

[72] Inventor **Gunter Maasshoff**
Glenview, Ill.
 [21] Appl. No. **845,423**
 [22] Filed **July 28, 1969**
 [45] Patented **May 25, 1971**
 [73] Assignee **Hawk Oil Field Equipment Corp.**
Evanston, Ill.

[56]

References Cited

UNITED STATES PATENTS

111,624	2/1871	Fogarty	91/347
1,661,466	3/1928	Cook	91/347
2,090,575	8/1937	De Motte	91/347
2,925,806	2/1960	Taylor	91/347

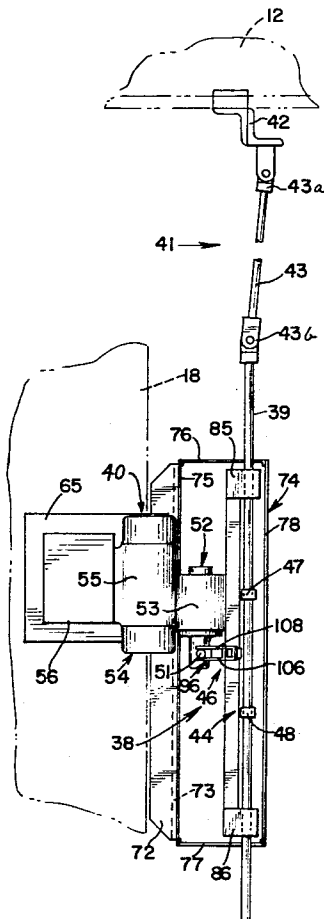
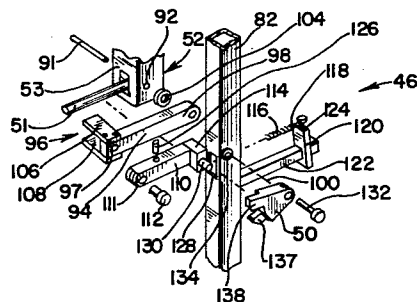
Primary Examiner—Paul E. Maslousky

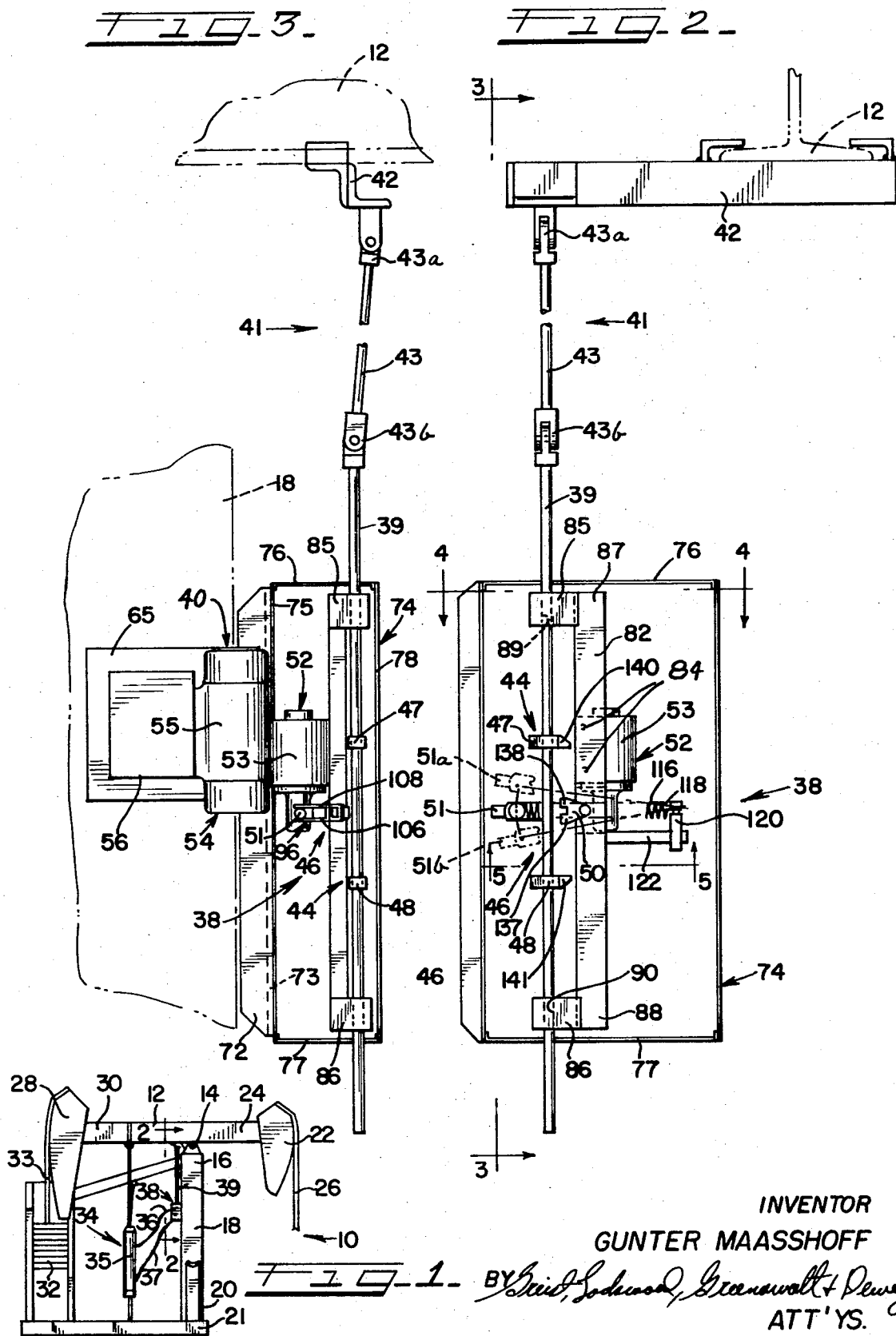
Attorney—Greist, Lockwood, Greenawalt and Dewey

[54] VALVE OPERATING MECHANISM 14 Claims, 7 Drawing Figs.

