Jan. 8, 1963 P. S. HEFFEL 3,072,059

OIL WELL FLOW CONTROL VALVE

Filed Nov. 5, 1956 3 Sheets-Sheet 1

Fig. 1

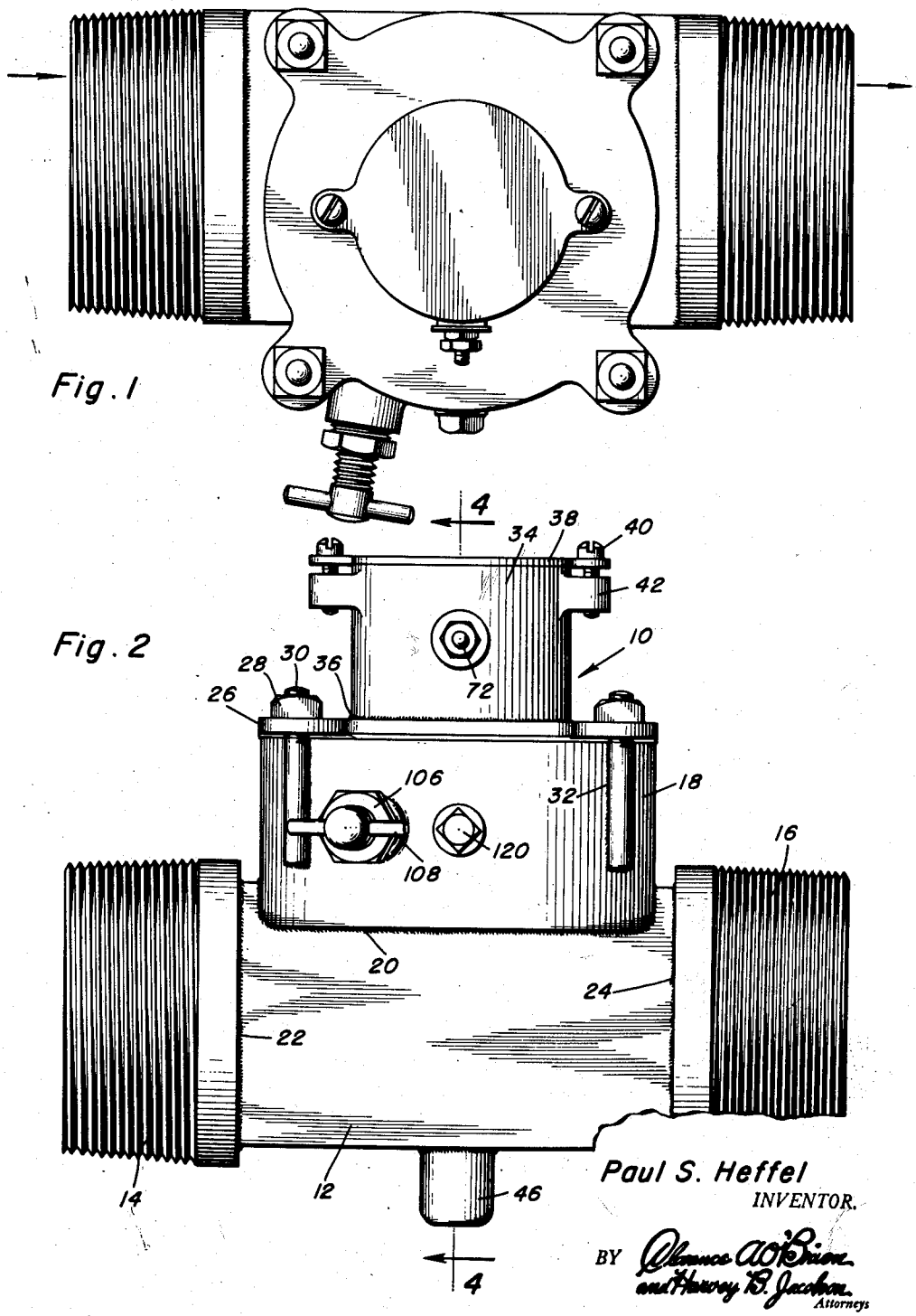

Fig. 2

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Filed Nov. 5, 1956 3 Sheets-Sheet 2

