April 20, 1943. M. B. THOMAS 2,317,121

GAS LIFT INTERMITTER

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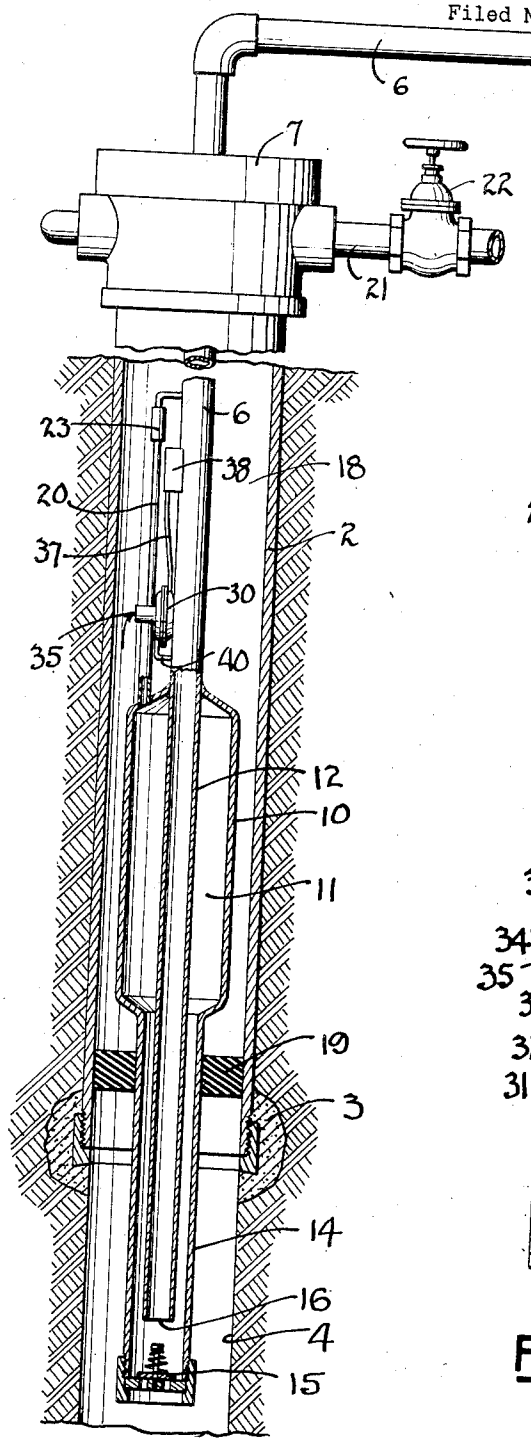


Fig. 1.

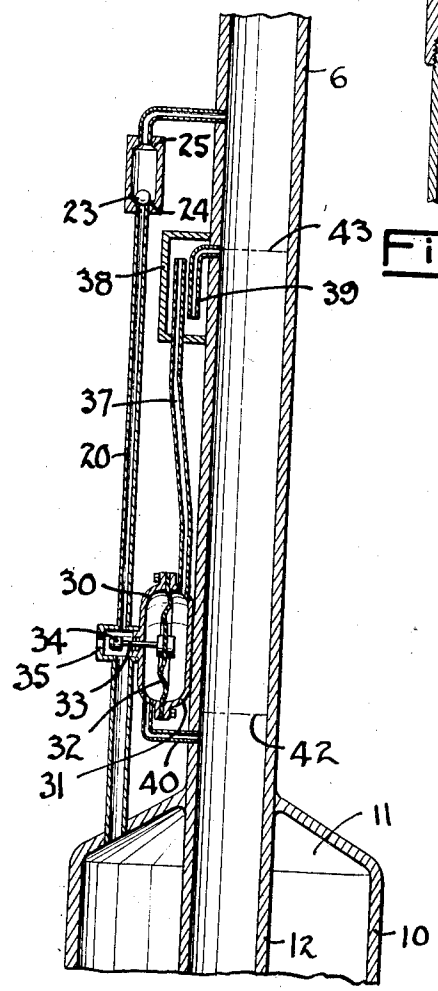


Fig. 2.

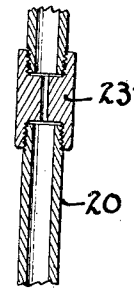


Fig. 3.

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GAS LIFT INTERMITTER

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6 Claims. (Cl. 103—231)

The invention relates to a gas lift intermitter for wells wherein the liquid from the well is expelled intermittently, depending upon the amount of liquid which accumulates, the pressure of the actuating fluid, and the rate of production from the well.

