

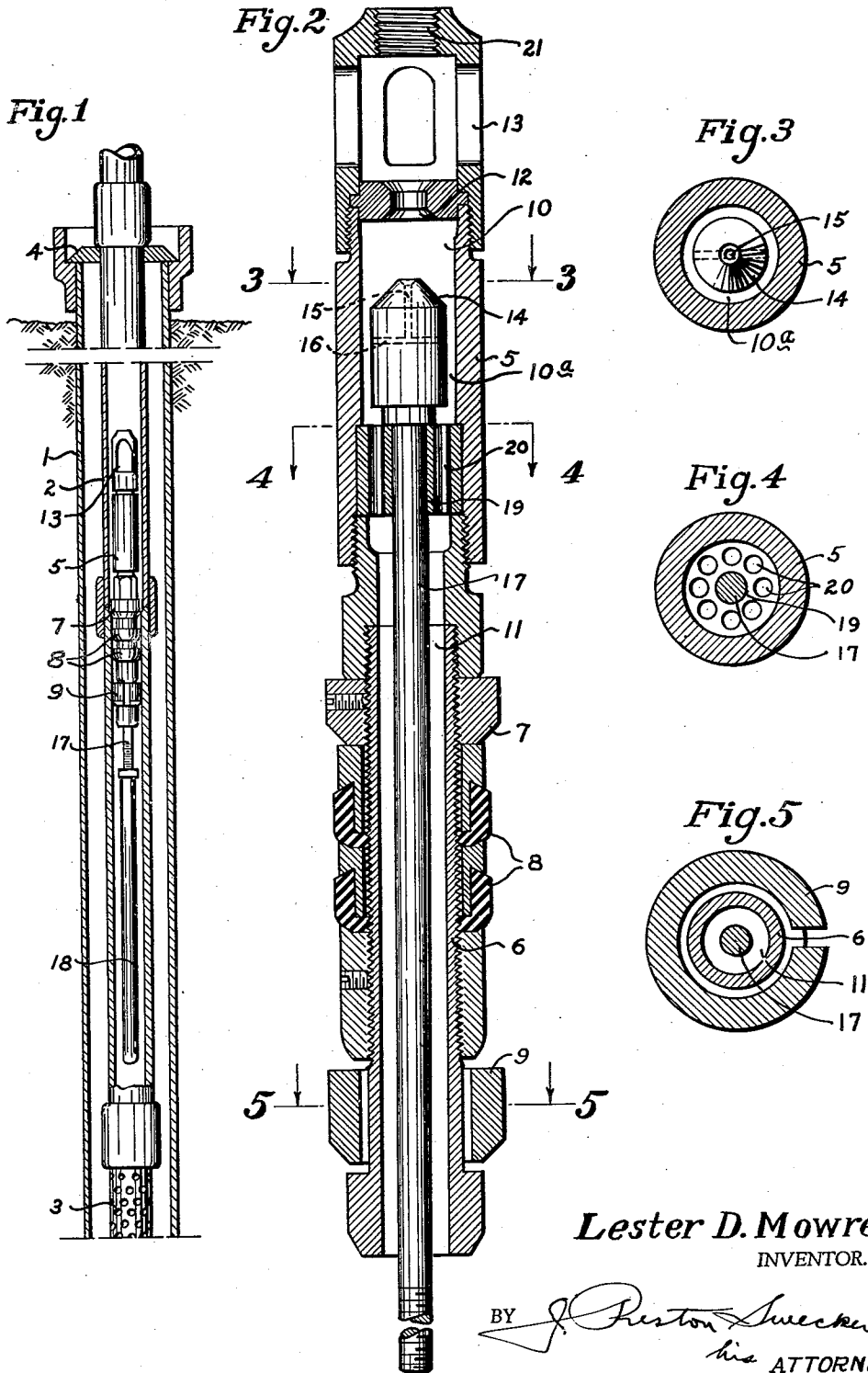
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L. D. MOWREY
BOTTOM HOLE REGULATOR

