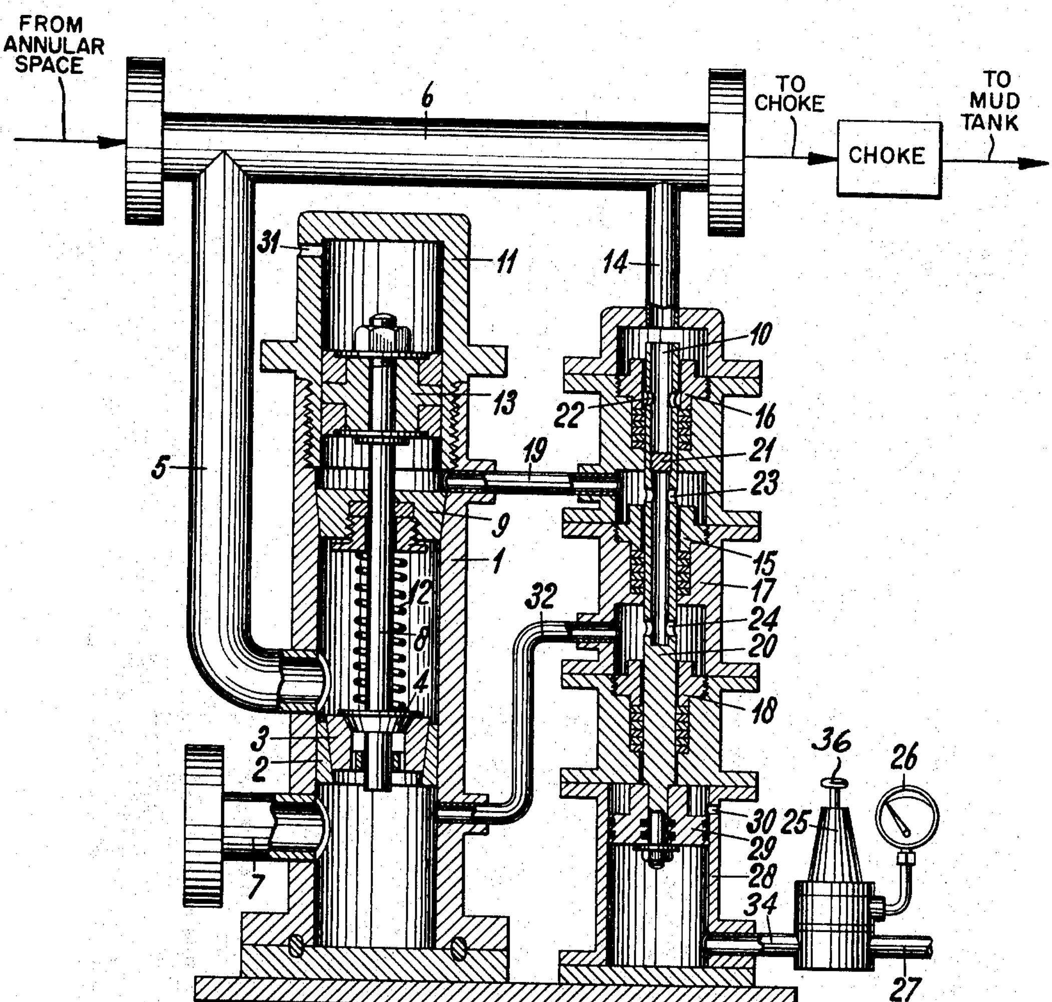
March 12, 1968

A. W. VAN GILS

3,372,761

MAXIMUM ALLOWABLE BACK PRESSURE CONTROLLER FOR A DRILLED HOLE

Filed June 30, 1965



INVENTOR
A. W. VAN GILS
By Jaskofo Osheroff, attys

United States Patent Office

3,372,761

Patented Mar. 12, 1968

1

3,372,761

MAXIMUM ALLOWABLE BACK PRESSURE CONTROLLER FOR A DRILLED HOLE

Adrianus Wilhelmus van Gils, Seria, Brunei

Filed June 30, 1965, Ser. No. 468,475
8 Claims. (Cl. 175—25)

ABSTRACT OF THE DISCLOSURE

This invention relates to a relief device to be used with a well and drill pipe where there is a mud return pipe communicating with the annular space around the drill pipe with a choke in the pipe. The pipe has a relief port between the well and the choke and a relief valve controls the port by being responsive to the pressure of the mud in the mud return pipe.

