

June 18, 1940.

C. V. TEMPLE

2,204,834

GAS LIFT VALVE

Filed Oct. 8, 1938

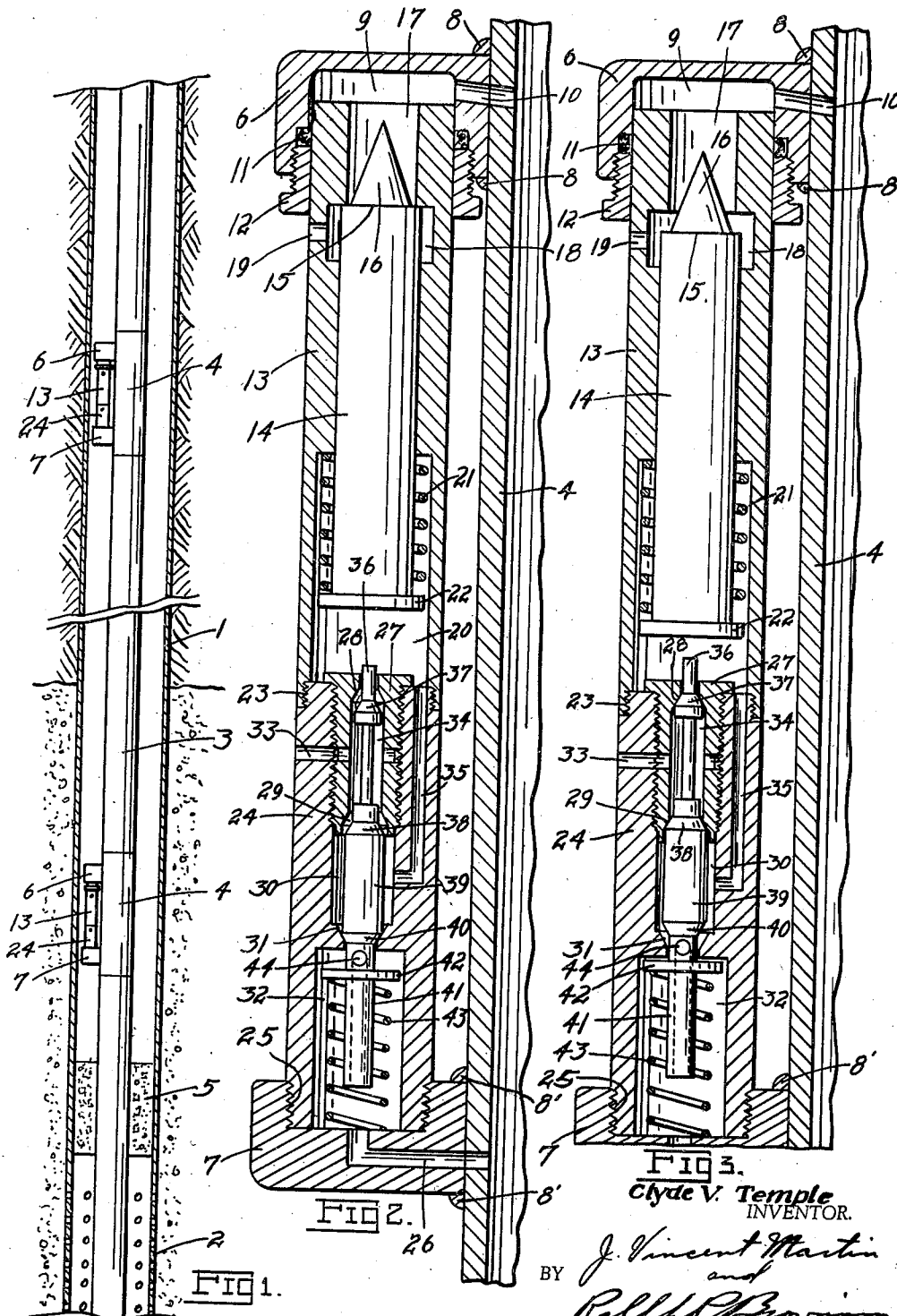


FIG. 3.
Clyde V. Temple
INVENTOR.

BY J. Vincent Martin
and
Ralph H. Browning
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,204,834

GAS LIFT VALVE

Clyde V. Temple, Tyler, Tex., assignor to The
Guiberson Corporation, Dallas, Tex., a corpo-
ration of Delaware

Application October 8, 1936, Serial No. 104,613

15 Claims. (Cl. 103—232)

This invention relates to that type of device for flowing liquids from wells customarily referred to as gas lift devices, and more particularly has reference to a valve mechanism where-
5 by the admission of gas or air to a column of liquid within a well may be controlled.