In the flowing of wells no two wells have the same characteristics, and it is of material advantage to provide an arrangement for flowing the well which will be contingent for its operation upon the accumulation of a predetermined quantity, volume or weight of liquid in the well. If the flowing device can be operated as a function of the accumulation of the liquid in the well, then it does not require any particular attention but will flow automatically to produce the quantity which is allowable or producable from that particular well.

The present invention contemplates that a balanced pressure control mechanism will be provided which will operate when a predetermined amount or pressure of liquid accumulates in the well so as to admit the pressure fluid to expel that accumulation of liquid, whereupon the mechanism will close and remain closed pending the accumulation of another head of liquid in the well.

It is one of the objects of the invention to provide a gas lift intermitter wherein the accumulation of liquid in the well to a predetermined level is balanced against a static column of liquid to operate the intermitter when the device is overbalanced.

Another object of the invention is to provide an intermitter chamber in wells wherein the liquid accumulating in the chamber will be discharged upon the occurrence of a predetermined volume of liquid.

Another object of the invention is to provide a pressure control device for gas lift intermitters wherein gas is allowed to bleed off from the intermitter chamber and then pressure fluid applied to the intermitter chamber through the same mechanism so that a full chamber of liquid may be accumulated for each cycle.

Another object of the invention is to provide a pressure fluid admission device for gas lift intermitters wherein part of the pressure fluid is applied to the intermitter chamber and part of it applied to the flow tubing.

Another object of the invention is to provide a control device for well intermitters wherein the device actuates when a predetermined amount or level of liquid accumulates in the flow tubing.

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

Fig. 1 is a side elevation of a well to which the invention has been applied and showing certain portions thereof in section.

Fig. 2 is a vertical sectional view through the control mechanism.

Fig. 3 is a broken sectional view of a choke which may be used in the bleeder line.

In Fig. 1 the well casing is indicated generally at 2 and extends downwardly into the well bore where it is usually sealed in position by a body of cement 3.

The liquid to be produced from the well flows into the well bore 4 beneath the casing and must be elevated to the surface. As previously pointed out, the flow into the well bore may be relatively slow and it is inefficient to provide a continually operating mechanism for elevating the liquid from the well. With the present device, however, the mechanism will remain inoperative until such time as there has occurred a predetermined accumulation of liquid from the well.

In order to provide for this accumulation of liquid a flow tubing 6 is positioned inside of the well casing and will be properly suspended from the casing head 7 at the well head. This tubing 6 may be of any desired length and extends downwardly in the well to an elevation adjacent the producing formation or to a position such that it is submerged in the static head of liquid in the well. The lower end of this tubing 6 carries an enlargement 10 which provides an intermitter or accumulation chamber 11. This chamber is arranged around the outside of the lower end 12 of the tubing and may be of any desired size or length. A tail pipe 14 extends downwardly from the enlargement or housing 10 and carries a standing valve 15, whereas, the tubing 6 is shown as extending downwardly through the intermitter chamber 11 and into the tail pipe 14. The lower end 16 of the tubing is open to receive a flow of liquid from the chamber 11.

In order to form a reservoir 18 inside of the casing 2 and outside of the tubing 6, a packer 19 is carried by the tail pipe 14 and arranged to form a seal with the inside of the casing 2. The casing head 7 closes the top of this chamber. An inlet 21 controlled by the valve 22 may be utilized to furnish pressure fluid in the reservoir 18.

As liquid accumulates from the formation 4

in the space below the packer 19 it will cause the standing valve 15 to open and will flow upwardly in the tail pipe 14. In view of the fact that the lower end 16 of the tubing 6 is open, the liquid will rise both in the tail pipe 14 and inside of the lower end 12 of the tubing 6.