[52] U.S. Cl. 91/277,
 91/314, 91/347
 [51] Int. Cl. F011 25/06,
 F011 31/02
 [50] Field of Search. 91/347, 314
 (Cursory), 277

ABSTRACT: A spring biased swing arm is operatively associated with a control arm of a valve assembly for moving the arm to quickly control the flow of fluid to a reciprocating hydraulic operating mechanism in a well pumping apparatus. The swing arm is moved with a snap action by a spring when a tripping block engages and moves a pivotally mounted toggle actuator which moves the spring over center to cause quick movement of the control arm to one of its operative positions.





INVENTOR
GUNTER MAASSHOFF
BY *Frederick L. Johnson, Greenwood & Dewey*
ATT'YS.

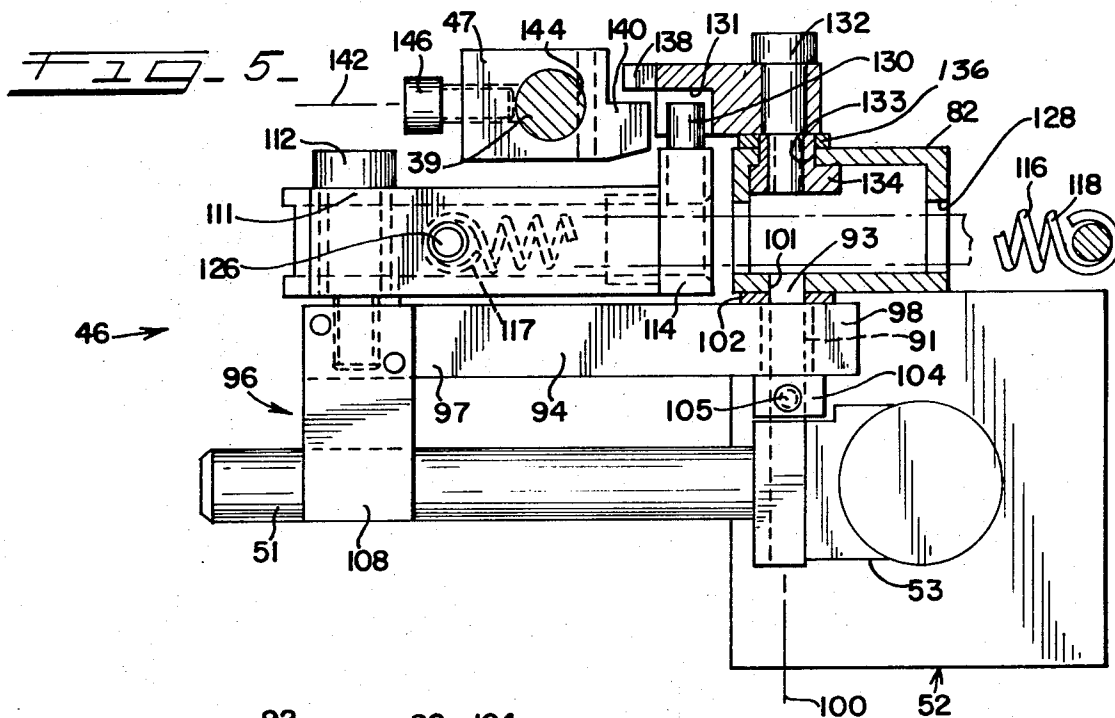
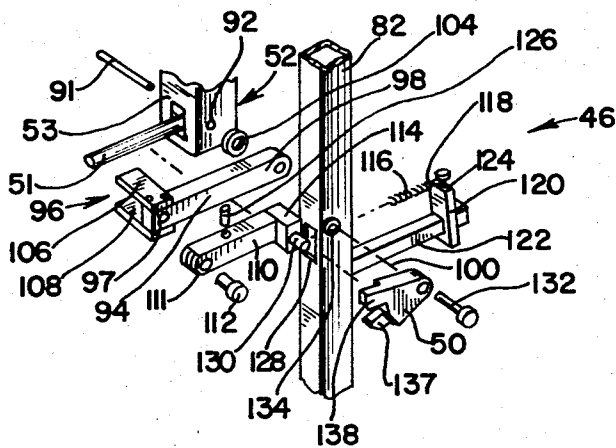


FIG. 6

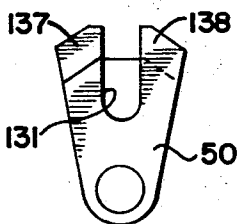
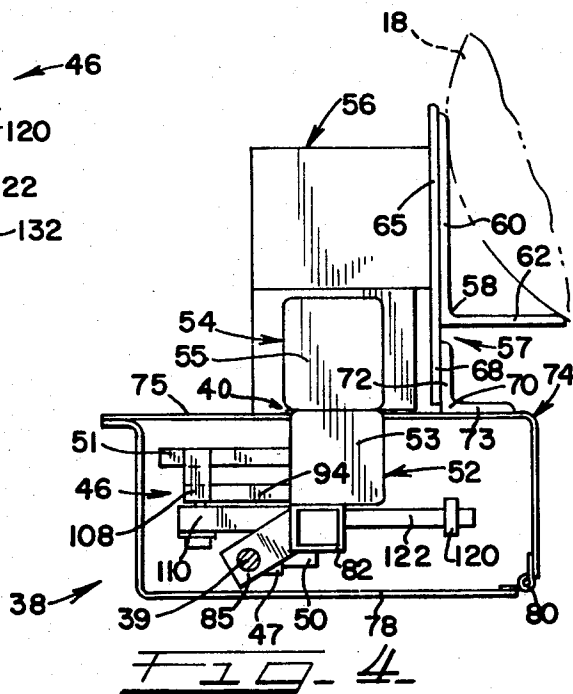


FIG. 7



INVENTOR

GUNTER MAASSHOFF

BY *Frederick Lockwood Mansuett & Dewey*
ATT'YS.

