapering surface 35 which extends laterally to provide a more or less rigid flange 36 which may have a rigid reinforcing member 37 therein which is in the form of a hollow annular disc, or plate.

The body 31 as seen in Fig. 3 tapers gradually at 38 with a diminishing amount of reinforcing material 34 therein so that the body becomes more and more flexible as it terminates in a downwardly extending skirt 40 which may have little or no reinforcing material therein so that the opposite sides 41 and 42 thereof, as seen in Fig. 4 may be collapsed by a very small pressure differential or flow of liquid upwardly thereagainst. The collapsing action automatically closes the passage 45 through the blowout preventer as seen in Fig. 4 and once the lower end of the passage 45 is closed an increase of pressure against the outer periphery 47 will tend to hold the blowout preventer closed and shut off any further upflow of fluid through the passage 45 of the preventer.

With a view to preventing the blowout preventer from turning inside out the body 31 has been gradually thickened and reinforced so as to insure that even relatively high pressure will be shut off by the preventer.

As seen in Fig. 2 the passage 45 of the preventer is of such size that a core barrel or other pipe 50 such as surveying, sampling, or testing tools may be passed downwardly through the drill pipe to enter and extend through the blowout preventer.

It is possible that this blowout preventer sleeve 39 may be disposed in any joint of the drill pipe or drill collar but in order to suitably support the blowout preventer, and insure that there is sufficient space available for its normal position and to also permit any upward pressure to exert itself about the outer periphery 47, a special drill pipe sub has been shown in Fig. 2 wherein the shoulder 51 receives the flange 36 and such flange will be clamped in position on the shoulder 51 by the pin member of the next section of pipe or drill collar which will be threaded into the box member 20. With this arrangement a chamber 52 is provided and any pressure moving upwardly therein will instantly collapse the flexible skirt portion 40 of the preventer regardless of whether there may or may not be a pipe or instrument 50 extending through the preventer.

It is preferable that the sub 21 be located proximate the bit 3 so that the instrument 50 will not pass entirely through the preventer when operations are carried out thereby, and also that the entire static head within the well bore may be utilized in effecting normal actuation of the preventer. It is understood of course that a retractable sleeve may be positioned in the preventer to prevent collapse thereof when lowering the drill pipe 4 into the well bore 2.

Broadly, the invention contemplates a means and method of automatically closing a drill or other pipe in a well bore by collapsing a flexible member upon the occurrence of an upward flow or pressure in the pipe.

What is claimed is:

1. An inside drill pipe automatic blowout preventer for insertion in the drill pipe employed in the rotary method of well drilling to close the lower end of the pipe and prevent an up-flow of fluid during the drilling operation comprising, a sub section of pipe forming a part of said drill

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pipe with pin and box threads thereon, a longitudinal passage extending throughout said sub section and including a portion between said pin and box threads, whose inside wall is spaced from a flexible lip type resilient sleeve valve portion of said preventer, a shoulder at the upper end of said passage portion adjacent said box threads, said sleeve valve having a reinforced radially extending flange thereon to engage and seat on said shoulder and to be held thereon by the pin end of the adjacent drill pipe section and having a reinforced skirt portion extending downwardly into said passage to create a pressure area in the passage and around the outside of said skirt below said shoulder, said skirt portion comprising a gradually thinning wall section terminating at its lower end in a relatively thin flexible lip end, said end normally remaining open for the movement therethrough of drilling fluids or instruments employed in the drilling and investigation of the well, said lip end being of such flexibility as to close upon any up-flow of fluid in said sub section into the pressure area around the exterior of the sleeve to automatically prevent such up-flow and blowout.

2. An inside drill pipe automatic blowout preventer for insertion in the drill pipe employed in the rotary method of well drilling to close the lower end of the pipe and prevent an up-flow of fluid during the drilling operation comprising, a sub section of pipe forming a part of said drill pipe with pin and box threads thereon, a longitudinal passage extending throughout said sub section and including a portion between said pin and box threads, whose inside wall is spaced from a flexible lip type resilient sleeve valve portion of said preventer, a shoulder at the upper end of said passage portion adjacent said box threads, said sleeve valve having a reinforced radially extending flange thereon to engage and seat on said shoulder and to be held thereon by the pin end of the adjacent drill pipe section and having a reinforced skirt portion extending downwardly into said passage to create a pressure area in the passage and around the outside of said skirt below said shoulder, said skirt portion comprising a gradually thinning wall

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section terminating at its lower end in a relatively thin flexible lip end, said end normally remaining open for the movement therethrough of drilling fluids or instruments employed in the drilling and investigation of the well, said lip end being of such flexibility as to close upon any up-flow of fluid in said sub section into the pressure area around the exterior of the sleeve to automatically prevent such up-flow and blowout, said sleeve valve being reinforced throughout substantially its entire body portion but to an increasingly greater extent in the body portion adjacent the upper end thereof to resist fluid pressure inversion thereof.

3. A blowout preventer for insertion within a drill pipe comprising a resilient hollow sleeve, means comprising a laterally extending rigid flange thereon to clamp said sleeve between two adjacent drill pipes, drill collar, or pipe sections which may be threaded together, an annular flexible skirt on said sleeve which tapers downwardly in wall thickness to a relatively thin lower lip end which normally flattens so that any upward movement of fluid in the pipe passes upwardly around such skirt until the pressure thereon the exterior of the skirt will collapse said skirt to prevent further up-flow through such skirt, said skirt being of a size to fit within the pipe and permit the passage of instruments both upwardly and downwardly therethrough, and to provide a lip type seal therearound.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
584,091	Leidich	June 8, 1897
996,588	Kennedy	June 27, 1911
1,596,520	Eskholme et al.	Aug. 17, 1926
1,824,411	Simmonds	Sept. 22, 1931
2,256,119	Lillich	Sept. 16, 1941
2,465,628	Border	Mar. 27, 1949

FOREIGN PATENTS

Number	Country	Date
348,834	Great Britain	Feb. 23, 1905