Fig. 4

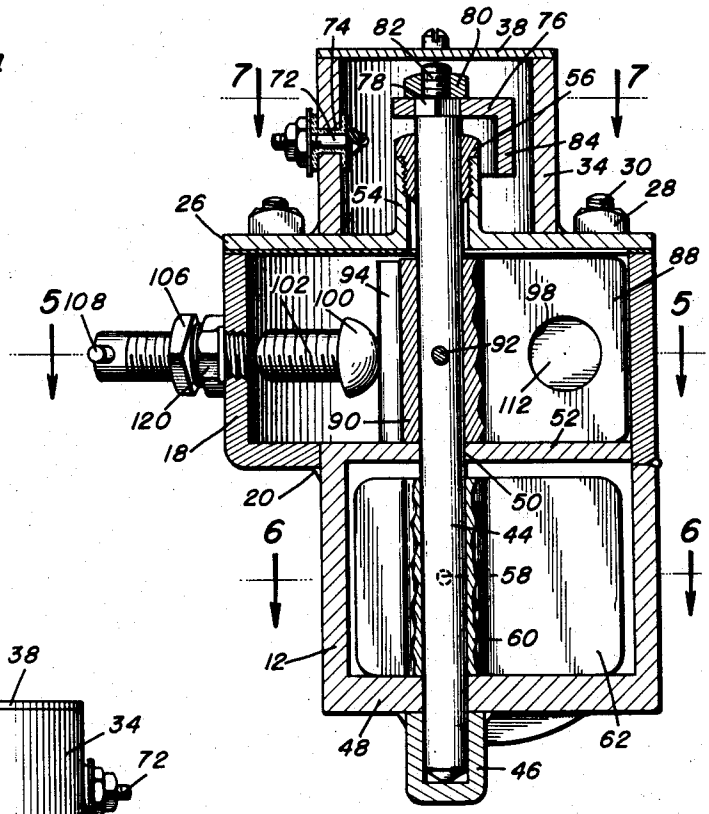


Fig. 3

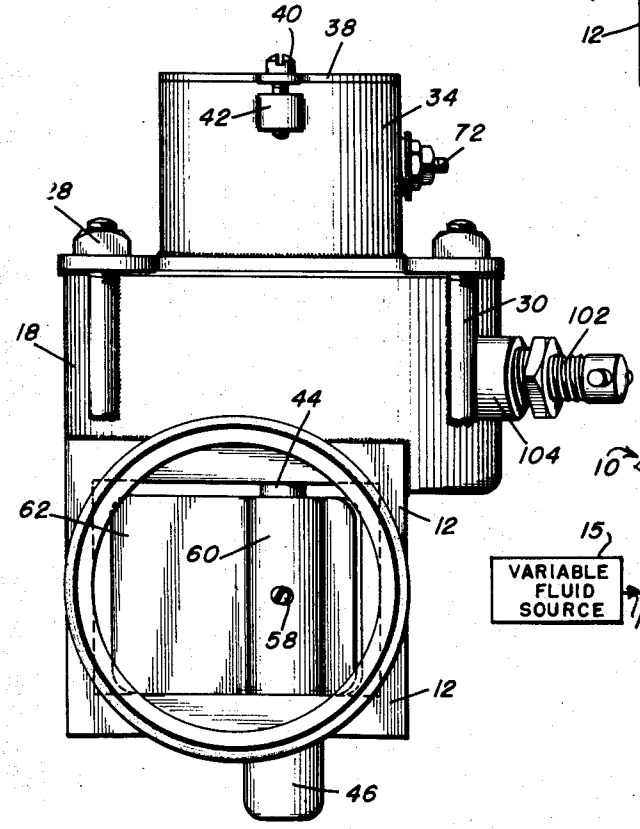
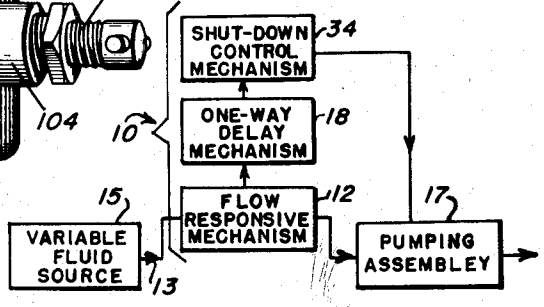