VALVE OPERATING MECHANISM

This invention relates to an improved valve operating mechanism for moving a control arm of a valve assembly between first and second operative positions on opposite sides of a neutral position.

More specifically, the present invention relates to an improved valve operating mechanism which is particularly adapted for use with a valve assembly for controlling the flow of hydraulic fluid to and from an hydraulic operating mechanism in a well pumping apparatus. In this respect, the valve operating mechanism of the present invention finds advantageous use in a pumping apparatus of the type disclosed in U.S. Pat. No. 3,369,490 issued to Harry W. Hawk on Feb. 20, 1968 or of the type disclosed in my copending application Ser. No. 811,400. However, it is to be understood, that the present invention can be used with any valve assembly where an operating mechanism is employed to move a control arm of the valve assembly to and from at least one operative position.

The improved valve operating mechanism of the present invention provides a novel quick acting switching mechanism for switching a valve assembly from one operative position to another operative position to reverse the flow of hydraulic fluid to and from an hydraulic operating mechanism connected to the valve assembly. The novel switching mechanism utilizes only one toggle spring and has a smooth and quick snap action without backlash.

In accordance with the present invention, an improved valve operating mechanism is provided for moving a control arm of a pilot valve about a pivot axis between first and second operative positions. The valve operating mechanism includes a toggle actuator which is mounted for pivoting movement about the pivot axis of the control arm and a swing arm which has a switching device connected thereto and operatively associated with the control arm. The swing arm extends in a direction away from the pivot axis and has a portion thereof which is operatively associated with the toggle actuator. A spring is secured at one end to the swing arm and at another end to a support spaced from said pivot axis in a direction away from the swing arm. The spring is arranged so that when the toggle actuator moves the swing arm, the tension force of the spring on the swing arm in the same general direction that the swing arm was moved by the toggle actuator, until the control arm is moved to one of its two operating positions.

A general object of the present invention is the provision of a new and improved valve operating mechanism for moving a control arm of a valve assembly to and from at least one operative position.

Another object of the present invention is the provision of a new and improved valve operating mechanism which is adapted for use with a commercially known pilot valve.

Another object of the present invention is the provision of an improved valve operating mechanism which can be started manually.

Another object of the present invention is the provision of a new and improved valve operating mechanism which has a smooth snap action without backlash after the toggle spring of the mechanism has moved a control arm of a valve assembly to an operative position.

Another object of the present invention is the provision of a new and improved valve operating mechanism of the type described in which a tripping mechanism is provided with adjustable tripping blocks for adjusting the length of the stroke of an hydraulic mechanism controlled by the valve operating mechanism.

Another object of the present invention is the provision of a new and improved valve operating mechanism including an adjustable tripping mechanism for moving a toggle actuator of the valve operating mechanism.

Another object of the present invention is the provision of a new and improved valve operating mechanism of the type described wherein a guide arm has a fork arrangement connected thereto which is adapted for straddling a control arm of a pilot valve. The guide arm is mounted for pivoting move-

ment about the pivot axis of the control arm and a swing arm is pivotally connected to the guide arm. The swing arm has means thereon for receiving impulses for moving the swing arm in one of two directions. Tensioning means is connected to the swing arm and arranged so that when the swing arm is moved by an impulse in one of the two directions, the tensioning means will exert a force on the swing arm which will continue and accelerate movement of the swing arm in the same direction it was moved by the impulse to thereby move the control arm to one of its operative positions.

Another object of the present invention is the provision of a new and improved valve operating mechanism of the type described in which a guide arm is provided for maintaining a switching device operatively associated with a control arm of a valve means during movement of the control arm.

Another object of the present invention is the provision of a new and improved valve operating mechanism of the type described in which the tension of a toggle spring of the mechanism can be easily adjusted manually without the use of a tool.

Still another object of the present invention is the provision of a valve operating mechanism in which a toggle actuator has a projecting portion which is positioned (a) to receive impulses from at least one tripping block mounted on a reciprocating control rod for transmitting the impulses to a toggle mechanism for operating a control valve and (b) to permit the tripping block to move past the projecting portion during overshoot movement of the control rod with the projecting portion being moved by the tripping block out of the path of the tripping block during overshoot movement of the control rod.

These and other objects and advantages of the present invention, including those inherent in the invention, will become apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a side elevational view of a well pumping apparatus including the valve operating mechanism of the present invention;

FIG. 2 is a fragmentary elevational view taken along lines 2-2 of FIG. 1;

FIG. 3 is a fragmentary side elevational view taken along lines 3-3 of FIG. 2;

FIG. 4 is a top plan view of the valve actuating mechanism of the present invention taken along lines 4-4 of FIG. 2;

FIG. 5 is an enlarged bottom plan view of the valve operating mechanism of the present invention taken along lines 5-5 of FIG. 2;

FIG. 6 is an exploded fragmentary perspective view of the valve operating mechanism of the present invention; and,

FIG. 7 is an enlarged view of the toggle actuator of the valve operating mechanism shown in FIG. 6.