2,411,667

Filed July 29, 1942

2 Sheets-Sheet 1



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Fig. 6

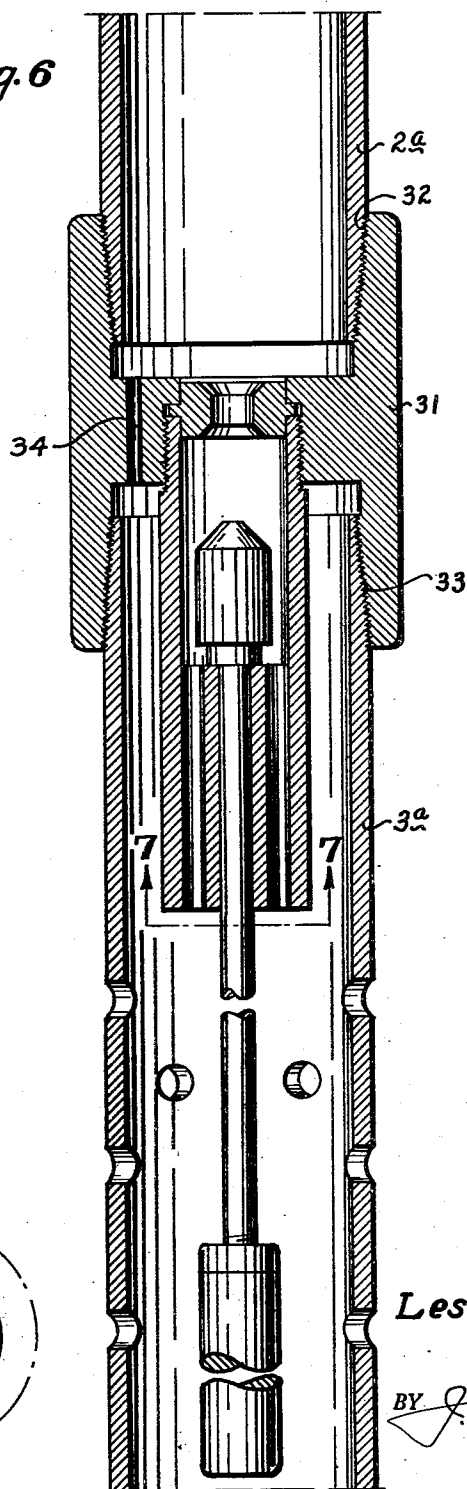
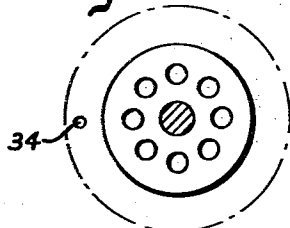


Fig. 7



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UNITED STATES PATENT OFFICE

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BOTTOM HOLE REGULATOR

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3 Claims. (Cl. 166—2)

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This invention relates to an improvement in bottom hole regulators, especially designed for controlling the pressure in a deep well, such as an oil or gas well.

When a well contains a substantial amount of gas, which exerts a pressure on the oil or fluid therein to cause flowing of the well, there is always danger that the flow of gas from the well will exhaust the gas pressure from the producing strata, thereby causing the pressure in the casing to drop to such extent as to prevent the oil from flowing out of the well.

The object of this invention is to provide for the automatic control of the flow of fluid in a flowing well to prevent the undue release of the gas from the casing and producing strata so as to maintain proper control over the flow of the well.

This object is accomplished by the provision of a valve in the flow tubing which is automatically responsive in its closing movement to the velocity of fluid flowing therethrough, so that, upon a substantial increase in the velocity of the fluid, the valve closes, and opens again automatically in response to the building up of a static head of liquid in the tubing thereabove. When the valve is closed, provision is made for by-passing some fluid therethrough, whereby a hydrostatic head may be built up above the valve, after the primary passage of the valve becomes closed. By slowing up or restricting the passage of the fluid into the tubing, the fluid will become nearly static, and the gas, being of lighter gravity than the oil fluid, will collect at the top of the annular space between the casing and the flow tubing. A slow equalization of hydrostatic pressures of the oil or other heavy fluid between the outside and inside of the flow pipe then takes place. When a predetermined differential pressure point is reached, before complete equalization, the valve will drop and open the primary passage, thus allowing full flow of fluid to be resumed.