Fig. 8



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Jan. 8, 1963 P. S. HEFFEL 3,072,059

OIL WELL FLOW CONTROL VALVE

Filed Nov. 5, 1956 3 Sheets-Sheet 3

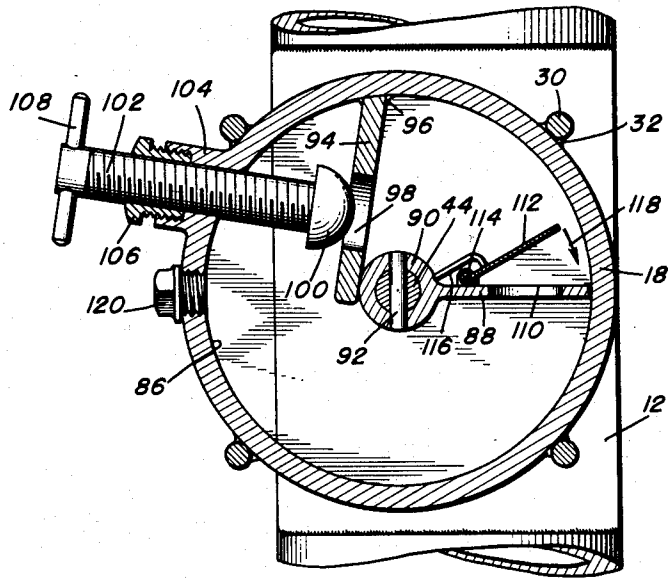


Fig. 5

Fig. 7

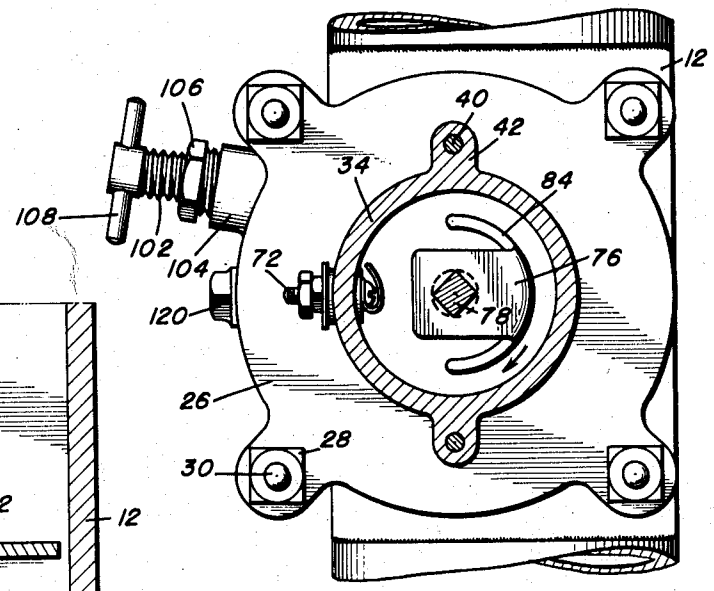
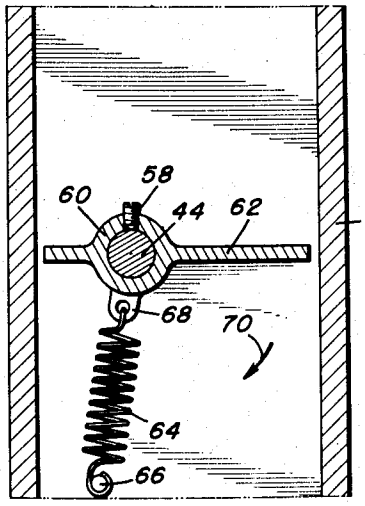


Fig. 6



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OIL WELL FLOW CONTROL VALVE

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Filed Nov. 5, 1956, Ser. No. 620,489
8 Claims. (Cl. 103—22)

This invention comprises a novel and useful oil well flow control valve and more particularly relates to means for controlling the actuation of an oil well pumping assembly, for stopping the same upon cessation of or a predetermined diminution in the rate of flow of the oil from the well.