Referring to FIG. 1, an oil well pumping apparatus of the type disclosed in the Hawk U.S. Pat. No. 3,369,490 and my copending application Ser. No. 811,400 referred to above, is generally indicated at 10. The apparatus 10 includes a walking beam 12 which is pivotally supported at 14 on the upper end 16 of a hollow Samson post 18 which has its lower end 20 secured to a base 21. A horsehead 22 is connected to the forward (right-hand) end 24 of the walking beam 12. Typically, a conventional polish rod (not shown) connected to a well pump in an oil well, is supported by one or more cables 26 from the horsehead 22. Another horsehead 28 is connected to the rearward (left-hand) end 30 of the beam 12 and suitable counterweights 32 are supported by one or more cables 33 from the horsehead 28. An hydraulic operating mechanism 34 of known type, including a cylinder 35, is connected to the beam 12 and is arranged to rock the walking beam 12 about its pivot support 14 when pressurized fluid is alternately admitted to the opposite ends of the cylinder 35. The pressurized fluid is delivered to and removed from the cylinder 35 through first and second fluid lines 36 and 37 which are connected from the ends of the cylinder 35 alternately either to a source (not shown) of pressurized hydraulic operating fluid or to a sump (reservoir) in the hollow Samson post 18.

The valve operating mechanism of the present invention is generally indicated at 38 in FIG. 1 and includes a movable control rod 39 connected to the walking beam 12 in such a way that the operation of the valve operating mechanism 38 is controlled by the rocking movement of the walking beam 12 about its pivot support 14. During rocking movement of the walking beam 12, the valve operating mechanism 38 operates a valve assembly 40 (FIG. 3) which is connected to the fluid lines 36 and 37 for alternately connecting fluid line 36 (or 37) to the source of pressurized fluid and, at the same time, connecting fluid line 37 (or 36) to the sump in the Samson post 18.

As best shown in FIGS. 2 and 3, the control rod 39 is positioned for vertical reciprocating movement and is connected by a linkage 41 to a bracket 42 fixed to the underside of the walking beam 12. Since any point on the walking beam 12 will traverse an arc when the walking beam 12 is rocked about its pivot support 14, the linkage 41 is provided to compensate for the arcuate movement of the bracket 42 and thereby maintain linear vertical movement of the rod 39. To this end, the linkage 41 includes a short connecting rod 43 pivotally connected at its upper end 43a to the bracket 42 and pivotally connected at its lower end 43b to the upper end of the control rod 39. As best shown in FIG. 3, the connecting rod 43 will move transversely of the longitudinal axis of the control rod 39 during rocking movement of the walking beam 12 to compensate for the arcuate nonlinear movement of the bracket 42.

As shown in FIG. 2, the valve operating mechanism 38 includes a tripping mechanism 44 and a toggle switching assembly or mechanism 46. The tripping mechanism 44 includes first and second blocks 47 and 48 which are adjustably mounted on the control rod 39. Rocking of the beam 12 will cause the control rod 39 to move up and down whereby the blocks 47 and 48 will "trip" (move) a toggle actuator 50 of the toggle switching assembly 46 upwardly or downwardly. As will be explained in detail in connection with the description of FIGS. 5 and 6, the toggle actuator 50, when moved upwardly or downwardly, will transmit an impulse in either an upward or downward direction to other parts of the toggle switching assembly 46 to move a control arm 51 extending from the valve assembly 40 (FIG. 3) upwardly or downwardly to a first or second operative position, which operative positions are indicated by phantom lines at 51a and 51b in FIG. 2. As shown in FIG. 3, the valve assembly 40 includes a pilot valve 52 enclosed in a valve housing 53 and a main valve 54 enclosed in a valve housing 55. The control arm 51 extends from the pilot valve 52. It will be understood that the valves 52 and 54 are of known construction and are commercially available.

To operate the hydraulic system of the pumping apparatus 10 for rocking the beam 12 about the pivot support 14, the toggle actuator 50 is first moved upwardly or downwardly (e.g., manually) to move the control arm 51 upwardly or downwardly to move a valve spool (not shown) in the pilot valve 52 to one or another of two operating positions to admit pressurized fluid into certain ports (not shown) in the main valve 54 to actuate a larger valve spool (not shown) of the main valve 54 to admit pressurized fluid to one or the other of the fluid lines 37 and 36 to operate the hydraulic operating mechanism 34 to move the walking beam 12 downwardly or upwardly about its pivot support 14. As the beam 12 approaches the lower (or upper) limit of its downward (or upward) stroke, the block 47 (or 48) will engage with the toggle actuator 50 and move the same downwardly (or upwardly) to move the control arm 51 to move the valve spool in the pilot valve 52 to the other one of its operating positions to actuate the main valve 54 to admit pressurized fluid to the other one of the fluid lines 36 and 37 to operate the hydraulic operating mechanism 34 to stop the downward (upward) movement of the beam 12 and then to move the walking beam 12 upwardly (or downwardly) about its pivot support 14. Once rocking movement of the beam 12 has been started, e.g., in the manner described above, the pumping apparatus 10 will continue to reciprocate the well pump to pump out fluid, e.g.,

petroleum, from the well, until rocking movement of the beam 12 is stopped. This can be done by reducing the pressure of the operating fluid, e.g., by stopping a pump (not shown) which develops the pressure of the hydraulic operating fluid or by locking the control arm 51 in a neutral position between the first and second operative positions.