As this liquid continues to rise it will enter the accumulation chamber 11. It is desirable to permit the escape of gas or air from the top of the chamber 11 so as to avoid building up a pressure in the chamber and to allow the chamber to fill completely with liquid. To accomplish this, a bleeder pipe 20 is shown as connected to the top of the housing 10 and this pipe extends upwardly where it is connected to the side of the tubing 6. As the liquid rises in the accumulation chamber, gas in the chamber will be displaced upwardly through the pipe 20 and discharged into the tubing 6. In order to control the flow through this by-pass or bleeder pipe 20, a freely movable check valve 23 has been provided which has a lower seat 24 and an upper seat 25. In this manner there can be no flow from the tubing 6 downwardly through the by-pass pipe 20 because the valve 23 will fall by gravity and engage the lower seat 24, and in this manner sand or foreign matter cannot settle into the control valve or accumulation chamber. On the other hand, if there is a sufficient upflow through this pipe 20 to lift the check valve 23 it will rise from its lower seat 24 and move up against the upper seat 25 to prevent the escape or leakage of pressure fluid into the tubing 6. In this manner the flow escaping from the intermitter chamber is controlled, and while a double seating check valve has been disclosed, it is intended that a suitable choke may be substituted for the check valve 23. Such a choke is shown in Fig. 3 at 23'.

As the liquid accumulates from the formation it will rise inside of the extension 12 of the tubing so that when the accumulation chamber 11 is filled, the tubing will also be filled.

Fig. 2 shows a control mechanism applied to the tubing above the housing 10, but this mechanism may be positioned inside of such housing 10 and is in the form of a balanced pressure device 30 which is disposed in the housing 31. A diaphragm 32 carries a valve stem 33 to actuate the valve member 34. The valve member, in turn, controls the pressure fluid entry 35 in the side of the pipe 20. It is the purpose of this valve to open to admit pressure fluid from the reservoir 18 so that such pressure fluid may flow downwardly through the pipe 20 into the accumulation or intermitter chamber to create a pressure on the top of the accumulated liquid in such chamber so as to force the liquid downwardly in the chamber and upwardly through the lower end 16 of the tubing 6.

In view of the fact that it is intended that the device will operate to admit pressure fluid only when a predetermined column of liquid accumulates in the tubing from the formation, the diaphragm 32 is arranged to be operated by a pressure differential which is obtained by balancing the pressure of a column of liquid in the riser or stand pipe 37 which extends upwardly from one side of the diaphragm 32 and from the housing 31. This stand pipe may be of any desired length, depending upon the characteristics or circumstances encountered in any particular well. In the present arrangement a trap 38 has been provided on the side of the tubing to receive the upper end of the stand pipe 37. A feed pipe 39 passes into the tubing inside of the trap 38 so that the stand pipe 37 will be maintained full of liquid so long as there is any liquid in the tubing. This trap forms a fluid seal for the stand pipe or riser to accommodate fluctuations of the liquid therein and to avoid contamination of the liquid in the riser tube.

Thus should salt water enter the feed pipe 39 it would settle to the bottom of the trap and the breathing of the diaphragm 32 would not draw any salt water or other sediment into the riser pipe 37 or the diaphragm housing 31.

This pressure on one side of the diaphragm 32, due to the column of liquid in the riser pipe 37, will normally hold the valve 34 in closed position on its seat of the entry port 35. It seems clear, therefore, that the length of this pipe 37 or the pressure created on the diaphragm due to the column of liquid therein will control the pressure which maintains the device inoperative.

To balance the static pressure on the diaphragm 32 a feed pipe 40 is connected from the tubing 6 to one side of the housing 31 which is on the other side of the diaphragm 32 from the static pressure. The pressure from this feed pipe 40 tends to balance the static pressure on the diaphragm 32. The pressure to be applied through this feed pipe 40 and tending to balance the diaphragm occurs due to the accumulation of liquid in the well tubing 6. Thus, as the liquid rises in the tubing 6, when it passes the elevation of the line 42, begins to build up a pressure through the feed pipe 40 against what may be termed the outside of the diaphragm 32. If this head of liquid continues to increase when it reaches the approximate elevation of the line 43, then the static pressure on the diaphragm from the riser pipe 37 will be substantially balanced. The liquids in the riser pipe and the well tubing may be of the same or different specific gravities so as to cause actuation of the diaphragm 32. A suitable liquid of lesser specific gravity than the liquid from the well may be used in the riser if a predominant pressure is desired on the diaphragm from the well tending to open the valve while a heavier liquid in the riser tube would give a predominant pressure on the diaphragm tending to hold the valve closed.

If the pressure on the diaphragm 32 is balanced the pressure in the reservoir 18 exerted on the exposed end of the valve 34 through the entry port 35 will create a predominant pressure on the outside of the diaphragm, tending to open the valve because this pressure from the reservoir 18 will be added to that of the pressure from the column of well liquid. In this manner a differential pressure will be available tending to open the valve. It seems obvious that the parts can be so adjusted and the type of liquid in the riser pipe 37 selected so that this differential pressure will determine the sensitivity of the control mechanism.

When the valve 34 opens there will be a flow of pressure fluid into the pipe 20 where it will flow downwardly into the accumulation or intermitter chamber and will be applied to the upper surface of the liquid in the accumulation chamber and will tend to expel the liquid upwardly through the tubing 6. When the liquid is thus expelled the head of liquid between the points 42 and 43 will have been expelled also, so that there will be a consequent reduction of pressure through the feed pipe 40 on the outside of the diaphragm 32 due to such removal. While this reduction in pressure occurs, the pressure in the

stand pipe 37 due to the head of liquid therein remains constant so that the diaphragm is overbalanced and the valve 35 will again close. This cycle of operation will proceed continuously depending upon the accumulation and discharge of the liquid in the tubing 6.

The check valve 23, or the choke 23 which may be used in its stead, may be so arranged that some of the pressure fluid can escape upwardly into the tubing 6 to assist in aerating the column of liquid discharging from the accumulation chamber. This is an optional feature and may or may not be incorporated with the invention, depending upon the circumstances or characteristics of any particular well.

This particular arrangement, however, need not be strictly adhered to for proper operation of the intermitter. Another arrangement that will be equally satisfactory is to locate the packer 19 between the control mechanism detailed in Fig. 2 and the accumulation chamber 11 with a passage connecting the two for conducting the pressure fluid from entry port 35 to the accumulation chamber 11. Also the check valve 15 may be located at the bottom of the housing 10 instead of at the bottom of a tail pipe 14.

In some instances where the wells are quite deep it may be desirable to aerate the column of liquid at different stages in the tubing, and to accomplish this the gas lift valve disclosed in my Patent 2,216,967 granted October 8, 1940, may be utilized if desired.

Broadly, the invention contemplates a fluid weight gas lift intermitter for wells.

What is claimed is:

1. An intermitter for wells comprising an intermitter chamber, a flow tubing extending thereinto, means to allow the inflow of well liquid to said chamber and tubing, means to introduce fluid pressure to the top of said chamber to expel the well liquid from said chamber through the tubing, and a control device for said means including a fluid weight pressure mechanism operable upon variation in the weight of the column of liquid accumulating in a relatively short section of the tubing.

2. A well flowing device including a tubing in the well, a housing enclosing the lower end of said tubing to form a chamber into which the well liquid may enter from the well bore, a connection from the top of the chamber to the tubing at a point spaced above the top of the housing to permit escape of gases accumulating in the chamber, a valve in said connection to admit pressure fluid to the chamber to expel the well liquid from the chamber upwardly thru the tubing, and means to open and close said valve upon the accumulation and removal respectively of a column of well liquid of a predetermined specific gravity in a predetermined section of said tubing.

3. A device for intermittently flowing the well liquid from a well thru the well tubing in the well, said device including a housing about the lower end of the tubing to form a chamber for the accumulation of well liquid entering from the formation, valve means to admit pressure fluid to the chamber to expel the well liquid therefrom and upwardly thru the tubing, and a mechanism to operate said valve means solely in response to variations in specific gravity of the well liquid extending along a relatively short section of the tubing above said chamber.

4. A well flowing device including a tubing, a housing enclosing the lower end of said tubing to form a chamber with the tubing, a valve to admit a pressure fluid, a connection to admit the pressure fluid to elevate the well liquid which enters the chamber and tubing, a connection having a passage between said chamber and said tubing to allow escape of gases from the top of said housing to the tubing above said valve, and means to actuate said valve solely in response to variations in specific gravity of the well liquid along a predetermined section of the tubing.

5. A gas lift device for producing liquid from an earth bore comprising a tubular member thru which the production liquid flows, a housing forming a chamber about the lower end of said member, said housing having a passage for admitting gas under pressure into the chamber thru the wall thereof, and means for opening and closing said passage solely in response to variations in the specific gravity of the liquid extending along a relatively short section of the member.

6. A gas lift device for producing liquid from an earth bore comprising a tubular member thru which the production liquid flows, a housing forming a chamber about the lower end of said member, said housing having a passage for admitting gas under pressure into the chamber thru the wall thereof, means for opening and closing said passage solely in response to variations in the specific gravity of the liquid extending along a relatively short section of the member, and a connection from said passage to the tubing above the short section to bleed gases from the chamber to the tubing as the well liquid enters said chamber from the formation.

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