It is an object of this invention to provide a valve for controlling the admission of gas or air into a column of liquid within a well in which a
10 main valve for controlling such admission is controlled by a pilot valve mechanism. It is a further object that such pilot valve mechanism may so control the operation of the main valve that the gas or air will not be admitted to the
15 column of liquid within the well until said column of liquid shall have attained a predetermined height.

It is a further object of this invention to provide a valve combination in which the main
20 valve will be operated by pressure admitted thereto through a pilot valve, and in which the pilot valve will in turn be operated in accordance with the pressures existing in the gas or air to be admitted to a column of liquid and the
25 pressure within the column of liquid itself.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing, it being distinctly understood
30 that such drawing and description are by way of example and illustration only, and are not to be taken by way of limitation. Limitation of the scope of this invention is to be only by the prior art and by the terms of the appended
35 claims.

In the drawing:

Fig. 1 is a view showing a well in vertical cross section, and illustrating in elevation the application of valves constructed in accordance
40 with this invention to a string of tubing within the well.

Fig. 2 is a vertical cross section illustrating one of the valves and a section of the tubing shown in Fig. 1 with the main valve in closed
45 position.

Fig. 3 is a view similar to Fig. 2, but showing the main valve in open position.

With reference again to Fig. 1, the well is illustrated as being provided with a casing 1, having a screen or perforated pipe 2 on the lower
50 end thereof within the producing formation. The tubing 3 extends to a position within the screen 2 through the interior of the casing, and is provided at intervals with short sections of fittings 4 to which the valves later to be de-

scribed are connected. At a point above the upper end of the screen or perforated pipe 2 there is provided a packing 5 which seals up the lower end of the space within the casing. It is to be understood, of course, that the tubing is open at
5 its lower end within the screen or perforated pipe 2 so that fluid entering through the screen or perforated pipe will flow into the tube and upwardly out of the well.

Each of the fittings 4 is provided with an upper
10 laterally extending member 6, and a lower member 7, both of which members are secured to the outer surface of the fitting 4 as by means of welding 8 and 8'.

The upper member 6 has a hollowed out portion
15 9 which is connected to the interior of the tubing by means of a passageway 10. Adjacent the lower end of this hollowed out portion 9 it is provided with a countersink 11 for the purpose of receiving packing or the like, and this countersink is threaded adjacent its lower end to re-
20 ceive the nut 12. The upper portion of the valve housing 13 extends into the hollowed out portion 9 and a fluid packed seal is formed between the walls of the hollowed out portion and the ex-
25 terior of this housing 13 by means of the packing 11 just referred to.

Within the housing 13 there is shown the main valve member 14 having a shoulder 15 adjacent its upper end adapted to seat against a corre-
30 sponding shoulder formed on the interior of the housing 13 to close the valve. Projecting beyond this shoulder 15 is a conical shaped portion forming a sort of metering pin adapted when the valve is partly open to restrict the amount
35 of gas or air entering therethrough. This conical shaped member 16 extends past the shoulder within the housing 13 and into the passageway 17 which leads to the hollowed out portion 9 of the member 6, and thence by way of the passage-
40 way 10 to the interior of the tubing. Just below the shoulder within the housing 13 the housing is provided with an enlarged portion 18 communicating with the exterior of the housing through the passageway 19. The lower portion
45 of the housing 13 is provided with an enlarged opening 20 of a size to receive the spring 21 which surrounds the lower end of the main valve element 14. This spring 21 bears against the flange 22 on the lower end of this valve element and serves to constantly urge the main valve to
50 open position.

The lower end of the housing 13 is interiorly threaded at 23 to receive the threaded upper end of the pilot valve housing 24, and the pilot valve

housing is in turn exteriorly threaded at its lower end into the socket member 7 which, as heretofore described, is welded or otherwise secured to the exterior wall of the tubing 4. This member

7 is provided with a passageway 25 thereto connecting the interior of the pilot valve housing 24 with the interior of the tubing.

At its upper end, the valve housing 24 is interiorly threaded to receive the bushing 27 in which are formed the downwardly facing valve seats 28 and 29. Below this bushing 27 the housing 24 is provided with a portion 30 of enlarged diameter which when the bushing 27 is in place forms a chamber within the housing. The lower end of this chamber is an upwardly facing valve seat 31 controlling an opening leading to the chamber 32 in the lower end of the pilot valve housing.

Through a passageway 33 in the pilot valve housing and the bushing 27, the space 34 between the valve seats 28 and 29 is placed in communication with the body of gas or air under pressure which is to be admitted into the column of fluid. The chamber 30 between the bushing 27 and the upwardly facing valve seat 31 is in communication with the chamber 20 in the lower part of the main valve housing through a passageway 35 which is clearly shown in Figs. 2 and 3 of the drawing.