It will be understood that the main valve 54 is also connected to other fluid lines having check valves, throttling valves, regulating valves, etc., of the type disclosed in the above-mentioned Hawk U.S. Pat. No. 3,369,490. Since these other fluid lines and valves, etc. form no part of the present invention, they are represented diagrammatically by the block 56 shown in FIGS. 3 and 4. In this respect, it will be understood, that the block 56 includes suitable connections for connecting the main valve 54 with the source of pressurized fluid (usually from a pump not shown) and to the reservoir in the Samson post 18.

As best shown in FIG. 4, the block 56 and the valve assembly 40 are mounted on a bracket assembly 57 which is fixed to the Samson post 18. The bracket assembly 57 includes an L-shaped angle bracket 58 having first and second leg portions 60, 62, the outer ends of which are fixed, e.g., welded, to the Samson post 18. A plate 65 is secured to one of the leg portions 60 and has a portion 68 which extends beyond the leg portion 62. The block 56 is shown mounted on the plate 65 with the main valve 54 secured to the block 56 and the pilot valve 52 secured to the main valve 54. The assembly 57 also includes an elongated L-shaped bracket 70 which has a first leg portion 72 secured to the extending portion 68 of the plate 65 and a second leg portion 73 secured to a cabinet assembly or housing 74 for supporting the same. The cabinet assembly 74 includes a fixed wall portion 75 secured to the leg portion 73, top and bottom walls 76 and 77 (FIG. 2) secured to the fixed wall portion 75, and a door 78 (FIG. 4) pivotally connected at 80 to the fixed wall portion 75. It will be noted, that, in FIGS. 2, 3 and 4, portions of the cabinet assembly 74 have been removed to show the valve operating mechanism 38 and, it will be understood, that the cabinet assembly 74 provides a protective enclosure for the valve operating mechanism 38 and for the pilot valve 52 which extends into the cabinet assembly 74 through the fixed wall portion 75. Preferably, the cabinet assembly 74 is also supported by the housing 53 of the valve 52 extending into the cabinet assembly 74.

As best shown in FIGS. 2 to 6, the valve operating mechanism 38 includes and is supported by a mounting bar 82 which is fastened by suitable means, such as screws generally indicated at 84 in FIG. 2, to the valve housing 53 of the pilot valve 52. It will be appreciated that the mounting bar 82 provides a convenient means for mounting not only the toggle switching mechanism 46, but also two rod guides 85 and 86 at the upper and lower ends 87 and 88, respectively, of the mounting bar 82 for slidably guiding the control rod 39. The rod guides 85 and 86 are provided with bores 89 and 90, respectively, for slidably receiving and guiding the control rod 39. If desired, a suitable sleeve bearing can be inserted in each of the bores 89 and 90. It will be understood, of course, that suitable openings (not shown) are provided in the top and bottom walls 76 and 77 of the cabinet assembly 74 for receiving the control rod 39 into the cabinet assembly 74 and for permitting the control rod 39 to move vertically on the rod guides 85 and 86 through the top and bottom walls 76 and 77.

The present invention is particularly adapted for use with a known type of pilot valve which is constructed with a control arm (such as the control arm 51) pivotally mounted on a pivot pin within a valve housing (such as the valve housing 53) with the pivot pin being received in the valve housing through an opening in the valve housing. The present invention makes advantageous use of a pilot valve construction of this type by removing the pivot pin and replacing same by a longer pin which will extend from the valve housing for pivotally mounting components of the toggle switching assembly 46.

The longer pin, referred to above, is generally indicated at 91 in FIGS. 5 and 6 and is inserted through an opening 92 in

the valve housing 53 with one end portion 93 of the pin 91 extending from the housing 53. As best shown in FIG. 6, the toggle switching assembly includes a guide arm 94 having a switching device 96 at a first end 97 thereof. The guide arm 94 is pivotally mounted at its opposite end 98 on the end portion 93 of the pivot pin 91 for pivotal or rotational movement about a pivot axis 100 of the control arm 51. The end portion 93 extends to the mounting bar 82 and is fitted (received) into a bore 101 in the mounting bar 82. The bore 101 is aligned with the opening 92 in the valve housing 53. Preferably, a washer 102 is situated between the mounting bar 82 and the guide arm 94 and a collar 104 having a setscrew 105 is situated between the valve housing 53 and the guide arm 94. The collar 104 is fastened by the setscrew 105 to the pin 91 to prevent axial movement of the pin 91.

As best shown in FIG. 6, the switching device 96 is a fork arrangement formed by two short bars 106 and 108 which extend from the first end 97 of the guide arm 94 toward the control arm 51 and which are positioned to straddle the control arm 51. A swing arm 110 is pivotally connected at a first end 111 thereof by a short pin 112 to the first end 97 of the guide arm 94 so as to connect the swing arm 110 with the switching device 96. A second end 114 of the swing arm 110 is positioned adjacent (juxtaposed to) the mounting bar 82. As will be explained hereinafter in detail, the second end 114 is adapted to receive impulses from the toggle actuator 50 for moving the swing arm 110 upwardly or downwardly to move the control arm 51 to operate the valves 52 and 54 to reverse movement of the hydraulic operating mechanism 34 to reverse rocking movement of the beam 12.