Many oil wells are customarily provided with pumping assemblies to raise the oil to the surface. The primary purpose of the present invention is to provide a device which may be operatively connected with the pumping assemblies and the oil flow line of such an oil well whereby to stop the operation of the pumping assembly when the flow of oil from the well ceases or decreases below a predetermined rate of flow, to thereby prevent unnecessary operation of the pumping assembly.

A further object of the invention is to provide a control device for an oil well pumping assembly which shall include means for controlling the activation of an oil well pumping assembly, a further means responsive to flow from the oil well for actuating the control means, together with an adjustable means for adjustably retarding or delaying effecting the control means by the flow responsive means.

A still further important object of the invention is to provide a control device in accordance with the preceding objects which shall be simple and compact in construction, readily adjusted to meet different conditions, and shall be highly effective and efficient for the purposes intended.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is an elevational view showing a control device incorporating therein the principles of this invention;

FIGURE 2 is a top plan view of the device of FIGURE 1;

FIGURE 3 is an end elevational view of the apparatus, taken from the left end of FIGURES 1 and 2;

FIGURE 4 is a view in vertical section taken substantially upon the plane indicated by the section line 4—4 of FIGURE 2 and showing the internal construction of the control device;

FIGURE 5 is a horizontal sectional view taken substantially upon the plane indicated by the section line 5—5 of FIGURE 4 and showing structural details of the interior of the adjusting means for varying the operative relation between the flow responsive means and the control means of the invention;

FIGURE 6 is a horizontal sectional view taken substantially upon the plane indicated by the section line 6—6 of FIGURE 4 and showing the flow responsive means;

FIGURE 7 is a horizontal sectional view taken substantially upon the plane indicated by the section line 7—7 of FIGURE 4 and illustrating the arrangement of the control means; and

FIGURE 8 is a schematic flow diagram illustrating the installational environment for the control device.

Many oil wells necessitate the use of a pumping assembly for producing a flow of oil from the well. In such

systems, it is highly desirable to promptly shut down the pumping assembly in response to such detrimental conditions as a leak in the oil flow line, a breakage of the pump rods, a leak in the flow tubing in the well, or when the well is pumped out of fluid, as when the pumping is discharging fluid from the well bore at a faster rate than the formation is supplying fluid into the well bore.

The primary intent of this invention is to provide an automatic control mechanism which in response to any of the above conditions, or if for any other reason there is a cessation of or a diminution of the rate of flow from the well below a predetermined minimum rate, will automatically shut down the pumping mechanism.

In an apparatus illustrated in the accompanying drawings for carrying out the purposes of this invention, and which is illustrative only of the principles of the invention, it will be seen that the control device consists of a housing assembly indicated generally by the numeral **10** as more clearly seen in FIGURE 2. This assembly comprises a lower member **12** preferably of a substantially tubular nature and which is threaded as at **14** and **16** upon its opposite ends whereby the same may be connected into the flow line **13** as diagrammatically shown in FIGURE 8 and may be connected with the pump tubing of an oil well constituting an uncontrolled variable source of fluid **15** having a pumping assembly **17** therefor. Mounted upon the top of the member **12** is a second casing **18** which may be secured thereto as by welding **20**, the threaded portions **14** and **16** being likewise secured to the member **12** as by welding **22** and **24** respectively. The casing **18** is provided with a removable cover or closure plate **26**, secured thereto as by nuts **28** which engage upstanding studs **30** which may be welded as at **32** or otherwise secured to the side of the casing **18**. Carried by the closure plate **26** is an uppermost casing **34**, secured to the cover plate as by welding **36**, and which in turn is provided with a removable cover or closure **38** detachably secured thereto as by fastening screws **40** engaging internally threaded bosses or lugs **42** projecting laterally from the casing **34**.

In accordance with this invention, the member **12** constitutes the casing of a flow responsive means; the member **18** comprises the casing of an adjusting means, while the casing **34** serves to house a control means for the pumping assembly.

Referring now primarily to FIGURE 4, it will be observed that the vertically disposed shaft or axle **44** extends vertically in these three casings. The lower end of the shaft is journaled as in a bearing means **46** disposed beneath the bottom wall **48** of the lower casing **12**, and this shaft passes through an aperture **50** in the top wall **52** of the lowermost casing, which top wall in turn forms a part of the bottom wall of the casing **18**.

The removable closure plates **26** of the casing **18** is provided with an upstanding tubular boss **54** which is internally threaded to receive a combined packing and bearing bushing **56** through which the upper end of the shaft **44** extends.

Referring now specifically to FIGURES 3, 4 and 6 it will be observed that the chamber in the casing **12** and forming a passage between the portions **14** and **16** constituting parts of a flow line of an oil well has the shaft **44** therein disposed to one side of the central longitudinal axis thereof. Secured upon this shaft as by a setscrew **58** in a hub portion **60** thereof is a flat plate-like member **62** constituting a vane. As will be best apparent from FIGURE 4 and FIGURE 6, this vane occupies the major portion or substantially all of the cross-sectional area of the chamber within the member **12** and thus is mounted for pivotal movement about an axis which is displaced from the vertical medial plane of the chamber. Consequently, as will be apparent from FIGURE 6, the vane

62 is mounted for oscillatory or pivotal movement about a vertical axis across the width of the chamber, and thus is responsive to the rate of flow of fluid or the flow of oil from the well which passes through the chamber and the casing 12. It will also be apparent that inasmuch as the vane 62 never blocks the flow passage through the casing 12 since its flow reacting surface area is slightly less than that of the flow area as shown in FIGURE 6, the vane 62 will also be fluid pressure balanced and its movement will not be influenced by pressure but only by fluid flow.

A tension spring 64 which is secured at one end as to a pin 66 in the chamber of the casing 12, and its other end is secured to an apertured lug 68 carried by the hub 60 yieldingly urges the vane 62 into a position which offers a maximum of obstruction to flow through the chamber. Obviously, the vane will be pivoted into a more or less open position in accordance with the rate of flow through the chamber or passage through the casing 12. This pivotal movement being indicated by the arrow 70 in FIGURE 6. It will thus be seen that the vane is moved in a position displaced from that shown in FIGURE 6 in response to a flow through the chamber, and is yieldingly returned to the position of FIGURE 6 by the spring means 64 upon diminution of flow. The spring 64 will of course be made of sufficient strength to enable the vane to respond to a predetermined rate of flow.

Referring next primarily to FIGURES 4 and 7 it will be seen that the control means is located in the chamber of the uppermost casing 34. This control means consists of any suitable form of stationary electric contact 72, mounted in a suitable insulated bushing or sleeve 74 extending through the wall of the casing 34, and which contact forms part of an electrical circuit, not shown, by means of which the flow including pressure in the oil flow line is controlled. For example, the electric circuit of which the member 72 forms a switch element may comprise the electric circuit of a motor for operating a pump jack, may consist of the ignition circuit of an internal combustion engine operating such a pump jack; or may comprise any suitable electrical circuit which in turn is employed to control in any desired manner the application of power to the pump jack of the pumping assembly 17. Inasmuch as the actual pumping assembly, the pump jack and the actuating means and the activating electric circuit thereof do not in themselves constitute any particular part of the invention claimed herein, and as they are well known to those skilled in the art, a further explanation and an illustration of the same is deemed to be unnecessary.

However, for the purpose of this invention, the control means housed in the casing 34 includes in addition to the stationary terminal 72, a movable terminal consisting of a plate 76 secured to the non-circular upper portion 78 of the shaft 44 as by a lock nut 80 engaged upon the threaded upper extremity 82 of the shaft. The plate 76 in turn is provided with a downturned arcuate flange or blade 84, which upon a predetermined rotation of the shaft 44 is adapted to engage the stationary contact 72 and with that contact close the electric circuit which activates or otherwise is vital to continued operation of the pumping assembly 17.

As so far described, it will now be apparent that upon sufficient oscillatory or pivotal movement of the vane 62 in response to a predetermined decrease in the rate of the flow through the chamber of the housing 12, that the spring 64 be effected to rotate the shaft 44 whereby the movable contact 84 will engage with the stationary contact 72, will thus ground or activate the circuit of which the stationary and movable contacts form parts, to thereby deactivate the pumping mechanism 17. However, as so far described and when merely the control means and the flow responsive means are utilized, the actuation of the control means will be in direct response to and in an invariable relation to the rate of flow. While in some instances a control device consisting merely of these two means may be found to be satisfactory, it is generally preferred in the interest of permitting adjustment of the device and its responsiveness to rates of flow to provide an adjusting means which comprises an adjustable unidirectional delay retarding device and which is disposed in the chamber of the housing 18.

Referring now especially to FIGURES 4 and 5, it will be seen that the housing 18 is circular to thus provide a cylindrical chamber 86 therein. This chamber is utilized as an adjustable dash-pot in the following manner.

A vane or blade 88 is provided with a hub portion 90 received upon the shaft 44 and secured thereto as by diametrically disposed pin 92, this blade extending radially from the shaft to the wall of the chamber 86. A partition 94 is welded as at 96 to the wall of the chamber 86 or otherwise is secured thereto, and extends outwardly of the chamber and tangentially abuts the hub 90. The partition 94 is provided with a by-pass or fluid bleed opening 98 which is adjustably controlled by the enlarged headed extremity 100 of an adjusting screw 102 which extends through an apertured boss 104 on the wall of the housing 18 and which boss in turn is provided with a packing gland 106. By means of a handle 108 the screw 102 may be adjusted to cause its head 100 to act as a valve and control and regulate the flow of fluid through the by-pass port 98 of the partition 94.

The blade 88 in turn is provided with an aperture 110 which is controlled by a valve disk 112, pivoted as at 114 to the plate. The valve disk is provided with a stop pin 116 carried thereby and which is adapted to abut the hub portion 90 as shown in FIGURE 5 to limit the opening movement of the valve member.

The arrangement is such that in the assembly of FIGURE 5, movement of the blade 88 by the shaft 44 in a clockwise direction, as indicated by the arrow 118, will permit the valve disk 112 to open and allow fluid disposed on the advancing side of the blade to pass through the port 110 to the other side thereof. Thus fluid can be readily transferred from the chamber in front of the blade to that behind the latter. However, upon reverse pivotal movement of the blade 88 the valve 112 will be closed and the fluid disposed between the blade 88 and the partition 94 will be trapped therein and can escape at a restricted rate through the blade or by-pass passage 98, this rate of escape being controlled by the valve member 100 which is manually adjusted as above mentioned.

Thus, the blade 88 constitutes a dashpot which is adjustable for applying a varying resistance to pivoting of the shaft 44 and of the flow responsive vane 62 in one direction, while permitting a quick pivotal movement thereof in the other direction.

It is intended that the adjustment of the by-pass or bleed passage 98 shall be such as to apply an adjustably varied resistance to pivoting of the shaft 44 in a direction which will result in the control member deactivating the pumping assembly. By this means, the control means is rendered less responsive to sudden and temporary variations at the rate of flow of oil through the well flow line and through the chamber of the housing 12, but is rendered responsive to a prolonged variation in such rate of flow.

A filling plug 120 is provided in the wall of the housing 18 to permit a suitable dashpot fluid to be introduced thereinto.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A shut down control device for an oil well having a pumping assembly and an oil flow line operatively associated therewith, a control means for terminating flow inducing pressure in the oil flow line when operative, a flow responsive means operatively mounted in said flow line and connected to said control means to render the control means operative upon predetermined reduction in flow of oil through said flow line, adjusting means operatively connected to said flow responsive means for applying an adjustable resistance to action of the flow responsive in actuating the control means to deactivate the pumping assembly, chambers separately enclosing each of said means, a shaft extending into each of said chambers for pivotal movement, each of said means being directly connected to said shaft, the chamber for said adjusting means being fluid tight.

2. The combination of claim 1 wherein said flow responsive means includes a passage for receiving flow through said conduit, a vane pivotally mounted in said passage for oscillation by flow through the latter, means urging said vane in a direction opposing flow induced movement thereof.

3. A control device for an oil well pumping assembly comprising control means for terminating flow inducing pressure in a conduit, fluid pressure balance means mounted in said conduit and responsive to flow therethrough operable on said control means to maintain said flow inducing pressure in the conduit, adjusting means operatively connected to said flow responsive means for adjustably retarding movement of the control means toward a deactivating position, a single shaft mounted for oscillation about its longitudinal axis, each of said means being directly connected to said shaft, said adjusting means comprising a fluid dashpot chamber, having a vane connected to said shaft oscillatable therein and a partition opposed to said vane, an adjustable by-pass in said partition for throttling flow therethrough.

4. The combination of claim 1 wherein said control means comprises a stationary contact and a movable contact adapted to control an electric circuit the movable contact being connected to said flow responsive means.

5. A shut down control device for an oil well pumping assembly comprising, control means rendered operative to terminate flow inducing pressure in a conduit connected to an uncontrolled source of fluid, pressure balanced flow responsive means mounted in non-blocking flow relation in said conduit and responsive to flow of fluid therethrough above a predetermined rate of flow to render the control means inoperative, and uni-directional delay means operatively connecting the pressure balanced flow responsive means to the control means in response to a decrease in fluid flow below said predetermined flow rate and immediate resumption of flow inducing pressure in response to an increase in fluid flow above said predetermined flow rate.

6. A shut down control device for an oil well pumping assembly comprising, control means operative to terminate flow inducing pressure in a conduit connected to an uncontrolled source of fluid, pressure balanced flow responsive means mounted in said conduit and responsive to flow of fluid therethrough above a predetermined rate of flow to render the control means inoperative, and means to delay the control means from becoming operative when fluid flow decreases below said predetermined rate, said fluid pressure balanced flow responsive means including a flow passage in said conduit, a vane member pivotally mounted in said flow passage having a flow impinging surface area less than the flow area of said flow passage to prevent blockage of fluid flow in said flow passage, said delay means comprising chamber means disposed adjacent to said flow responsive means, movable partition means mounted in the chamber means and directly connected to said flow responsive means for movement therewith, movement retarding fluid disposed within said chamber means, fixed partition means mounted within said chamber means, adjustable aperture means in said fixed partition means for retarding movement of the movable partition means in both directions, and one-way valve mounted on the movable partition means for reducing the fluid retarding effect thereon in one direction only.

7. The combination of claim 6, wherein said control means is directly connected to said flow responsive means and delay means for movement therewith.

8. A shut down control device for an oil well pumping assembly comprising, control means operative to terminate flow inducing pressure in a conduit connected to an uncontrolled source of fluid, pressure balanced flow responsive means mounted in said conduit and responsive to flow of fluid therethrough above a predetermined rate of flow to render the control means inoperative, and means to delay the control means from becoming operative when fluid flow decreases below said pretermined rate, said delay means comprising chamber means disposed adjacent to said flow responsive means, movable partition means mounted in the chamber means and directly connected to said flow responsive means for movement therewith, movement retarding fluid disposed within said chamber means, fixed partition means mounted within said chamber means, adjustable aperture means in said fixed partition means for retarding movement of the movable partition means in both directions, and one-way valve means mounted on the movable partition means for reducing the fluid retarding effect thereon in one direction only.

References Cited in the file of this patent

UNITED STATES PATENTS

868,464	Mann	Oct. 15, 1907
1,420,769	Smith	June 27, 1922
1,697,223	Brumbaugh	Jan. 1, 1929
2,550,093	Smith	Apr. 24, 1951
2,680,168	Murphy	June 1, 1954
2,687,457	Smith	Aug. 24, 1954
2,697,984	Pankratz	Dec. 28, 1954
2,734,107	Reichel	Feb. 7, 1956
2,953,659	Edwards	Sept. 20, 1960