Aug. 30, 1938. E. A. RODGERS 2,128,475

FLOW CONTROLLING VALVE FOR OIL WELLS

Filed Aug. 8, 1936 2 Sheets-Sheet 1

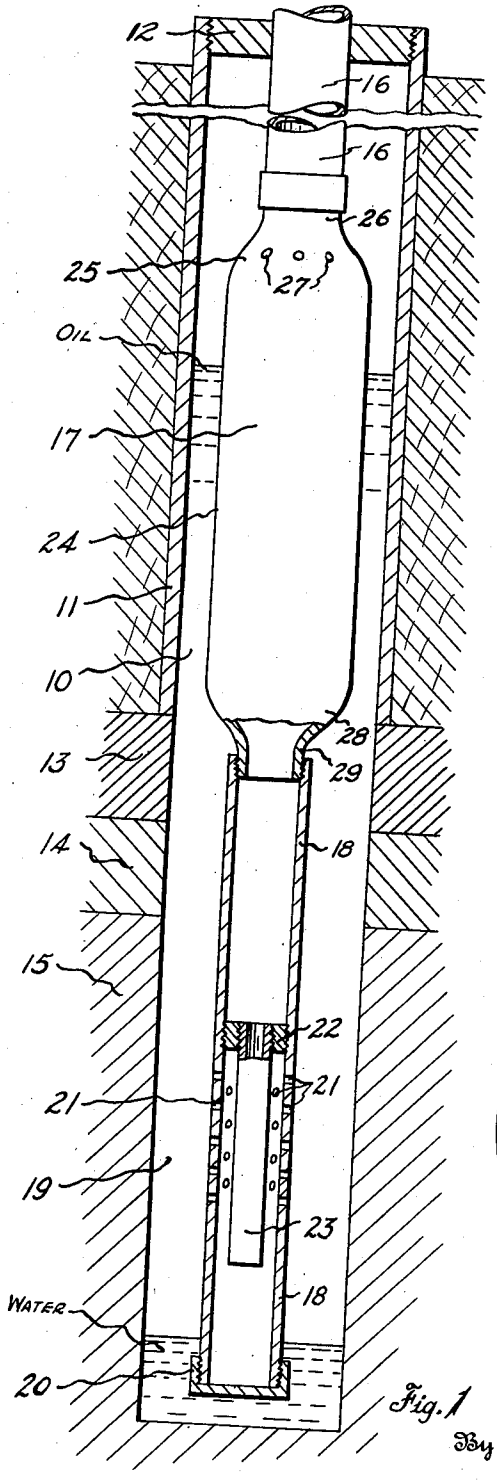


Fig. 1

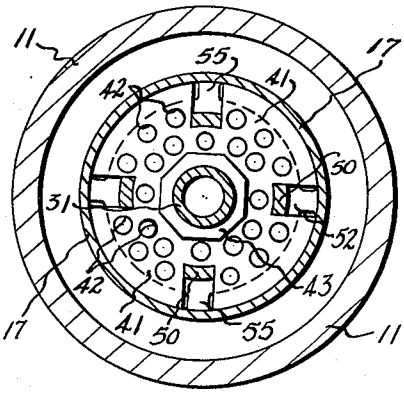


Fig. 4

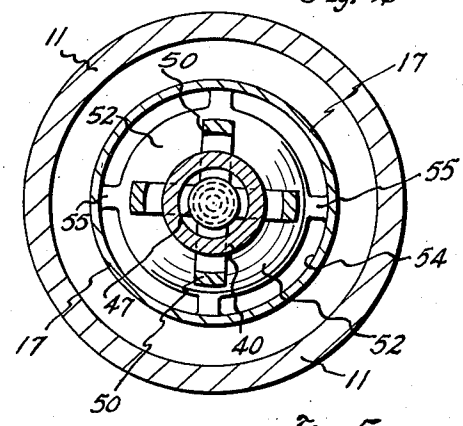


Fig. 5

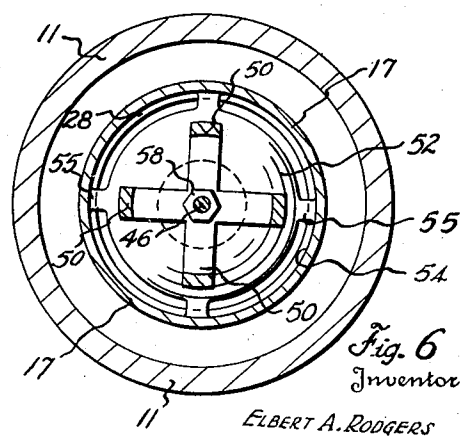


Fig. 6

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FLOW CONTROLLING VALVE FOR OIL WELLS