A preferred embodiment of the invention, together with a modification thereof, are shown in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view, partly in elevation, through a well, showing the invention applied thereto;

Fig. 2 is an enlarged vertical section through the regulator of this invention;

Fig. 3 is a cross section therethrough, on the line 3—3 of Fig. 2;

Fig. 4 is a similar view on the line 4—4 of Fig. 2;

Fig. 5 is a similar view on the line 5—5 of Fig. 2;

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Fig. 6 is a vertical section through a modified form of regulator; and

Fig. 7 is a cross section therethrough on the line 7—7 of Fig. 6.

The invention is shown as applied to a deep well of the type in which oil flows out through tubing in response to gas pressure in the well. The well is shown in Fig. 1, as having the usual casing 1 within which is suspended the flow tubing 2, having a perforated screen 3 at the bottom thereof through which fluid is admitted to the tubing. The upper end of the casing 1 is sealed off by the usual head 4, and gas pressure is built up in the casing 1 around the outside of the tubing 2, acting on the oil in the well to discharge the same through the tubing.

Gas at high pressure ordinarily will channel through the liquid in the well without taking with it the maximum amount of oil, if allowed to flow unimpeded. After a channel is established through the liquid the gas will flow with great force and volume, as the oil will seldom flow with sufficient rapidity to keep the gas subsided to the extent of flowing only oil or the maximum amount of oil and minimum amount of gas.

Attempts have been made heretofore to control the oil ratio with respect to the gas, but the apparatus was complicated and required much attention, but without accomplishing satisfactory results. The present regulator has been designed to work automatically with a minimum of moving parts which require little or no attention over a long period of operation.

One form of the regulator, shown in Figs. 2 to 5, is constructed of a body 5, having a depending portion 6 suspended therefrom adapted to extend into a reduced or lower section of tubing and provided with a seat 7 to be supported thereon. Packing 8 surrounds the depending portion 6 to seal off the same within the tubing. A spring ring 9 surrounds the lower end of the depending portion 6 to hold the same by friction when properly seated and in place in the tubing.

The body 5 has a valve chamber 10 therein in open communication with a passageway 11 extending through the depending portion 6 and open at the bottom to the lower portion of the tubing 2 for upward flow of fluid through the regulator and for discharge through a valve seat 12 and cage 13 attached to the upper end of the body 5. A valve 14 is located in the valve chamber 10 in position to engage the seat or to close off the passageway therethrough. An annular passage 10a is formed between the valve 14 and the body 5, constricting the passage, so that fluid

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flowing therethrough will cause a lifting action on the valve 14 when in open position.

The valve 14 has an axial opening 15 in the upper end thereof in open communication with a transverse opening 16 extending to opposite sides and below the seating end of the valve to allow a much reduced passage of fluid through the regulator when the valve 14 is closed against the seat 12. The pilot opening 16 can vary in size to handle larger or smaller quantities of fluid. A larger pilot opening will permit the passage of a greater quantity of fluid and thus allow the predetermined pressure between the inside and outside of the pipe to be reached more quickly, thus accelerating the valve action. A comparatively smaller pilot opening will slow down the passage of fluid and thus the reverse action brought about.

The valve 14 is connected with a valve stem 17, which stem 17 extends downward through passageway 11 and carries a weight 18 suspended from the lower end thereof within the lower portion of the tubing 2, as shown in Fig. 1, normally tending to hold valve 14 open.

The weight 18, attached to the valve 14, determines the differential of pressure which exists between the inside and the outside of the flow pipe. The heavier the weight the greater will be the difference in pressures, i. e., the valve will be closed more slowly and opened more quickly, which will keep the flow of fluid inside the flow string lighter. A lighter weight would operate in a reverse manner.

A guide 19, is provided for guiding the stem 17, and has circumferentially spaced holes 20 therein. A threaded connection 21 is provided at the upper end of the cage 13 for connection of a conventional sucker rod, to allow the insertion and removal of the regulator and the placement of the same in the tubing.

Under normal flowing conditions, the gas pressure existent in the producing formation will exert a pressure on the surface of the oil within the casing forcing the oil to rise upward in the tubing until the oil flows out at the upper end of the tubing 2. In this course, the oil will pass through the passageway 11 and through the annular passage 10a, by the valve 14 and out through the valve seat 12 and cage 13 for discharge through the tubing 2. If an excessive flow of fluid passes by the valve 14, the velocity thereof will act to close and hold the valve against the seat 12, thus closing off the major flow through the tubing, and allowing only such flow as results from the reduced passage through the openings 15 and 16. Under normal conditions, as long as there is a liquid seal at the bottom of the well, the escape of gas in large quantities is prevented.