The invention aims at a maximum allowable back pressure controller for a drilled hole.

When drilling a hole in the earth for obtaining oil or natural gas a drilling bit is used which is fixed to the lower end of a hollow drill pipe which is rotated. The drilling bit has a greater diameter than the hollow drill pipe so that there will be an annular space around the drill pipe.

Through the hollow drill pipe mud is pumped downwards, which mud penetrates through holes in the drilling bit into the abovementioned annular space and then surges upwards. The upsurging mud carries along the crushed rock. At the top of the well the mud flows away with the rock dust through a gutter towards a sediment tank where the solids settle from the mud. The cleared mud flows to a tank, from which a piston pump pumps the mud back into the hollow drill pipe.

It may occur that, before the desired depth has been reached, a layer is bored in which oil, gas or water are present under such a pressure that these substances flow into the well against the hydrostatic pressure of the mud column. The well will then undesiredly start to produce. The oil, the water or the gas then will rise in the said annular space with the result that the quantity of mud emitted from the well is larger than that pumped into the well. This can be perceived in the rise of the mud surface in the mud tank.

If this process proceeds too long all the mud is blown out of the annular space. In order to prevent this danger the equipment of each well includes a blow out preventor. This part has two half rings provided with rubber surfaces which lie over the ground surface around the drill pipe and which, after the drilling bit is stopped, are pressed against the stationary drill pipe and in this way close the annular space at the top.

Drilling can only proceed after the mud has been given a greater specific gravity by admixing substances.

Heavier mud is circulated under back pressure in the space and gives a higher static pressure at the bottom of the well which must be able to prevent the inflow of gas, oil or water.

It is not possible to simply substitute heavy mud for the light mud in the well, for during this substitution a high pressure must prevail at the bottom of the well. Therefore, a tube is provided under the blow out preventor, said tube being in communication with the annular space and discharging into the mud tank. In this tube there is an adjustable choke or throttle valve. The substitution of one kind of mud for another in the well is effected by putting the pump in operation and slightly opening the choke or throttle valve to such an extent that the pressure in the well does not rise above the allowable pressure. If the pressure in the well rises, e.g. by plugging of the choke by formation cuttings or cavings carried along by the mud, it may occur that at a weaker spot in the rock through which the well has been drilled the mud is pressed into the rock. Alternatively a crack will appear in the rock through which crack the contents of the well could escape towards the surface. Then a crater would be formed sideways which could not be closed. The well would then be useless. It is a very difficult problem to maintain the correct pressure in the well, but it is essential.

2

According to the invention a relief device is connected at the top of the annular space of the well, which relief device is adjusted to the correct pressure which is the maximum allowable back pressure to prevent a formation breakdown.

In order to prevent the valve of the relief device from opening partially, thereby causing heavy wear of this valve and its seat as a result of the abrasive mud and high velocities, the apparatus is, according to the invention, so constructed that the relief valve can only be either completely open or completely closed. To this end the relief valve is connected by a spindle to a piston on which a medium under pressure can work, said medium emanating from an adjustable control device. This medium may be mud under pressure in which case the piston has a much greater surface than the relief valve, and the relief valve will be completely opened or closed by this difference in surface.

For urging the mud towards the piston of the relief valve an admission valve may be used having an adjustable load. For this adjustable load the said admission valve may, according to the invention, be connected by a spindle with an air piston upon which air works, the pressure of which is adjusted by the aid of a reducing valve of known construction.

For the removal of the mud working on the piston of the relief valve a discharge valve can be used and that in such a way that if one valve is open the other is closed and vice versa.