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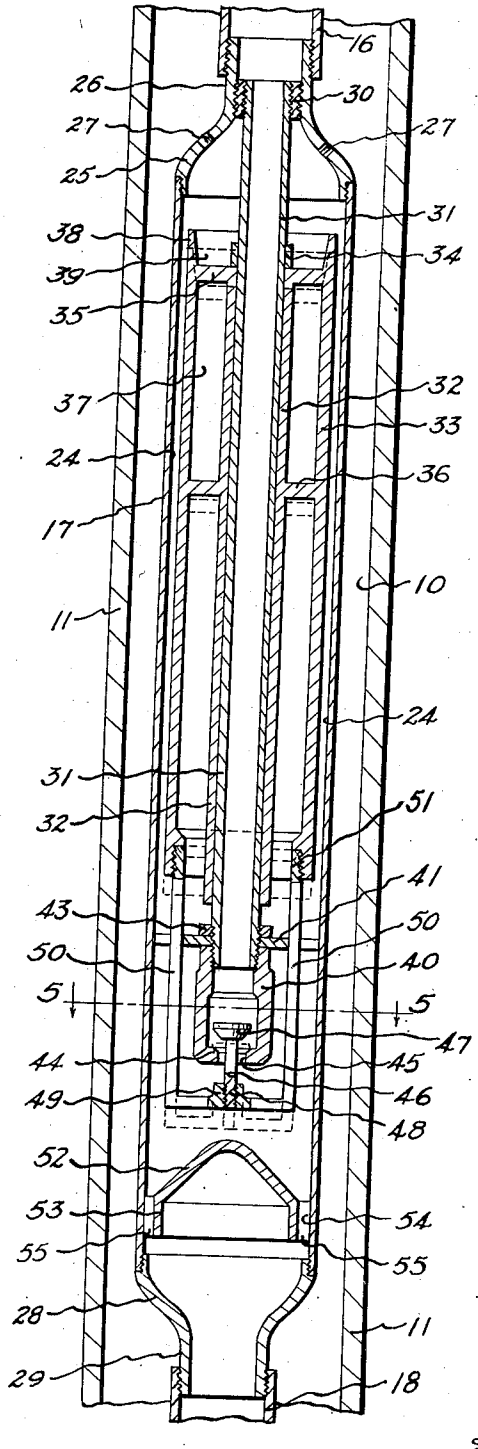


