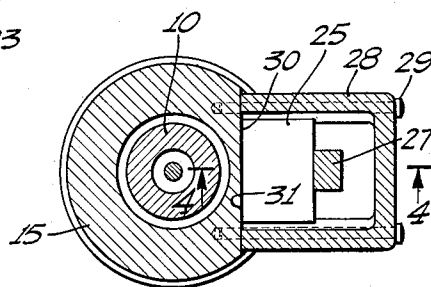
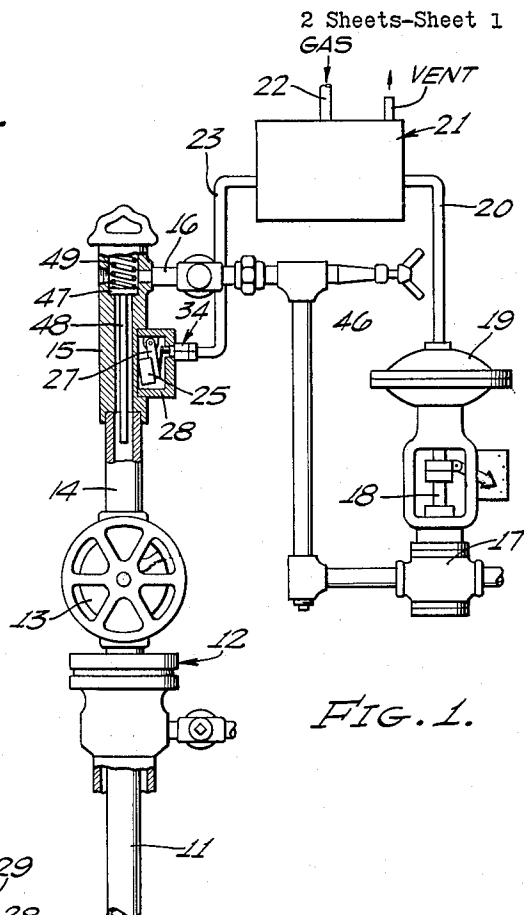


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FREE PISTON WELL PUMP ASSEMBLY

Filed Feb. 15, 1957

2 Sheets-Sheet 1



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3,012,512

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2 Sheets-Sheet 2

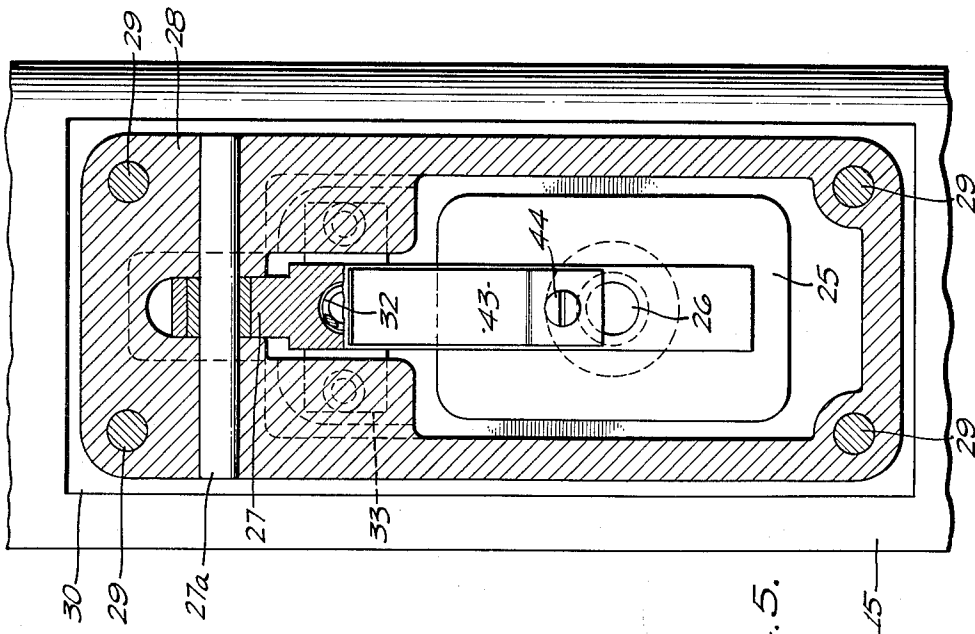


Fig. 5.

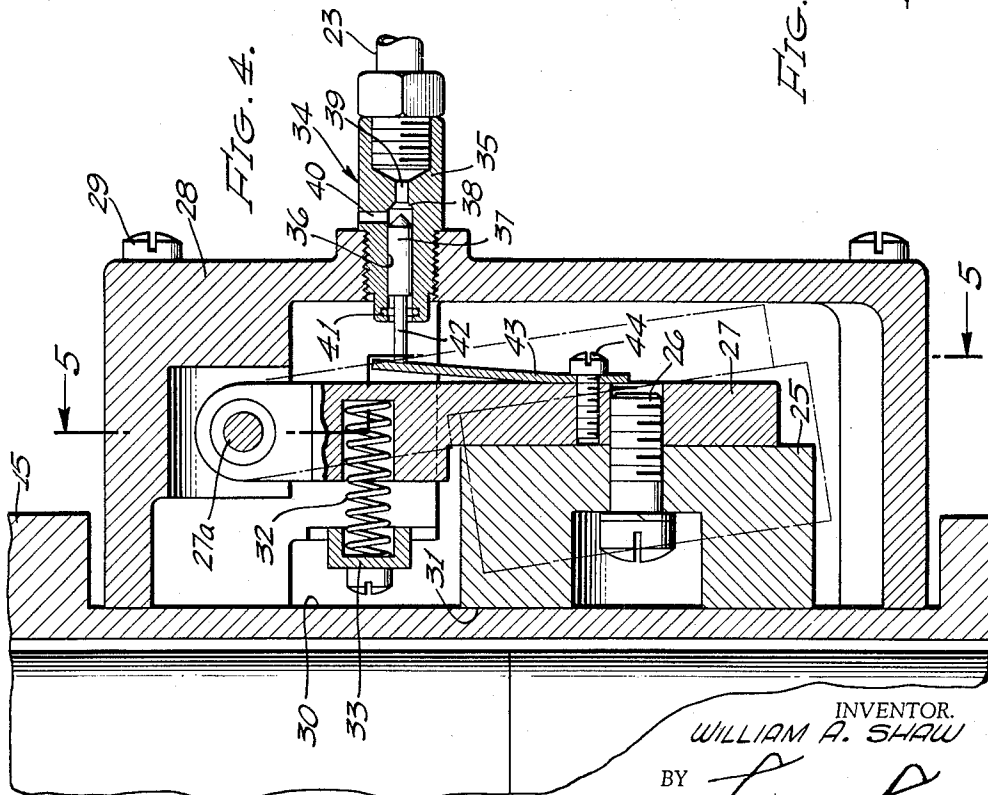


FIG. 4.

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1

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FREE PISTON WELL PUMP ASSEMBLY

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This invention relates to free piston well pumping apparatus and is particularly directed to improvements over the device shown in the Spalding Patent 2,757,614.

As shown in the Spalding patent, a valved plunger travels upwardly through the eduction tube, carrying a load of well fluid above it. When the plunger reaches the upper end of its travel, it enters the well head assembly and comes to rest. The plunger mechanically actuates a trigger on the well head assembly and this trigger acts through suitable relay mechanism to initiate closing movement of a valve in the discharge line leading from the well head. The mechanically operated trigger imposes the requirement of a lateral port in the wall of the well head structure and further requires stuffing box means at the point where a movable element of the trigger assembly extends exteriorly of the well head structure. Furthermore, the direct operated mechanical trigger is subjected to severe impact forces when it is contacted by the rapidly moving plunger.

It is the principal object of this invention to overcome these difficulties and to provide an improved apparatus for actuating a movable element mounted exteriorly of the well head structure, whenever the plunger reaches the upper end of its travel. Another object is to provide a magnetically responsive device which actuates a vent valve element whenever the plunger enters the well head structure.

Other and more detailed objects and advantages will appear hereinafter.

In the drawings:

FIGURE 1 is a diagrammatic side elevation partly in section, showing a well head structure embodying my invention.

FIGURE 2 shows a longitudinal sectional elevation thereof on an enlarged scale.

FIGURE 3 is a sectional plan view taken substantially on the lines 3—3 as shown in FIGURE 2.

FIGURE 4 is a sectional view taken substantially on the lines 4—4 as shown in FIGURE 3.

FIGURE 5 is a sectional elevation taken substantially on the lines 5—5 as shown in FIGURE 4.

Referring to the drawings, the plunger 10 is preferably the type shown in the Knox et al. Patent 2,642,002, and the plunger is provided with a valve (not shown) at its lower end. The plunger is adapted to travel freely within the eduction tube 11 which extends into the well. The upper end of the eduction tube 11 is connected to the well head assembly generally designated 12. This assembly 12 includes the gate valve 13, the nipple 14 and the well head member 15. It will be understood that a continuous passage is provided from the eduction tube 11 into the interior of the tubular well head member 15. A well fluid discharge line 16 extends from the upper end of the well head member 15, and a flow controlling valve assembly 17 is mounted in the discharge line. The valve stem 18 moves downward against the action of the spring (not shown) to open the valve 17 whenever pressure is supplied to the diaphragm chamber 19. Pipe 20 extends to the diaphragm chamber 19 from the control mechanism generally designated 21. This control mechanism may take the form shown in the Spalding Patent 2,757,614 or the form shown in the copending application of Donald G. Knox, Serial No. 591,144, filed June 13, 1956, now abandoned. This control mechanism 21 receives gas

2

under pressure through line 22 and is connected to the vent pipe 23. The action of the control mechanism 21 is to close the valve 17 whenever the pipe 23 is vented to atmosphere, and to open the valve 17 when pressure is allowed to build up within the pipe 23.

In accordance with my invention, means are provided for venting the pipe 23 to atmosphere whenever the plunger 10 enters the well head member 15 at the upper end of its travel. As shown in the drawings, this means includes a permanent magnet member 25 fixed by means of one or more fastening elements 26 to a swinging arm 27. A pin 27a pivotally supports the arm 27 within the housing 28. The housing 28 is in turn fixed to the well head member 15 by means of cap screws 29.

The well head member 15 is constructed of material which is magnetically non-responsive whereas the plunger 10 is constructed of magnetically responsive material. I have found that carbon steel or medium alloy steel is satisfactory for the plunger and that 18—8 austenitic stainless steel or other suitable non-magnetic material is satisfactory for the well head member 15. A flat face 30 is provided on the outer surface of the member 15 and the housing 28 rests on this face. The magnet member 25 is provided with a flat face 31 which is adapted to engage the face 30.

A coil spring 32 is mounted within the housing 28 and bears at one end on the stationary abutment 33 and at the other end on the arm 27. The spring 32 acts to move the arm 27 in a direction to swing the magnet member 25 away from the face 30 on the well head member 15. To promote an environment free of any attraction for the magnet member 25 it is also to be understood that the housing 28 and parts within the housing as well as the screws 29 are made of materials which are magnetically non-responsive.

A vent valve assembly generally designated 34 is mounted on the housing 28 and this assembly includes a body 35 having a bore 36 which slidably receives the movable valve element 37. The forward end of this valve element 37 is adapted to close against the seat 38 formed in the body 35. A port 39 in the body connects the seat with the vent pipe 23 and a lateral port 40 in the body communicates with the bore 36 adjacent the seat 38. When the valve element 37 is in the open position as shown in FIGURE 4, the vent pipe 23 is vented to atmosphere through the port 40.

A retainer ring 41 is mounted on the body 35 to prevent the valve element 37 from moving completely out of the bore 36. A small stem 42 on the valve element 37 projects through the retainer ring and extends out of the bore 36 into contact with the leaf spring 43. This leaf spring 43 is fixed to the arm 27 by means of the fastener element 44.

In operation the plunger 10 moves upward in the eduction tube 11 by gas pressure beneath the plunger. Well fluid above the plunger passes upward through the well head assembly 12 and into the interior of the well head member 15. The well fluid then passes outward through the well fluid discharge line 16, through the adjustable flow bean 46 and through the flow controlling valve 17. When the plunger 10 strikes the bumper collar 47 within the well head member 15, the magnetically non-responsive spear 48 fixed on the collar extends down through the interior of the plunger 10 and opens the plunger valve (not shown). The bumper spring 49 cushions the shock of the plunger as it reaches the upper end of its stroke. A pilot rod 50 fixed on the bumper 47 slides through a central opening 51 in the bushing 52 as the spring 49 compresses under load.

The presence of the plunger 10 in the position shown in FIGURE 2 causes the magnet member 25 to swing on the arm 27 against the action of the spring 32 and

to bring the magnet member 25 into contact with the face 30 of the member 15. This movement of the swinging arm 27 moves the leaf spring 43 to the left as viewed in FIGURE 4 with the result that gas pressure in the vent pipe 23 moves the valve element 37 to open position, allowing the vent pipe 23 to be vented to atmosphere through the port 40. Venting of the control pipe 23 causes the control mechanism 21 to vent the pipe 20 thereby reducing the pressure in the diaphragm head 19 and allowing the valve of steam 18 to move upward to closed position. The valve 17 closes slowly.

Opening of the valve (not shown) in the plunger 10 by means of the spear 48 permits the plunger 10 to drop by gravity down through the eduction tube 11. When the plunger 10 drops out of the well head member 15, the magnet member 25 is no longer attracted and therefore, the spring 32 swings the arm 27 in a counter-clockwise direction to the dotted line position shown in FIGURE 4. This action causes the leaf spring 43 to engage the stem 42 of the valve element 37 and move the valve element into contact with the seat 38, thereby closing the vent port 40. The build up of gas pressure within the vent pipe 23, as supplied by the control mechanism 21 then causes the control mechanism 21 to pressurize the pipe 20 leading to the diaphragm chamber 19. The valve stem 18 moves downward compressing the valve spring (not shown) and opens the valve 17.

The cycle then repeats.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a free piston well pump device, the combination of a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, a well fluid discharge line extending from the well head member, a magnet member mounted for movement on the well head member exteriorly thereof, the magnet member being attracted by the plunger when the plunger is positioned within the well head member to cause movement of the magnet member, and means whereby movement of the magnet member when so attracted is effective to close the well fluid discharge line.

2. The combination set forth in claim 1 wherein the plunger is formed of magnetically responsive material and wherein at least a portion of the well head member is formed of magnetically non-responsive material.

3. In a free piston well pump device having a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, and wherein a well fluid discharge line extends from the well head member to a flow-controlling valve, the combination of: means including a movable element mounted on the well head member for actuating the flow-controlling valve, said means acting to close the flow-controlling valve in response to movement of said element, a magnet member mounted for movement on the well head exteriorly thereof, the magnet member being attracted and moved by the plunger when the plunger is positioned within the well head, means to actuate the movable element in response to movement of the magnet member, whereby entry of the plunger into the well head from the eduction tube is effective to initiate closing of the flow-controlling valve.

4. In a free piston well pump device having a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, and wherein a well fluid discharge line extends from the well head member to a flow-controlling valve, the combination of: means including a vent valve mounted on the well head member for actuating the flow-controlling valve, said means acting to close the flow-controlling valve in response to opening of the vent valve, a magnet member mounted for movement on the

well head exteriorly thereof, the magnet member being attracted and moved by the plunger when the plunger is positioned within the well head, means to open the vent valve in response to movement of the magnet member, whereby entry of the plunger into the well head from the eduction tube is effective to initiate closing of the flow-controlling valve.

5. In a free piston well pump device of the type described, the combination of: a plunger formed of magnetically responsive material, a tubular well head member adapted to receive the plunger and having at least a portion thereof formed of magnetically non-responsive material, an arm pivotally mounted exteriorly of said well head member, a magnet member carried on the pivoted arm, resilient means acting on said arm to move the magnet member in a direction away from said portion of the well head member, the magnet member being attracted by the plunger when the plunger is positioned within the well head member to move the magnet member in opposition to the resilient means, a valve element movably mounted relative to the well head member, the arm having a part adapted to contact the valve element, whereby entry of the plunger into the well head is effective to move the arm and to actuate the valve element.

6. In a free piston well pump device of the type described, the combination of: a plunger formed of magnetically responsive material, a tubular well head member adapted to receive the plunger and having at least a portion thereof formed of magnetically non-responsive material, said portion having a flat outer face, an arm pivotally mounted exteriorly of said well head member, a magnet member carried on the pivoted arm and engageable with said outer face, resilient means acting on said arm to move the magnet member in a direction away from said outer face, the magnet member being attracted by the plunger when the plunger is positioned within the well head member to move the plunger into contact with said outer face, a valve element movably mounted relative to the well head member, the arm having a part adapted to contact the valve element, whereby entry of the plunger into the well head is effective to move the arm in opposition to the resilient means and to actuate the valve element.

7. In a free piston pump within a well casing having an eduction tube, a plunger adapted to be raised with its load of liquid from the lower end of said tube to the upper end thereof by fluid pressure, a discharge line from said tubing, a valve to open and close said discharge line, the combination of: means including a relay valve unit operatively connected with said valve and having an actuating member including a magnet, the magnetic attraction set up between said magnet and the plunger when the latter is at the upper end of its travel causing the actuating member to move and operate said discharge valve to closed position.

8. In a free piston well pump device having a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, and wherein a well fluid discharge line extends from the well head member to a flow-controlling valve, the combination of: means including a movable element mounted on the well head member for actuating the flow-controlling valve, said means acting to close the flow-controlling valve in response to movement of said element, means including a magnet positioned externally of the well head member and operable to actuate the movable element when the plunger comes within the proximity of the magnet, whereby entry of the plunger into the well head from the eduction tube is effective to initiate closing of the flow-controlling valve.

9. In a free piston well pump device having a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, and wherein a well fluid discharge line extends from the well head member to a flow-controlling valve, the combination of: means including a movable

5

element mounted on the well head member for closing the flow-controlling valve, means including a magnet positioned externally of the well head member at one side thereof and operable to actuate the movable element when the plunger comes within the proximity of the magnet, whereby entry of the plunger into the well head from the eduction tube results in closing of the flow-controlling valve.

10. In a free piston well pump device having a plunger adapted to travel within an eduction tube and to come to rest within a well head member at the upper end of the eduction tube, and wherein a well fluid discharge line extends from the well head member to a flow-controlling valve, the combination of: means including a relay valve mounted on the well head member for closing the flow-controlling valve, means including a magnet positioned externally of the well head member and operable to actuate the relay valve when the plunger comes within the proximity of the magnet, whereby entry of the plunger into the well head from the eduction tube is effective to initiate closing of the flow-controlling valve.

11. In a device having a valved plunger adapted to travel freely under pressure substantially the full length

6

of an eduction tube in a well, the combination of: a control valve operatively connected to the eduction tube to control flow therefrom, a movable element positioned adjacent and exteriorly of the upper end of the eduction tube and adapted to be magnetically actuated upon arrival of the plunger at the upper end of its travel, and pneumatically operated means including a pilot valve for closing the control valve upon actuation of said movable element.

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