The figure shows an embodiment of the relief device according to the invention in cross section.

The device comprises a casing 1 with a partition wall 2 lying across the casing, said partition wall having a valve seat 3 with which the relief valve 4 cooperates. In the casing 1 and above the partition wall 2 a branch pipe 5 of the pipeline 6 discharges through which the mud coming from the well flows, one end of said pipe line 6 being connected to the annular space of the well, and the other end to said choke or throttle valve.

Moreover, the casing 1 has a discharge connection 7 lying at the other side of the partition wall 2, through which discharge connection 7 mud flows away when the relief device is in operation.

The relief valve 4 has a spindle 8 which is passed liquid-tight through a cross wall 9 which has been erected in the casing. At the top of the casing 1 a cylinder 11 has been screwed on comprising a piston 13 upon the spindle 8 of the valve 4. The cylinder 11 has a venthole 31 at its top. Around the valve spindle 8 a compression spring 12 has been arranged pressing upon the relief valve 4 and against the said crosswall 9.

The discharge pipe 6 has another branch pipe 14 running to a casing 15 of a control device. This casing 15 comprises three transverse packing units 16, 17 and 18 which divide the casing 15 into four partitions. The partly hollow spindle 20 which is passed liquidtight through the packing units 16, 17 and 18, has been provided by three sets transversely drilled portholes 22, 23 and 24.

In the bottom of the wider tubular top part 10 of spindle 20 the plug 21 is screwed in. This plug 21 divides the inside of the spindle 20 into two partitions. For moving the portholes 22, 23 and 24 of the hollow spindle 20 in and out the packing units 16, 17 and 18 an air piston 29 is also mounted on the solid part of the spindle 20 which piston can slide in a wider air cylinder 28. In the wall of the air cylinder 28 and above the piston 29 a vent hole 30 has been arranged.

The following three pipe lines are connected to the casing 15. Pipe line 19 connects the space between the packing units 16 and 18 with the space beneath the piston 13. Pipe line 32 connects the space between the packing units 17 and 18 with the cylinder space which is connected to the relief pipe 7. The third pipe line 34 communicates with the space beneath the air piston 29 and comes from an air reducing valve 25 with manometer 26 to which air under pressure is supplied through a pipe line 27.

The device operates as follows. When the light mud in the well is to be substituted by a heavier mud and the choke or throttle valve operates correctly and has been correctly adjusted, the light mud flows into the device through the branch pipe 5. The relief valve 4 is then closed. The admission port 22 of the control device is then too closed, because the air reduced to the correct pressure according to the circumstances in the well keeps the air piston 29 in an upward position. If the pressure of the mud in the well becomes too high, which pressure is also present in the branch pipe 14, the spindle 20 is pressed downwards under the influence of the said pressure against the force by which the air piston 29 is pressed upwards. The admission port 22 moves below packing unit 16. Simultaneously with the opening of the admission port 22 the discharge ports 23 and 24 are moved inside packing units 17 and 18 and closed. The mud now arriving between the packing units 16 and 17 flows through the pipe line 19 to the space beneath the piston 13. The latter rises to its utmost place and opens the relief valve 4 completely against the pressure of the spring 12. The excess mud now flows through the opened valve seat 3 and flows away to the relief tube 7. As the relief valve 4 is completely opened and does not cause a narrow slitlike passage, the valve 4 does not suffer any wear to speak of.

If the pressure in the mud in the discharge pipe 6 has again reached its correct value, the air coming from the reducing valve 25 again presses the air piston 29 upward by which the admission port 22 of the control device is closed and the discharge ports 23 and 24 are opened. The open discharge ports 23 and 24 provide a connection between the pipe lines 19 and 32. The mud present under the piston 13 is now pressed away by the action of the spring 12 through the line 19, through the opened discharge ports 23, 24 and through the pipe line 32 to the relief tube 7. The device is now again in its starting position.

It will be clear that the reducing valve 25 is adjusted, for example, at such a pressure, which may be read off on its manometer 26, that in the connections 5 and 6, and, therefore, also in the well, a too high and dangerous pressure cannot occur. It will be clear that if the proportion of surfaces of spindle 20 and the air piston 29 is known, the scale on the manometer 26 can additionally be directly calibrated to the working pressure of the well which renders conversion superfluous.

What I claim is:

1. A relief device for use with a well and a drill pipe having an annular space therebetween, comprising mud return conduit means communicating with said annular space, a choke in said mud return conduit means, said conduit means directing mud from the annular space through said choke, a relief port in said conduit means between said well and said choke, a relief valve controlling said port and including a spindle and piston, means normally urging said relief valve to port-closing position, means for conducting mud from said conduit means to actuate said piston for moving said valve to port-opening position, and means closing and opening said conducting means in response to a predetermined mud pressure in said mud return conduit means, said means opening said conducting means when the mud pressure in said mud return conduit means exceeds said predetermined pressure and closing said conducting means when the mud pressure in said mud return conduit means is less than said predetermined mud pressure.

2. A relief device according to claim 1, wherein said means normally urging said valve to a port-closing position comprises a spring.

3. A relief device according to claim 2, wherein said means closing and opening said conducting means comprises a control valve in said conducting means, said control valve operating against an adjustable load, and means for adjusting said load to determine the predetermined mud pressure in response to which said control valve opens and closes said conducting means.

4. A relief device according to claim 3, wherein said adjustable load comprises fluid under pressure and wherein said means for adjusting said load includes means for manually varying the pressure of said fluid.

5. A relief device according to claim 4, wherein said control valve includes a spindle and a piston, said fluid under pressure acting on said piston to comprise said adjustable load.

6. A relief device according to claim 5, wherein said conducting means comprises a first conduit for directing mud from said mud return conduit means to said control valve and a second conduit for directing mud from said control valve to said piston of said relief valve, said mud acting on said control valve spindle to open said control valve when the pressure of said mud is sufficient to overcome said adjustable load, said adjustable load returning said control valve to the closed position when the pressure of the mud is not sufficient to overcome said adjustable load.

7. A relief device according to claim 6, wherein said control valve spindle has a longitudinal opening therein and a porthole providing communication between said longitudinal opening and said second conduit when said control valve is open, said longitudinal opening being in open communication with said first conduit, and means blocking said porthole when said control valve is closed, thereby preventing communication with said second conduit.

8. A relief device according to claim 7, wherein said spindle has a second longitudinal opening not communicating with said first longitudinal opening, said spindle having a second and a third porthole each communicating with said second longitudinal opening, when said control valve is closed said second porthole communicating with said second conduit and said third porthole communicating with a relief port in said control valve, whereby when said control valve is closed the mud pressure acting on said piston of said relief valve is relieved through the control valve, and means preventing communication be-

tween said second porthole and said second conduit when said control valve is open.

References Cited

UNITED STATES PATENTS

303,765	8/1884	Tracy	166—53
2,043,428	6/1936	Cullen	166—91
1,560,567	11/1925	Grant	137—492.5
2,082,329	6/1937	Foran et al.	175—205 X
2,265,461	12/1941	Wagner	137—492.5 X
2,285,049	6/1942	Parks	166—91
2,639,725	5/1953	Albright	137—492.5
2,728,547	12/1955	Crookston et al.	137—492.5 X
2,741,262	4/1956	Crookston	137—492
2,786,652	3/1957	Wells	175—38 X
2,955,614	10/1960	Meynig	166—63 X
3,198,207	8/1965	Willis et al.	137—492.5 X
3,213,939	10/1965	Records	175—38 X

OTHER REFERENCES

Bell, Frank S.: High Pressure Drilling and Blowout Prevention, in the Oil and Gas Journal, Oct. 14, 1957, pp. 139, 147–149, 163–165 relied on.

CHARLES E. O'CONNELL, *Primary Examiner.*

I. A. CALVERT, *Assistant Examiner.*