Fig. 2

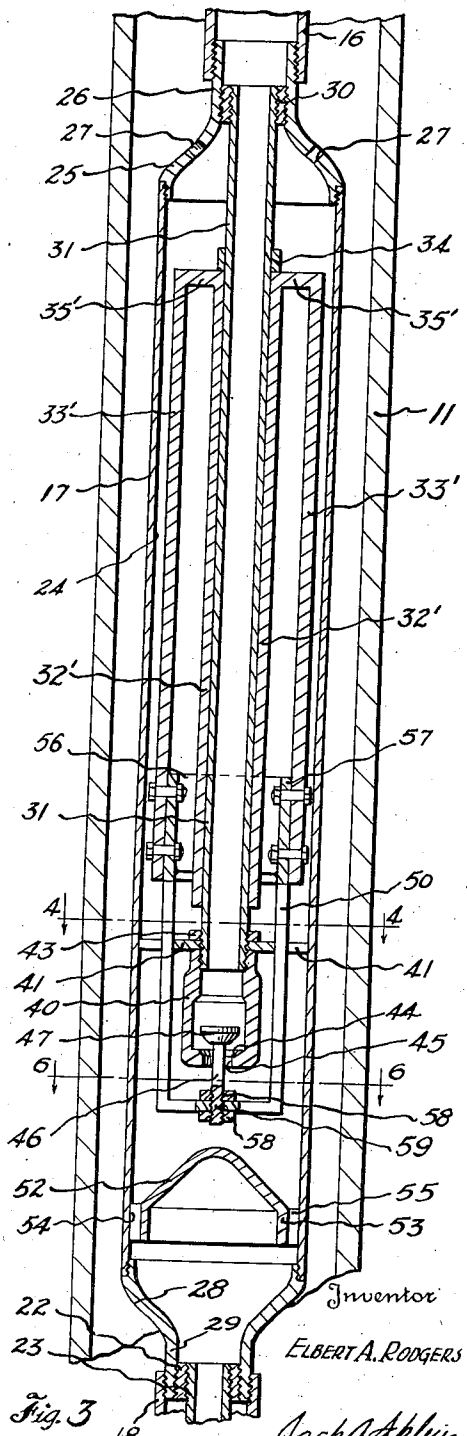


Fig. 3

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FLOW CONTROLLING VALVE FOR OIL WELLS

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5 Claims. (Cl. 166—2)

This invention relates to flow controlling valves for oil wells and the like.

The principal object of the invention is to provide a valve device that can be placed in a productive well to control the flow, whereby to conserve the resources and prolong the producing life of the well, and also to be applied to rehabilitate a well that is declining in productivity or even has become nonproductive.

An important object is to produce a valve device that will operate effectively to maintain a liquid level at or above a pre-determined minimum.

Another object is to produce a valve assembly whereby a separation of the oil, other liquids and free gas is attained and the outflow and wastage of gas is prevented.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a view, partly in section and partly in elevation, showing a valve assembly as applied in a well in accordance with one adaptation of the invention;

Figure 2 is a vertical section, on an enlarged scale, of the valve assembly shown in Figure 1;

Figure 3 is a vertical section of a modified valve structure;

Figure 4 is a cross section taken on about the line 4—4 of either Figure 2 or 3;

Figure 5 is a cross section on the line 5—5 of either Figure 2 or 3; and

Figure 6 is a cross section on the line 6—6 of either Figure 2 or 3.

Referring now to the drawings, the numeral 10 designates generally an oil well in which is placed a lining tube or casing 11. The upper end of the casing 11 is closed by the usual head, conventionally shown at 12, while the lower end of the casing terminates in contact with the impervious stratum 13 which overlies the gas producing formation or sand 14, next below which is the oil producing formation or sand 15. This illustration represents a practical installation in the conservation control of productive wells and the rehabilitation of declining or non-productive wells. However, the valve device of the present invention is not limited to the particular adaptation illustrated, but is adaptable to various other installations where it is desired to maintain a liquid level at or above a certain minimum in the well for controlling outflow of liquid and for stoppage of outflow and waste of gas.

At the lower end of the flow line tubing 16, which extends down in the casing 11 from the head 12, is attached a shell or shield 17 in which the valve assembly, to be presently described, is contained. To the lower end of the shell or shield 17 is attached a tube 18 which extends down into the well reservoir 19 and is closed at its lower end by a plug or cap 20.

Some distance upward from its lower end the tube 18 is provided with a multiplicity of apertures 21 and above the apertures 21 said tube 18 is closed by a stopper 22 having a central opening in which is fitted the upper end portion of a pipe 23 whose lower end terminates below the apertures 21 of the tube 18.

The shell or shield 17, as shown, preferably comprises a body cylinder 24 at the upper end of which is a head 25 having a reduced coupling extension 26 to which the flow line tubing 16 is attached, said head having vent openings 27 therein communicating with the surrounding space in the well casing 11, while at the lower end of the cylinder 24 is a head 28, similar to the head 25 but having no vent openings therein. The lower head 28 has a reduced coupling extension 29 to which the upper end of the tube 18 is attached.

Within the coupling extension 26 of the upper head 25 of the body cylinder 24 is a stopper bushing 30 in which is fitted the upper end portion of a supplemental flow line tubing extension 31 which extends some distance down in the shell or shield 17 and has slidably sleeved thereon the tubular guide stem 32 of a cylindrical float element 33, said supplemental flow line tubing extension 31 having a stop collar 34 fixed thereon to limit the uppermost position of the float element 33 on said flow tube extension 31.

The upper end of the float cylinder 33 in the modification shown in Figure 2 is closed by a head 35, some distance below which is a partition 36, providing a closed buoyant chamber 37 therebetween, and surrounding the head 35 is an annular flange 38 providing a cup 39 which may vary in depth in different modifications. The lower end of the float cylinder is open and the tubular guide stem 32 projects a short distance beyond the end of the cylinder, while the flow line tubing extension 31 projects further beyond the end of the member 32.