A tensioning means in the form of a spring 116 is connected at one end 117 (FIG. 5) to the swing arm 110 and at the other end 118 to an adjustable bracket 120 (FIG. 6) positioned at a point spaced away from the swing arm 110. The bracket 120 is adjustably positioned on a piece of bar stock 122 extending from and secured to the mounting bar 82. The adjustable bracket member 120 is of the type having an opening which is of a similar configuration as the cross section of the piece of bar stock 122, and in which the distance between the upper and lower sides of the opening is greater than the vertical width of the piece of bar stock 122 so that when a tensioning force is applied to the upper end 124 of the bracket 120, the bracket 120 will incline (as shown in FIG. 6) at an angle with respect to the bar 122. The upper and lower sides of the opening in the bracket 120 will then bear against the bar 122 and in this way, the bracket 120 will be fixed at one position. To adjust the position of the bracket 120, the upper end 124 connected to the end 118 of the spring 116 is moved against the spring tension to bring the bracket 120 into a 90° position with respect to the bar 122. In this 90° position, the bracket 120 can be moved horizontally along the bar 122 toward or away from the mounting bar 82 to a new position to thereby adjust the tension force of the spring 116 on the swing arm 110.

In the illustrated embodiment, the swing arm 110 is elongated and hollow to form a hollow control link. The end 117 of the spring is received into the hollow control link (arm) 110 and is secured to the link (arm) 110 by a suitable means, such as by a pin 126, shown in FIGS. 5 and 6. The remainder of the spring 116 extends through a slot 128 formed in the mounting bar 82 and, as explained above, the other end 118 of the spring 116 is connected to the upper end 124 of the bracket 120. The slot 128 through the mounting bar 82 is sufficiently wide (vertically) to allow for limited vertical movement of the spring 116 transversely of the longitudinal axis of the spring 116.

The means for receiving an impulse at the second end 114 of the swing arm 110 is a short projection 130 which extends transversely of the swing arm 110 toward the toggle actuator 50. As shown in FIGS. 5, 6 and 7, the toggle actuator 50 has a recess 131 for receiving the projection 130 and is mounted for pivoting movement on a pivot pin 132 secured in a bore 133 in the mounting bar 82. As best illustrated, in FIGS. 5 and 7, the recess 131 has a generally U-shaped cross section and extends

inwardly of the actuator 50 generally parallel to the pivot axis 100. As shown in FIG. 5, the axis of the bore 133 is coincident with the pivot axis 100 of the bore 101 and the pin 91. A sleeve member 134 is fitted into the bore 133 for threadably receiving and supporting the pivot pin 132. Preferably, a washer 136 is positioned between the toggle actuator 50 and the mounting bar 82 and around a portion of the sleeve member 134.

The outer end of the toggle actuator 50 is provided with first and second lugs 137 and 138 (FIG. 7) which are positioned in the path of movement of the blocks 47 and 48 (FIG. 2) on the control rod 39. As best shown in FIG. 2, the block 47 has a projection or dog 140 extending therefrom in a direction toward the lugs 137 and 138 on the toggle actuator 50 and the block 48 has a projection or dog 141 (similar to dog 140) extending from the block 48 in a direction toward the lugs 137 and 138.

As shown in FIG. 5, the dog 140 is offset to one side of the longitudinal axis 142 of the block 47. It will be understood that the dog 141 (FIG. 2) is also offset, but to the other side, of the longitudinal axis of the block 48. As shown in FIG. 6, the lugs 137 and 138 are offset from each other with the lug 137 extending along the side of the toggle actuator 50 having the recess 131 therein and with the lug 138 extending along the other side of the toggle actuator 50. With this arrangement, the dog 140 on the block 47 will only engage with the lug 137 when the control rod 39 is moved downwardly viewing the control rod 39 as shown in FIG. 2. On the other hand, the dog 141 on the block 48 will only engage with the lug 138 when the control rod 39 is moved upwardly.

Preferably, the radius from the pivot axis 100 to the area of engagement of the lug 137 (or 138) of the toggle actuator 50 with the respective dog 140 (or 141) is long enough to permit the dog 140 (or 141) to be moved past the toggle actuator 50. When this happens, the lug 137 (or 138) is moved downwardly (or upwardly) out of the path of movement of the respective dog 140 (or 141) and the other lug 139 (or 137) is swung to a position in the path of movement of the other dog 141 (or 140). Then, on the reverse upward (or downward) movement of the control rod 39, the other dog 141 (or 140) will engage and move the other lug 138 (or 137) out of the path of movement of the dog 141 (or 140), and in so doing, will move the other lug 137 (or 138) to a position in the path of movement of the dog 140 (or 141). It is to be understood that, due to the time lag and to the momentum of the beam 12, the reversing of the movement of the cylinder 35 does not occur instantaneously. As a result, there is some overshoot of the axial movement of the control rod 39 and the blocks 47, 48 thereon during a downward or upward stroke of the cylinder 35, such that the block 47 (or 48) is moved past (bypasses) the toggle actuator 50 during a downward (or upward) stroke of the cylinder 35. However, with the construction of the present invention, the toggle switching mechanism 46 is protected from damage from overshoot or overriding of the control rod 39 during an upward or downward stroke of the cylinder 35.

As shown in FIG. 5, the control rod 39 is provided with a flat side 144 and each of the blocks 47 and 48 is provided with a flat sided circular opening of similar configuration to the cross section of the control rod 39. The flat side of each of the openings in the blocks 47 and 48 is fitted or seated against the flat side 144 on the control rod 39. In this way, rotational movement of the blocks 47 and 48 about the longitudinal axis of the control rod 39 is prevented. Also, each of the blocks 47 and 48 is provided with a setscrew, such as the setscrew 146 (FIG. 5) in block 47, for fixing each of the blocks 47 and 48 at predetermined vertical positions on the control rod 39 and to permit adjustment of the vertical positions of the blocks 47 and 48 as desired. With this construction, the length of the up and down strokes of the hydraulic operating mechanism 34 is easily regulated by adjusting the vertical position of the block 47 and/or the block 48 on the control rod 39.