Extending downwardly through the bushing 27 is a valve stem 36 carrying thereon valve elements 37 and 38 adapted to seat, respectively, against the seats 28 and 29 in the bushing 27. Within the chamber 30 this valve stem is of somewhat enlarged diameter as shown at 39, and at its lower end is provided with a reduced tapered section forming a valve element 40 adapted to seat against the upwardly facing valve seat 31. The lower portion 41 of this valve stem is surrounded by a washer or the like 42 fixedly mounted thereon adapted to receive the upper end of a spring 43 which constantly urges the valve stem together with all its valve elements into their uppermost position. The lower portion 41 of this valve stem is provided with a bore opening laterally at 44 just below the valve element 40. So that when the valve element 40 is moved from its seat, fluid contact is established between the chamber 30 and the interior of the tubing.

In operation, the space within the casing above the packer 5 is filled with gas or air under a predetermined pressure. Considering, for the sake of simplicity, the operation of but a single valve, it will be assumed that in the beginning there is no oil standing in the tubing above this valve. Under these conditions, in view of the fact that the valve element 37 is considerably smaller than the valve element 38, the pressure of the gas or air in the space between the casing and the tubing will cause the valves 37 and 38 to be unseated, and will cause the valve stem 36 to move downwardly until the valve element 40 is seated against its seat 31. When in this position, the air or gas under pressure will enter through the passageway 33, pass downwardly by the valve 38 and upwardly by the valve 37, thus entering the chamber 20 both through the passageway 35 and directly past the upper end of the stem 36. This gas under pressure will act upon the lower end of the main valve element 14 and will force it to closed position against the action of the spring 21.

As the oil flows into the well from the producing formation, and the oil column rises in the

tubing 3, it will upon reaching a certain height exert a pressure through the passageway 35 which taken with the force exerted by the spring 33 will be sufficient to move the valve stem 36 and its associated valves so that the valve 38 will be unseated and the valves 37 and 38 will be seated despite the pressure exerted by the gas or air within the casing. When this occurs, no more gas or air can flow from the space within the casing into the chamber 20, and the chamber 20 will be vented through the passageway 35, the chamber 30, and the passageways 44 and 33 into the tubing. The pressure within the chamber 20 will thus be permitted to fall until it is the same as the pressure within the tubing. Since the space above the valve element 14 is always at the same pressure as the space within the tubing, the only force then exerted on the main valve element 14 will be that exerted by the spring 21 tending to move the main valve to open position.

When the main valve is thus moved to open position air or gas under pressure is admitted from the space within the casing into the tubing through the passageways 19 and 10, and the column of fluid within the tubing is aerated and caused to move upwardly and out of the well.

As soon as the column of fluid has moved upwardly and out the well so that the pressure exerted through the passageway 26 is relieved by a predetermined amount, the force with which this pressure has been urging the valve stem 36 upwardly is reduced so that the pressure from the interior of the casing acting with unbalanced forces upon the valve elements 37 and 38 may again move the valve stem 36 downwardly. When the valve stem 36 is moved downwardly a slight amount, a small amount of gas or air will be admitted into the chamber 30, and to the chamber 20, thus tending to close the main valve 14, and as soon as there is sufficient differential between the pressure within the casing and that within the tubing, the valve stem 36 will again move to its lower position as shown in Fig. 2, in which position the gas or air pressure will be permitted to close the main valve 14.

It is to be noted that the upper end of the valve stem 36 projects into the chamber 20, and that when the main valve is moved to fully open position upon closing of the valves 37 and 38 it will strike the valve stem 36 and tend to open these valves and close the valve 40. It is contemplated that this action may take place and that the valves 37 and 38 may be moved slightly from their seat several times as the tubing pressure drops, before the valves 37 and 38 finally are opened far enough to seat valve 40.

It will be seen from the foregoing that there has been provided a device in which a pilot valve serves to control the action of the main valve for admitting gas or air under pressure into a column of fluid. In this connection it may be stated that wherever in this specification and the accompanying claims "gas" is referred to, the term is to be taken as having reference to any gaseous medium. It is further apparent that this pilot valve is controlled by the pressure exerted by the column of fluid so that it will be operated to cause the opening of the main valve when the column of fluid within a tubing has reached a predetermined height.

It is further to be noted that by this invention there has been provided a device in which a relatively large and heavy main valve is positively actuated in accordance with the movements of a relatively light and sensitive pilot valve.

It will readily be seen that the resulting apparatus is of a highly sensitive and efficient nature, and is fully capable of carrying out all the objects and advantages sought by this invention.

5 Having described my invention, I claim:

1. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated main valve for controlling the admission of gas into the flow line, and a pilot valve for controlling the pressure acting on said main valve to actuate the same, said pilot valve being subject in its operation to variations in pressure in said flow line.

2. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated main valve for controlling the admission of gas into the flow line, a pilot valve for controlling the pressure acting on said main valve to actuate the same, said pilot valve being subject in its operation to variations in differential between the pressure of gas to be admitted into said flow line and the pressure within the flow line itself.

3. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve, a pressure actuated pilot valve for controlling the pressure acting on said main valve to actuate the same, and means connected to said pilot valve and subject to the pressure existing within said flow line for actuating said pilot valve in accordance with variations of pressure within said flow line.

4. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated main valve for controlling the admission of gas into a column of fluid, a pilot valve for controlling the pressure acting on said main valve to actuate the same, and means connected to said pilot valve and subject to the pressure within said flow line and to the pressure of the gas to be admitted into said flow line, whereby said pilot valve will be actuated according to variations in the differential between said pressures.

5. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated valve for controlling admission of gas into the flow line, and a pilot valve for controlling the pressure acting on said first mentioned valve to hold said first mentioned valve in closed position when the pressure in said flow line is below a predetermined minimum, and to permit said first mentioned valve to move to open position when the pressure in said flow line rises above said minimum.

6. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated valve for controlling admission of gas into the flow line, means for constantly urging said valve to open position, a pilot valve for admitting pressure to hold said first mentioned valve in closed position when the pressure in said flow line is below a predetermined minimum, and to relieve a portion of said pressure to permit said means to move said first mentioned valve to open position when the pressure in said flow line rises above said minimum.

7. In combination with a flow line positioned in a well, a gas lift pumping device, including, a pressure actuated main valve for controlling the admission of gas into the flow line, a spring tending to open said main valve and a pilot valve for controlling the pressure acting on said main valve to govern the actuation thereof.

8. In combination with a flow line positioned

in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, and pilot valve means for selectively subjecting said parts to the pressure of the gas to be admitted to said flow line and to the pressure within said flow line.

9. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, pilot valve means for selectively subjecting said parts to the pressure of the gas to be admitted to said flow line and to the pressure within said flow line, and means constantly urging said pilot valve means to a position subjecting said main valve parts to the pressure within said flow line.

10. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, and pilot valve means for controlling the admission of pressure to said parts to actuate the main valve, said pilot valve means comprising a valve for admitting to said parts the gas to be admitted to said flow line, and means for closing said last mentioned valve and subjecting said parts to the pressure within said flow line when the column of fluid in the flow line attains a predetermined height.

11. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, and pilot valve means for controlling the admission of pressure to said parts to actuate the main valve, said pilot valve means comprising a valve for admitting to said parts the gas to be admitted to said flow line, a second valve for subjecting said parts to the pressure within said flow line, and loading means constantly urging both of said last mentioned valves toward a position subjecting said parts to the pressure within said flow line.

12. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, and pilot valve means for controlling the admission of pressure to said parts to actuate the main valve, said pilot valve means comprising a valve for admitting to said parts the gas to be admitted to said flow line, a second valve for subjecting said parts to the pressure within said flow line, loading means constantly urging both of said last mentioned valves toward a position subjecting said parts to the pressure within said flow line, said last mentioned valves having parts subjected to the pressure of said gas to oppose the action of said loading means and parts subjected to the pressure within said flow line to aid the action of said loading means.

13. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main valve having parts adapted to be actuated by fluid pressure, and pilot valve means for controlling the admission of pressure to said parts

to actuate the main valve, said pilot valve means comprising a valve for admitting to said parts the gas to be admitted to said flow line, a second valve for subjecting said parts to the pressure within said flow line, loading means constantly urging both of said last mentioned valves toward a position subjecting said parts to the pressure within said flow line, said last mentioned valves having parts subjected to the pressure of said gas to oppose the action of said loading means and parts subjected to the pressure within said flow line to aid the action of said loading means, said last mentioned valves also having a part adapted to be actuated by movement of the main valve to open position to move said last mentioned valves to admit to the fluid pressure actuated parts of the main valve the gas to be admitted to said flow line.

14. In combination with a flow line positioned in a well, a gas lift pumping device, including, a main valve for controlling the admission of gas into the flow line, said main

valve having parts adapted to be actuated by fluid pressure, and pilot valve means for selectively subjecting said parts to the pressure of the gas to be admitted to said flow line and to the pressure within said flow line, said pilot valve means including a part adapted to be actuated by movement of the main valve to open position to move said pilot valve means to admit to the fluid pressure actuated parts of the main valve the gas which is to be admitted to said flow line.

15. In combination with a flow line positioned in a well casing, a gas lift pumping device including a pressure actuated main valve for controlling the admission of gas into a flow line, said valve being controlled by the varying differential pressures in the flow line and the casing, a spring tending to open said valve, and pilot valve means to control the pressure acting on the said main valve so that when said pressure is reduced to a predetermined point, said spring will open said main valve.

CLYDE V. TEMPLE.