The projected end portion of the flow line tubing extension 31 is externally screw threaded to

receive a hollow valve seat member 40, said end portion of the flow tubing extension being fitted in a central opening in a centering and bracing plate 41 which is perforated throughout, as at 42, and is fitted peripherally to the body cylinder 24 of the shell or shield 17. A lock nut 43 is provided on the tubular member 31 to secure the plate 41 and hollow valve seat member 40 in fastened relation.

The valve seat member 40 is formed with an internal annular beveled seat portion 44 surrounding its inlet opening 45, through which the stem 46 of a valve head 47 works. Said valve head, as shown, is beveled annularly on its under side to engage the counterpart seat portion 44 and its stem 46 is attached, as at 48, to a central boss or hub portion 49 of a yoke-like frame 50 whose upper end portion is formed as a ring 51 and fitted, preferably by screw-threading, in the lower end portion of the float cylinder 33.

In the lowered position of the float cylinder 33 the valve head 47 is seated on the seat portion 44 of the member 40, whereby the opening 45 is closed, but in its raised position the cylinder 33 is in contact with the stop collar 34 on the supplemental flow tube member 31 where it is held by its buoyancy when the liquid level is at or above the minimum for which the valve device is set in the well to maintain. In this connection, it is noted that ample clearance is provided between the lower end of tubular stem 32 of the float cylinder 33 and the lock nut 43 to allow the valve head 47 sufficient movement to seat on the seat portion 44 of the member 40 when the liquid level falls and the float cylinder 33 accordingly drops.

In the lower portion of the shield cylinder 24 is an inverted cupped or hollow conical baffle element 52 having a cylindrical base portion 53 which is of a diameter less than that of the cylinder 24, affording a restricted annular space 54 for the flow of liquid therethrough, said baffle element being supported concentrically in the cylinder 24 by spider arms or radial strut members 55.

In the operation of the valve device of the present invention, the device is located in the well at the depth where the liquid level is to be maintained, and in the illustration in Figure 1 of the drawings it is some distance above the oil producing sand or formation, even above the impervious stratum that usually overlies the gas production formation next above the oil producing formation. However, the valve device may be otherwise located in various installations.

The body of the liquid in the well of the illustration shown is under the producing pressure from below and the gas pressure head in the casing above the liquid level. Hence it is forced through the apertures 21 in the reservoir tube 18, whence it passes up through the pipe 23 into the valve shield 17, the free gas practically separating from the liquid as the liquid enters the apertures 21. However, such free gas that may be in the liquid that passes up through the pipe 23 is caused to separate from the liquid by the inverted cupped baffle 52 between the periphery of which and the shield cylinder the liquid passes from the pipe 23 in the tube 18.

From above the baffle 52, assuming the liquid level in the well casing 11 and valve shield cylinder 24 is high enough to buoy the float cylinder 33 and lift the valve head 47 from the seat 44, the liquid passes through the opening 45 of the member 40 and into the flow tube extension 31, whence it flows up through the tubing 16 either under the pressure in the well or by the suction of a pump applied in or to the tubing 16.

If the liquid level in the well drops sufficiently to lower the float cylinder 33 and close the valve head 47 on its seat 44, the outflow of the liquid, of course, ceases. So, too, there is no escape of the gas through the opening 45, as the gas is held above the body of liquid. However, should the liquid level fall below the opening 45 of the valve seat member 40, the valve head 47 may or may not open, depending upon the relative pressures in the well and flow line tubing, which pressures can be regulated from the surface by providing chokes or tube controlling means or by otherwise varying the pressure in the tubing and also by pressure controlling means applied to the well casing.

Obviously, back pressure of sufficient strength in the flow line tubing 16 will hold the valve head 47 to its seat, whereas, if the pressure in the well is the greater, the valve head 47 will open. However, under most ordinary circumstances, the pressure on the entire float assembly within the shield 17 will be equalized so that the valve head 47 remains closed until the liquid is restored to the level to lift the float cylinder 33; but, should it be desirable or become necessary, the opening and closing of the valve member 47 can be controlled, at will, from the surface, as above pointed out.

In Figure 3 of the drawings, a modification of the valve assembly is illustrated, wherein the general principle is the same as in the structure shown in Figure 2. There is this difference, however, in that the annual collar or flange 38 and cup 39 is eliminated from the float cylinder 33' whose upper end wall or head 35', as shown, is plain flat. So, too, the intermediate partition wall 36 and closed buoyant chamber 37 are eliminated.

To brace the lower portions of the tubular stem 32' and the cylinder 33' strut members 56 are preferably provided in some convenient and practical manner. As shown, the strut members are formed integrally with the ring member 57 which is bolted or otherwise secured on the inside of the lower open end portion of the cylinder 33', said ring member having the yoke-like frame 50 formed integrally therewith or otherwise secured thereto. In this modification the stem 46 of the valve head 47 is screw-threaded into the frame 50, as at 59 and secured in place by opposed jam nuts 58.

Obviously, the structure of the valve device may be modified otherwise than herein shown without departing from the spirit and scope of the invention as defined in the appended claims. The invention, therefore, is not limited to the specific construction and arrangement shown in the accompanying drawings.

What I claim and desire to secure by Letters Patent, is:

1. A flow controlling device for oil and gas wells and the like, comprising, a hollow cylindrical shield having a restricted vent opening in its top portion and an inlet opening in its bottom but otherwise closed to outside communication, a tubular flow member supported axially in said shield and attachable at its upper end communicably with the lower end of a flow tube within the well, said tubular flow member having an inlet opening in the lower end portion thereof, a float member sleeved slidably on said tubular flow member, a valve head carried by said float mem-

ber and located in controlling relation to the inlet opening of said tubular flow member, the valve head lifted to open said inlet opening when the float is raised by the fluid in the well at or above a determined level and lowered with the float to close said inlet opening when the liquid is at a lower level, and a liquid intake tube connected communicably with said shield through the inlet opening at the bottom thereof, said shield having a baffle therein between its inlet opening and the valve-controlled inlet opening of said tubular flow member.

2. Well flow controlling means, comprising, a tubular flow member attachable communicably to the flow line tubing of the well, a float operated valve for opening and closing said tubular flow member, a hollow shield encasing said tubular flow member and said valve and its operating float, said shield having an inlet opening in its lower portion and a vent opening in its upper portion, but being otherwise closed to outside communication, an intake tube supported dependingly from the bottom portion of said shield, said intake tube being closed at its lower end but perforated thereabove, and a tubular flow member within said intake tube connected at its upper end communicably with said shield through the inlet opening of the latter, the lower end of said tubular flow member being open and below the perforations of said intake tube.

3. A well flow controlling device, comprising, a vertical elongate hollow cylindrical shield supportedly attachable at its upper end to the lower end of the flow line tubing of the well, said shield having a vent opening in its top portion and an axial inlet opening in its bottom but otherwise closed to outside communication, an axial tubular flow member supported at its upper and lower ends in said shield, said tubular flow member being communicable at its upper end with the flow line tubing attached to the shield and having a hollow valve member attached to its lower end, said hollow valve member having an axial inlet opening in its lower end and an internal annular seat surrounding said opening, a float member sleeved slidably on said tubular flow member and provided with a depending yoke-like frame, and a vertically movable and upwardly opening valve head located within said hollow valve member in cooperative relation to the annular seat thereof, said valve head having an axial stem extending downwardly through the inlet opening of said hollow valve member and supportedly attached to said yoke-like frame of the float member.

4. A well flow controlling device, comprising, a vertical elongate hollow cylindrical shield supportedly attachable at its upper end to the lower end of the flow line tubing of the well, said shield having a vent opening in its top portion and an axial inlet opening in its bottom but otherwise closed to outside communication, an axial tubular flow member supported at its upper and lower ends in said shield, said tubular flow member being communicable at its upper end with the flow line tubing attached to the shield and having a hollow valve member attached to its lower end, said hollow valve member having an axial inlet opening in its lower end and an internal annular seat surrounding said opening, a float member sleeved slidably on said tubular flow member and provided with a depending yoke-like frame, a vertically movable and upwardly opening valve head located within said hollow valve member in cooperative relation to the annular seat thereof, said valve head having an axial stem extending downwardly through the inlet opening of said hollow valve member and supportedly attached to said yoke-like frame of the float member, and a transverse baffle located centrally in the lower portion of the shield between the axial inlet thereof and the valved inlet of said tubular flow member.

5. The well flow controlling device as set forth in claim 4 and further describing the baffle as comprising an inverted cup member spaced annularly from the wall of the shield.

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