This regulator may be placed in the tubing whenever excessive gas pressure is encountered and may be readily removed therefrom by the use of conventional sucker rods. When the regulator is once seated in proper position the sucker rods may be removed by unscrewing the same at 21, or other suitable coupling means may be provided. This procedure may be reversed for removal of the device from the tubing. The annular seating ring 7 is provided on the regulator to engage the top of the working barrel or a joint of reduced-size pipe, although any other suitable mounting may be used whereby the regulator is supported in the tubing.

A modification of the means of mounting the regulator within the tubing is shown in Fig. 6, in

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which an upper body portion 31 is provided with threads at 32 which connect with the upper portion of tubing 2a and with threads 33 to connect with the lower portion of the tubing or perforated pipe 3a. By having the regulator thus rigidly secured within the tubing, the pressure will not move the regulator relative to the tubing, even though the pressure should become sufficiently great to move the regulator as described above.

The operation of the regulator within the tubing for regulating the flow of fluid therethrough is substantially the same as described in connection with Figs. 2 to 5. When the regulator is in place it does not interfere with the normal flow through the tubing but acts automatically to check excessive flow of fluid therethrough which would result in the loss of gas with a resultant drop in the gas pressure on the strata, which gas pressure is vital to the flowing of the oil from the well.

This bottom hole regulator is simple in construction and with the minimum number of parts to provide the necessary valve action for control of the fluid and gas. It is, therefore, inexpensive to manufacture and to use, and at the same time it provides the needed control within the tubing without interfering with the normal flow of fluid therethrough.

I claim:

1. A bottom hole regulator adapted for mounting in a string of flow tubing, comprising a tubular body, a cage connected with the upper end of the body and having means for detachable engagement with a supporting device adapted to lower the regulator into the tubing, a ring surrounding the tubular body and projecting outwardly beyond the periphery thereof in position to seat upon a supporting shoulder in the tubing, packing means surrounding the tubular body below said ring for closing the space between the tubular body and the tubing, a valve seat mounted in the tubular body, a guide member fixed in the tubular body at a point spaced downwardly from the seat, said guide member having circumferentially spaced openings therethrough, a valve stem slidably mounted in the guide member, and a valve mounted on said stem and positioned between the guide member and the seat in position to engage the seat.

2. A bottom hole regulator adapted for mounting in a string of flow tubing, comprising a tubular body, a cage connected with the upper end of the body and having means for detachable engagement with a supporting device adapted to lower the regulator into the tubing, a ring surrounding the tubular body and projecting outwardly beyond the periphery thereof in position to seat upon a supporting shoulder in the tubing, packing means surrounding the tubular body below said ring for closing the space between the tubular body and the tubing, a valve seat mounted in the tubular body, a guide member fixed in the tubular body at a point spaced downwardly from the seat, said guide member having circumferentially spaced openings therethrough, a valve stem slidably mounted in the guide member, a valve mounted on said stem and positioned between the guide member and the seat in position to engage the seat, a weight carried by the lower end of the valve stem normally tending to hold the valve seated upon the guide member, and a spring ring surrounding the tubular body below the packing in position for frictional engagement with the tubing.

3. A bottom hole regulator adapted for mount-

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ing in a string of flow tubing, comprising a tubular body, a cage connected with the upper end of the body and having means for detachable engagement with a supporting device adapted to lower the regulator into the tubing, a ring surrounding the tubular body and projecting outwardly beyond the periphery thereof in position to seat upon a supporting shoulder in the tubing, packing means surrounding the tubular body below said ring for closing the space between the tubular body and the tubing, a valve seat mounted in the tubular body, a guide member fixed

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in the tubular body at a point spaced downwardly from the seat, said guide member having circumferentially spaced openings therethrough, a valve stem slidably mounted in the guide member, a valve mounted on said stem and positioned between the guide member and the seat in position to engage the seat, a weight carried by the lower end of the valve stem normally tending to hold the valve seated upon the guide member, and a spring ring surrounding the tubular body in position for engagement with the tubing.

LESTER D. MOWREY.