It will be understood that the control arm 51 is shown in FIGS. 2 to 5 in a middle or neutral position which is between the operative positions 51a and 51b. In this neutral position, the spring 116 and the swing arm 110 are in alignment with the guide arm 94 and the control arm 51 and no tension forces of the spring 116 on the swing arm 110 will be in a direction to move the guide arm 94 or the control arm 51 about the pivot axis 100. Stated otherwise, in the neutral position, the longitudinal axis of the spring 116 is parallel to the longitudinal axes of the guide arm 94, the swing arm 110 and the control arm 51 and the tension force of the spring 116 on the swing arm 110 is along the longitudinal axis of the swing arm 110.

In the operation of the valve operating mechanism 38, the control rod 39 is reciprocated up and down by the walking beam 12, as the beam 12 is rocked about the pivot support 14. On the upstroke of the control rod 39, the toggle actuator 50 will be moved upwardly by the engagement of the dog 141 with the lug 138 and the projection 130 in the recess 131 of the toggle actuator 50 will be moved upwardly with the actuator 50 to move the second end 114 of the swing arm 110 upwardly. When this happens, the longitudinal axis of the spring 116 will be moved out of parallel relationship with the longitudinal axes of the guide arm 94 and the control arm 51 and will exert a torque or moment force on the first end 97 of the guide arm 94 (by virtue of the connection of the end 111 of the swing arm 110 to the end 97 of the guide arm 94) tending to move the guide arm 94 clockwise about the pivot axis 100. The spring 116 then will quickly move the guide arm 94, the switching device 96, and the control arm 51 with a snap or toggle action in a clockwise direction about the pivot axis 100. Suitable stops (not shown) within the valve housing 53 of the pilot valve 52 will limit movement of the control arm 51, the upper limit being at the first operative position 51a and the lower limit being at the second operative position 51b.

It is to be appreciated that only a small displacement or movement of the toggle actuator 50 is required to initiate the toggle action since as soon as the spring 116 is moved slightly out of parallel relationship with the longitudinal axes of the guide arm 94 and the control arm 51, sufficient torque is exerted by the spring 116 on the outer or distal end of the control arm 51 to quickly move or snap the control arm 51 into one of its operative positions 51a or 51b.

When the control arm 51 is moved to the first operative position 51a, the valve spools in the valves 52 and 54 are positioned so that the fluid line 37 is connected to the source of pressurized fluid and the fluid line 36 is connected to the reservoir in the Samson post 18. Then, as pressurized fluid is delivered through the fluid line 37 to the cylinder 35, upward movement of the cylinder 35 is stopped, and movement of the cylinder 35 in the downwardly direction is begun.

As the control rod 39 approaches the end of its downstroke, the dog 140 will engage with the lug 137 of the toggle actuator 50 to move the same downwardly in a counterclockwise direction and thereby move the second end 114 of the swing arm 110 downwardly. When this happens, the tension force of the spring 116 on the first end 97 of the guide arm 94 will be in a direction to move the guide arm 94 and the control arm 51 counterclockwise about the pivot axis 100 to move the control arm 51 downwardly to its second operative position 51b (FIG. 2). When the control arm 51 is in the second operative position 51b, the valve spool within the pilot valve 52 is positioned so that the fluid line 36 is connected to the source of pressurized fluid and the fluid line 37 is connected to the reservoir. Then, as pressurized fluid is delivered through the line 36 to the cylinder 35, downward movement of the cylinder 35 is stopped and upward movement of the cylinder 35 is begun. In this way, the walking beam 12 is rocked about its pivot support 14.

From the above description it will be appreciated that the valve operating mechanism 38 of the present invention has a number of advantages, some of which are as follows:

1. It can easily be used with a known, commercially available pilot valve.

2. With the lugs 137 and 138 of the toggle actuator 50 normally out of engagement with the blocks 47 and 48, the control arm 51 or the toggle actuator 50 can be moved manually to initiate rocking movement of the beam 12. In other words, an operator can manually start the rocking movement of the walking beam 12 merely by moving the control arm 51 or the toggle actuator 50 upwardly or downwardly.

3. The toggle switching mechanism 46 provides a quick snap action of the control arm 51 either upwardly or downwardly without backlash when the swing arm 110 is moved toward one of the operative positions 51a or 51b of the control arm 51.

4. The spring tension can be easily and simply adjusted by moving the bracket 120.

5. The adjustable blocks 47 and 48 provide simple and efficient means for adjusting the extent or length of the up and down strokes of the hydraulic operating mechanism 34.

6. The valve operating mechanism 38 is compact whereby the valve operating mechanism 38 and the pilot valve 52 can be easily enclosed with the cabinet assembly 74 supported by, and adjacent to, the Samson post 18.

7. The tripping mechanism 44 and the toggle switching mechanism 46 provide a very effective means for controlling the rocking movement of the beam 12 to control the number of strokes of the well pump connected thereto at both a slow speed, i.e., a few strokes per minute, and a fast speed, i.e., over 20 strokes per minute.

8. The construction of the valve operating mechanism allows for overshoot of the control rod 39 without damage to the valve operating mechanism.

9. Only a small movement of the toggle actuator 50 is needed to initiate the toggle action.

I claim:

1. An improved valve operating mechanism for use in a well pumping apparatus wherein a beam is pivotally supported for rocking movement, an hydraulic operating mechanism is connected to said beam for rocking said beam about its pivot support between predetermined upper and lower limits and includes a cylinder means having fluid connections to a source of pressurized hydraulic fluid, said fluid connections including valve means having a control arm movable between first and second operative positions for controlling the flow of hydraulic fluid to and from said cylinder means and said valve operating mechanism is controlled by the rocking movement of said beam and is arranged to quickly switch said control arm to one or the other of its operative positions to reverse the rocking movement of said beam as it approaches one of its predetermined upper and lower limits, said valve operating mechanism including a control rod connected to said beam and arranged for reciprocating movement during rocking movement of said beam, at least one tripping block secured to said control rod, a swing arm movable between first and second positions corresponding to said first and second operative positions of said control arm, and having a portion thereof which has means for receiving an impulse from said tripping block through an impulse transmitting means during a stroke of said reciprocating control rod for moving said swing arm toward one of said first and second positions thereof, a switching means operatively associated with said control arm and connected to said swing arm at a point spaced from said portion thereof and means connected at one end to said swing arm and at another end to a point spaced from said swing arm for exerting a tension force on said swing arm, said tension exerting means being operative in response to movement of said swing arm by an impulse to move said swing arm to one of said first and second positions to move said switching means and thereby move said control arm to one of said first and second operative positions.

2. A valve operating mechanism according to claim 1 in which said valve switching means comprises a fork arrangement which is arranged to straddle a portion of said control arm extending from said valve means.

3. A valve operating mechanism according to claim 1 including a guide arm having a first portion which is connected

to said valve switching means and to said swing arm and a second portion which is pivotally mounted on a pivot axis, said guide arm serving to maintain said valve switching means operatively associated with said control arm of said valve means during movement of said control arm to and from said first and second operative positions.

4. A valve operating mechanism according to claim 1 in which said tensioning means is fixedly secured at one end to said swing arm and is adjustable secured at another end to a support spaced from said swing arm.

5. A valve operating mechanism according to claim 4 in which said swing arm is elongated and hollow and said one end of said tensioning means extends into and is secured to said hollow swing arm.

6. A valve operating mechanism according to claim 1 wherein said impulse transmitting means is a toggle actuator which is mounted for pivoting movement about a pivot axis, said toggle actuator having a projecting portion which is positioned to receive an impulse from said tripping block for transmitting said impulse to said swing arm and to permit said tripping block to move past said projecting portion during overshoot movement of said control rod carrying said tripping block, said projecting portion being moved by said tripping block out of the path of said tripping block during overshoot movement of said control rod.

7. A valve operating mechanism according to claim 6 in which said toggle actuator has a recess therein and said means on said swing arm for receiving an impulse comprises a projection extending from said swing arm into said recess.

8. A valve operating mechanism according to claim 7 in which said recess in said toggle actuator extends into said actuator in a direction parallel to the pivot axis of said actuator and has a generally U-shaped cross section.

9. A valve operating mechanism according to claim 1 in which at least one tripping block is adjustably positioned on said control rod for adjusting the extent of the stroke of the control rod to thereby adjust the extent of rocking movement of the beam.

10. A valve operating mechanism according to claim 1 in which two tripping blocks are adjustably positioned on and secured to said control rod.

11. In a well pumping apparatus, the combination of: a beam pivotally supported for rocking movement, an hydraulic operating mechanism connected to said beam for rocking said beam about its pivot support between predetermined upper and lower limits and including a cylinder means having fluid connections to a source of pressurized hydraulic fluid, said fluid connections including valve means of the type having a valve housing and a control arm which extends from the hous-

ing and which is movable between first and second operative positions for controlling the flow of hydraulic fluid to and from said cylinder means and a valve operating mechanism controlled by the rocking movement of said beam and arranged to quickly switch said control arm from one of its operative positions to the other of its operative positions to reverse the rocking movement of said beam as it approaches one of its predetermined upper and lower limits, said valve operating mechanism including a control rod connected to said beam and arranged for reciprocating movement during rocking movement of said beam, at least one tripping block secured on said control rod, a swing arm movable between first and second positions corresponding to said first and second operative positions of said control arm and having a portion thereof which has means for receiving an impulse from said tripping block through an impulse transmitting means during a stroke of said reciprocating control rod for moving said swing arm toward one of said first and second positions thereof, a switching means operatively associated with said control arm and connected to said swing arm at a point spaced from said portion thereof and means connected at one end to said swing arm and at another end to a point spaced from said swing arm for exerting a tension force on said swing arm, said tension exerting means being operative in response to movement of said swing arm by an impulse to move said swing arm to one of said first and second positions to move said switching means to move said control arm to one of said first and second operative positions.

12. A pumping apparatus according to claim 11 in which said valve operating mechanism includes a mounting bar which is secured to and supported by said valve housing, and said tensioning means is supported by said mounting bar.

13. A pumping apparatus according to claim 12 including a guide arm having a first portion which is connected to said valve switching means and to said swing arm and a second portion which is mounted for pivotal movement about a pivot axis between said mounting bar and said valve housing.

14. A pumping apparatus according to claim 12 wherein said impulse transmitting means is a toggle actuator which is mounted for pivotal movement about a pivot axis adjacent said mounting bar, said toggle actuator having a projecting portion which is adapted to receive impulses from said tripping block for transmitting said impulses to said portion of said swing arm and to permit said tripping block to move past said projecting portion during overshoot movement of said control rod carrying said tripping block, said projecting portion being moved by said tripping block out of the path of said tripping block during overshoot movement of said control rod.

50

55

60

65

70

75

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,580,138

Dated May 25, 1971

Inventor(s) Gunter Maasshoff

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 43, insert -- will continue and accelerate movement of the swing arm-- between "arm" and "in".

Column 5, line 21, "11" should be --111--.

Column 6, line 39, "139" should be --138--.

Signed and sealed this 19th day of October 1971.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents