

Dec. 25, 1962

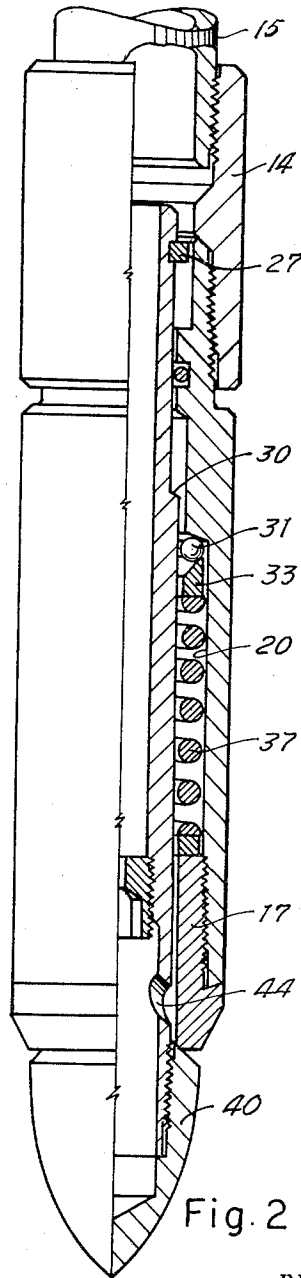
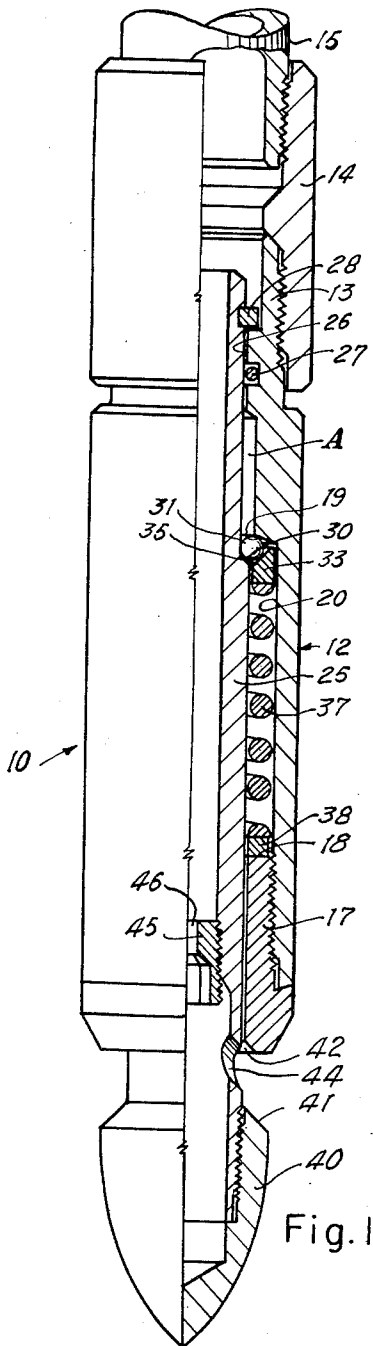
G. M. RAULINS

3,070,119

WELL TOOLS

Filed July 20, 1959

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

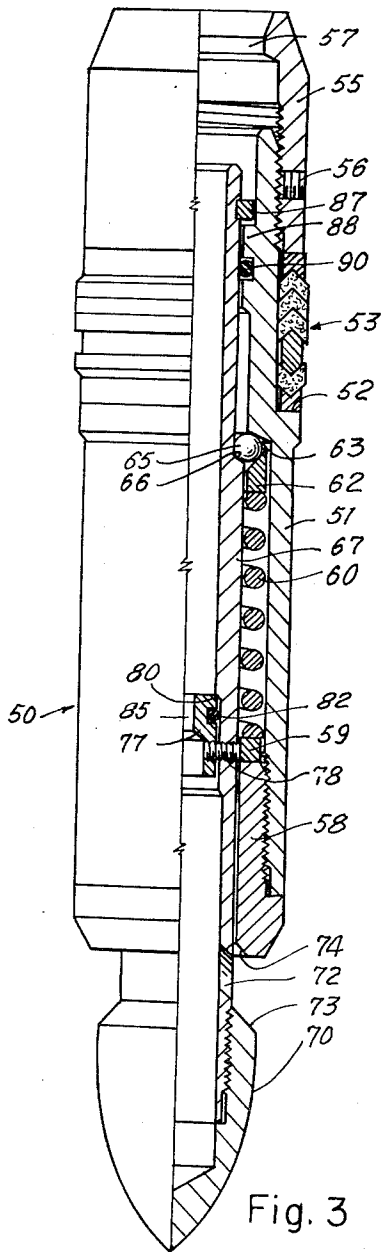


Fig. 3

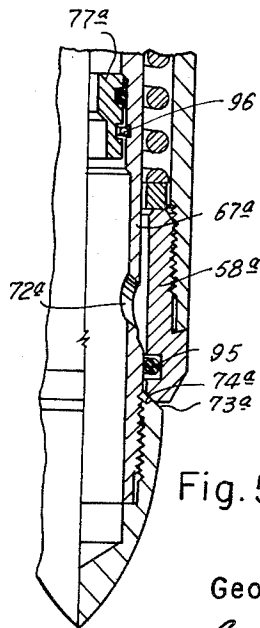


Fig. 5

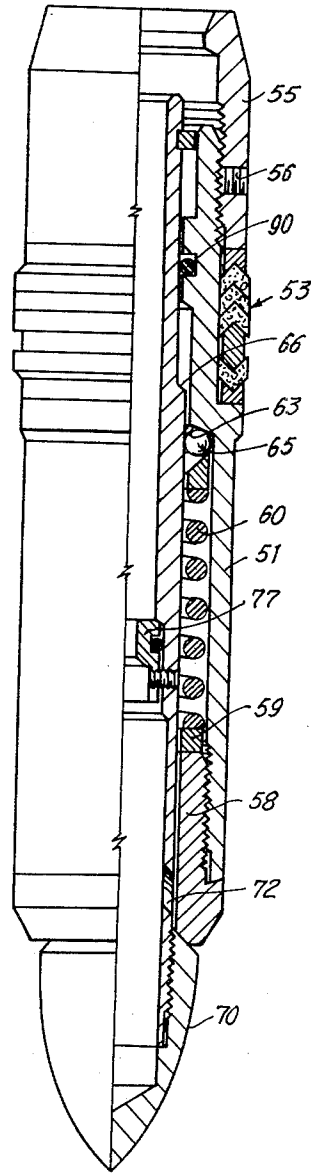


Fig. 4

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3,070,119

WELL TOOLS

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17 Claims. (Cl. 137-460)

This invention relates to well tools and more particularly to pressure differential operated safety valves.

An object of the invention is to provide a new and improved pressure differential operated safety valve which is releasably held in open position by a latch means until a pressure differential of predetermined value occurs across the valve which causes it to close.

Another object is to provide a pressure differential safety valve which closes with a snap action whereby the seating surfaces of the valve are not subjected to the cutting action of abrasive particles carried in fluids flowing through the valve.

Still another object is to provide a safety valve which closes upon the occurrence of a pressure differential of predetermined value thereacross and which will not open even when the pressure thereacross is again equalized but must be opened either by suitable well tools lowered through the well flow conductor whose fluid flow the valve controls or by a pressure differential of a predetermined value which acts in a direction opposite to that which closed the valve.

A further object is to provide a very short compact safety valve for well flow conductors whereby the safety valve may be installed even in well flow conductors which have bends of relatively short radius.

A still further object is to provide a safety valve for installation in a well flow conductor to control flow of well fluids therethrough which includes a housing having a valve slidably mounted thereon and movable between a lower open position and an upper closed position wherein the valve is releasably held in its lower open position by a latch means engageable with the housing and with the valve.

Another object is to provide a safety valve for well flow conductors wherein the latch means is yieldably held in latching engagement with the valve seat by a resilient spring which does not bias the valve downwardly towards open position after the valve has moved to its closed position.

Still another object is to provide a safety valve for well flow conductors which is provided with sealing means for sealing between the valve and the well flow conductor whereby flow of fluids past the safety valve in the well flow conductor can take place only through the valve.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIGURE 1 is a vertical partly sectional view of the safety valve embodying the invention showing the valve in open position;

FIGURE 2 is a view similar to FIGURE 1 showing the valve of FIGURE 1 in closed position;

FIGURE 3 is a vertical partly sectional view of modified form of the safety valve showing the safety valve in open position;

FIGURE 4 is a view similar to FIGURE 3 showing the valve of FIGURE 3 in closed position; and

FIGURE 5 is a fragmentary partly sectional view showing another modified form of the safety valve.

Referring now to FIGURES 1 and 2 of the drawing, the pressure differential operated safety valve 10 includes

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a tubular housing 12 having a reduced threaded upper end portion 13 on which is secured a coupling 14 into whose upper threaded bore may be received the connector sub 15 of any suitable well tool for anchoring the safety valve in a well flow conductor and sealing between the valve and the well flow conductor above the safety valve so that flow of well fluids through the well flow conductor can take place only through the safety valve. Such well tools for anchoring the safety valve and sealing above it may be of the type manufactured by Otis Engineering Corporation, Dallas, Texas, illustrated on page 4130 and 4131 of the Composite Catalog of Oilfield Equipment and Services, 1957 edition.

The housing is provided at its lower end with a spring retainer ring 17 which is threaded thereto and provides an upwardly facing shoulder 18 longitudinally spaced from the upwardly and inwardly extending annular shoulder 19 provided by the enlarged lower portion 20 of the bore A of the housing. A valve extension 25 extends slidably through the valve housing 12 past an internal annular flange 26 of the valve housing which has an internal annular recess in which is disposed the O-ring 27 which seals between the valve extension and the valve housing. Downward movement of the valve extension in the housing is limited by a split ring 28 disposed in an external annular recess of the valve extension above the internal annular flange 26 of the valve housing. The split ring engages the upper annular shoulder of the internal flange when the valve extension is moved to the lower position illustrated in FIGURE 1.

The valve extension is enlarged intermediate its ends to provide a downwardly and outwardly extending cam shoulder 30 which engages a plurality of latch balls 31 disposed between the shoulder 30 and the inwardly and upwardly extending cam shoulder 19 of the valve housing.

The latch balls 31 are releasably held in the inner positions illustrated in FIGURE 1 wherein they prevent upward movement of the valve extension in the valve housing by a cam ring 33 which is disposed between the valve housing and the valve extension below the downwardly facing shoulder 19 of the valve housing. The cam ring has a downwardly and inwardly sloping annular cam shoulder or surface 35 which also engages the latch balls and tends to hold them in the inner latching positions illustrated in FIGURE 1. The cam ring is biased upwardly toward the latch balls and the intermediate downwardly facing shoulder 19 of the valve housing by a spring 37 whose opposite ends engage the downwardly facing annular end surface of the cam ring and the upper annular end surface of the spring compression adjusting spacer ring 38 whose opposite lower annular end surface abuts the upper end of the retainer ring 17. The upward force exerted on the cam ring 33 may be varied or adjusted by varying the thickness of the adjusting ring 38.

The lower end of the valve extension 25 is provided with a valve 40 having a downwardly and outwardly extending shoulder 41 which is adapted to engage the annular downwardly and outwardly extending valve seat 42 of the retainer ring 17, when the valve and valve extension are in the upper position illustrated in FIGURE 2, to prevent flow of fluids through the downwardly and outwardly extending flow ports 44 of the valve extension. A bean 45 is threaded in the valve extension 25 above the flow ports 44 and provides a reduced orifice 46 whose size, in conjunction with the strength of the spring 37 and the thickness of the particular adjusting ring 38 of the valve, determines the value of the upwardly acting pressure differential necessary to cause the valve extension and the valve to be moved upwardly from the open position illustrated in FIGURE 1 to the closed position illustrated in FIGURE 2.

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It will be apparent that when the upwardly acting pressure differential across the valve extension 25 and the valve reaches or exceeds the predetermined value, the upwardly acting force exerted by such pressure differential on the valve extension 25 will be of sufficient force to cause the downwardly and outwardly extending shoulder 30 of the valve housing to cam the latch balls outwardly between the downwardly facing shoulder 19 of the valve housing and the downwardly and inwardly extending cam shoulder 35 of the cam ring 33, the cam ring being cammed downwardly by the latch balls against the resistance of the spring 37 to permit such outward movement of the latch balls.

It will be apparent that such upward movement of the valve housing causes the annular shoulder 41 of the valve 40 to sealingly engage the valve seat 42 to close the flow ports 44 of the valve extension and thus prevent flow of fluids upwardly into the tubular valve extension, through the orifice of the bean 45 to the connector sub 15 and thence upwardly to the well flow conductor above any suitable sealing means of the anchoring tool by means of which the safety valve is secured in the well flow conductor.

When the increase in the pressure differential across the safety valve has caused the valve to move to the upper position illustrated in FIGURE 2, spring 37 exerts no force which would tend to move the valve extension downwardly relative to the valve housing since the latch balls 31 now engage the outer surface of the valve extension below the downwardly and outwardly extending annular cam shoulder 30 of the valve housing.

If it then is desired to again move the valve 40 to its open position after the upwardly acting pressure differential across the safety valve has been equalized a suitable tool may be lowered by means of a flexible line to engage the valve extension and move it downwardly until the cam shoulder 30 thereof is again positioned below the downwardly facing shoulder 19 of the housing whereupon the force exerted by the spring 37 moves the cam ring 33 upwardly and the latch balls are cammed inwardly by the downwardly and inwardly extending cam shoulder 35 of the cam ring to their latching positions illustrated in FIGURE 1.

Alternatively, fluid under pressure may be introduced through the connector sub 15 into the valve to create a pressure differential which exerts a downwardly acting force on the valve extension and the valve and moves the valve extension downwardly from its closed position illustrated in FIGURE 2 to the open position illustrated in FIGURE 1. With the latch balls again in their inner latching positions illustrated in FIGURE 1, the valve extension again will remain open until an upwardly acting pressure differential occurs having a predetermined value which is of sufficient force to cause the latch balls 31 to again be cammed outwardly by the downwardly and outwardly extending cam shoulder 30 of the valve extension whereupon the valve extension again will move with a snap action into its closed position. When the balls are moved out of engagement with the latch surface 30, the spring does not oppose any further upward movement of the valve extension 25 and permits such snap action closing.

It will now be apparent that the safety valve illustrated in FIGURES 1 and 2 includes a tubular housing in which a tubular valve extension 25 is slidably mounted for limited longitudinal movement, that the valve extension is provided with flow ports 44 which communicate with the exterior of the valve extension when the valve housing is in its lower open position and that such flow ports 44 are closed from communication with the exterior of the valve housing when the valve extension is moved upwardly in the valve housing and the shoulder 41 of the valve 40 engages the valve seat 42.

It will further be seen that the valve extension is maintained in its open position by a latch means, such as a

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plurality of latch balls which are held in their inner latching positions whereby they engage a downwardly facing shoulder of the valve housing and the upwardly facing cam shoulder 30 of the valve extension to limit upward movement of the valve extension in the valve housing.

It will further be seen that the cam ring 33 which holds the latch balls 33 in their inner latching position is biased upwardly by a spring 37 whose force may be varied by varying the thickness of the adjusting ring 38.

It will further be seen that upon the occurrence of an upwardly acting pressure differential of a predetermined value across the valve, the cam shoulder moves the latch balls outwardly whereupon the latch balls and the spring no longer exert any force which would tend to prevent upward movement of the valve extension and of the valve to their upper closed position whereby a snap closing action of the valve is obtained.

It will further be seen that the spring of the valve does not exert any downwardly biasing force on the valve extension and valve which would tend to move the valve downwardly to open position once the valve has moved to its closed position.

It will thus be apparent that due to the snap action provided by the combination of the upwardly biased cam ring and the latch balls 31 there is no tendency for excessive wear of the surface 41 and the valve seat 42 due to particles carried by the fluids flowing therepast. Such wear would tend to occur if the valve extension moved upwardly slowly whereby the velocity of flow of the fluids which would increase as the pressure differential increased if the valve extension and the valve 40 moved slowly toward their closed position.

The valve seat 42 and the sealing surface 41 of the valve may be spaced far apart when the valve is in open position, and thus not subject to rapid flow of fluids thereacross, due to the provision of a latch means which provides a snap action closing of the valve.

It will further be seen that the bean 45 may be provided with an orifice 46 of any suitable cross-sectional area to provide for the proper rate of flow of well fluids through the safety valve.

Referring now to FIGURES 3 and 4 of the drawing, the valve 50 includes a tubular housing 51 reduced at its upper end to provide an upwardly facing shoulder 52 which limits downward movement of the seal assembly 53 disposed on the tubular housing. A seal retainer ring 55 is threaded on the upper end of the tubular housing 51 and its lower end limits upward movement of the seal assembly 53 of the tubular housing. The retainer ring 55 may be secured against rotational movement on the tubular housing by a set screw 56. The retainer ring may also be provided with an internal flange 57 by means of which any suitable locking device may be attached to the safety valve.

The lower spring retainer ring 58 supports the compression adjusting ring 59 which adjusts the force exerted by the spring 60 on the cam ring 62 disposed in the tubular housing below the downwardly and outwardly extending shoulder 63 thereof. The latch balls 65 are adapted to engage the downwardly facing shoulder 63 of the tubular housing and the downwardly and outwardly extending cam shoulder 66 of the tubular valve extension 67 to releasably latch or hold the valve extension and its valve 70 in the lower open position illustrated in FIGURE 3 wherein the flow ports 72 of the valve extension are in communication with the exterior of the tubular housing since the downwardly and outwardly extending shoulder 73 of the valve 70 is now spaced from the valve seat 74 provided on the spring retainer ring 58.

A bean 77 is secured in the valve extension by a screw 78 which is disposed in the aligned threaded bores in the bean 77 and in the valve extension. The valve extension may be provided with a downwardly facing internal annular shoulder 80 which engages the upper end of the

bean to prevent any upward movement of the bean in the bore of the valve extension. The bean may be provided with an external annular recess in which the O-ring or other sealing means 32 may be disposed to seal between the bean and the valve extension. The bean of course is provided with an orifice 85 of any suitable cross-sectional area.

The valve extension 67 adjacent its upper end is provided with a split ring 87 received in an annular external recess of the valve extension which engages the upwardly facing shoulder of the internal flange 88 of the valve housing to limit downward movement of the valve extension in the tubular housing. An O-ring 90 or other suitable sealing means is disposed in an internal annular recess of the internal flange 88 to seal between the valve extension and the valve housing 51.

It will now be apparent that the valve 50 functions in exactly the same manner as the safety valve 10 illustrated in FIGURES 1 and 2 to prevent flow of well fluids there-through upon the occurrence of a pressure differential which exceeds a predetermined value and that the valve 70 closes with a snap action due to the camming action of the downwardly and outwardly extending cam shoulder 66 of the valve extension with the latch balls 65.

It will further be seen that the valve 50 is provided with sealing means 53 for sealing between the tubular housing and any well flow conductor in which the valve is disposed to prevent flow of fluids between such well flow conductor and the tubular housing whereby flow of fluids can take place only through the flow port 72, the valve extension and the orifice 85 of the bean 77.

In FIGURE 5 is illustrated a modified form of the valve wherein the spring retainer ring 58a is provided with an internal recess in which is disposed an O-ring 95 which seals between the retainer ring and the valve extension 67a below the flow ports 72a. The O-ring 95 may be provided to prevent leakage between the valve surface 73a and the valve seat 74a when the valve is in its closed position and thus give added protection against the cutting action of particles which may be carried by any fluids leaking between the valve and the valve seat. The bean 77a is shown locked in position in the valve extension 67a by a snap ring 96 which is received in aligned external and internal recesses, respectively, of the bean 77a and the valve extension.

It will now be seen that in both forms of the safety valve illustrated and described the valve closes with a snap action so that the closing action between the valve seat and the valve is of very short duration and the seating surfaces thereof are therefore not subjected to the cutting action of abrasive particles carried in the fluids flowing therebetween for a relatively long period of time during the closing movement of the valve towards the valve seat.

It will further be seen that the spring 60 which biases the cam ring toward engagement with the latch balls is subjected to only very slight additional compression when the valve closes so that a suitable range of adjustment of the force exerted on the cam ring by the spring may be provided with a very short spring, such adjustment being obtained by varying the thickness of the adjusting ring. Since the spring may be very short, the total length of the safety valve may be quite short to permit its use in well flow conductors in relatively inaccessible locations which must be reached by movement of the safety valve through well flow conductors having relatively short radius bends.

It will further be seen that once the safety valves illustrated and described have closed due to the occurrence of a predetermined upwardly acting pressure differential thereacross, the valves will not open of themselves since the springs thereof exert no downwardly biasing force on the valve extension once the valves have been moved to closed positions and it is necessary to move the valves to their lower positions by the use of suitable well tools

or by creating a downwardly acting pressure on the valves, as with a pump pressure.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A valve including: an elongate tubular housing; an annular valve seat on said housing; an elongate tubular valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through said housing, said tubular valve means having communication at one end with the bore of the housing on one side of said valve seat and at the other end with the exterior of the housing on the opposite side of said valve seat, said other end of said valve member having a closure head thereon spaced longitudinally outwardly away from said seat beyond the communication of said valve member with the exterior of said housing, said closure head being engageable with said seat to close off flow of fluids through the housing; means carried by and movable with said valve means for providing a differential in fluid pressure acting on said valve means as a result of fluids flowing through said housing; and latch means engageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions.

2. A valve including: an elongate tubular housing; an annular valve seat on said housing; an elongate tubular valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through said housing, said tubular valve means having a flow passage therein communicating at one end with the exterior of the housing on one side of said seat and at its other end with the bore of the housing on the opposite side of said seat when said valve member is in an open position; a valve closure means on said tubular valve means spaced longitudinally outwardly thereon from the valve seat beyond said one end of said flow passage of said valve means and movable with said valve means into engagement with said valve seat for closing off flow of fluids through the housing; means carried by and movable with said valve means for providing a differential in fluid pressure acting on said valve means as a result of fluids flowing through said housing; and latch means engageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions, said latch means including oppositely facing shoulders on said valve means and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position, and means releasably holding said movable means between said shoulders.

3. A valve including: an elongate tubular housing; a valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through the valve housing; and latch means en-

gageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions, said latch means including oppositely facing shoulders on said valve means and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position, and means releasably holding said movable means between said shoulders, said holding means for said movable means including a cam means engageable with said movable means and resilient means biasing said cam means toward said movable means.

4. A valve including: an elongate tubular housing; a valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through the housing; and latch means engageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions, said latch means including oppositely facing shoulders on said valve means and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position, and means releasably holding said movable means between said shoulders, said holding means for said movable means including a cam means engageable with said movable means and resilient means biasing said cam means toward said movable means, said cam means having an upwardly and outwardly extending cam shoulder, said shoulders of said latch means on said valve means and on said housing each extending inwardly and upwardly.

5. A valve including: an elongate tubular housing; a valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through the housing; and latch means engageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions, said latch means including oppositely facing shoulders on said valve means and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position, and means releasably holding said movable means between said shoulders, said holding means for said movable means including a cam means engageable with said movable means and resilient means biasing said cam means toward said movable means, said cam means having an upwardly and outwardly extending cam shoulder, said shoulder of said latch means on said housing extending inwardly and upwardly, said resilient means engaging said housing and said cam means and biasing said cam means toward said shoulder of said housing.

6. A valve including: a tubular housing having a valve

seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve means coengageable for limiting movement of said valve means from closed position toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means.

7. A valve including: an elongate tubular housing; an annular valve seat on said housing; an elongate tubular valve means mounted on said housing and movable between open and closed positions for controlling flow of fluids through said housing, said valve means having a flow passage therein communicating at one end with the exterior of the housing on one side of said seat and at its other end with the bore of the housing on the opposite side of said seat when said valve means is in an open position; a valve closure means on said valve means spaced longitudinally outwardly thereon from the valve seat beyond said one end of said flow passage of said valve means and movable with said valve means into engagement with said valve seat for closing off flow of fluids through the housing, means carried by and movable with said valve means for providing a differential in fluid pressure acting on said valve means as a result of fluids flowing through said housing; and latch means engageable with said valve means and said housing for releasably holding said valve means in said open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve means having means engageable with said latch means upon movement of said valve means from open toward closed position for holding said latch means in released position wherein said latch means is ineffective to restrain movement of said valve means between said open and closed positions, said tubular housing having means thereon adapted to be connected with an anchoring device for releasably securing said housing in a well flow conductor, said housing having thereon external seal means engageable with said flow conductor when said valve is disposed therein for directing flow through said housing.

8. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing engageable with said valve means limiting movement of said valve means between open and closed positions; latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means; and means in said flow passage of said valve extension restricting the effective orifice of said flow passage.

9. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below

said valve seat when said valve means is in open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said valve extension and said housing having coengageable means limiting movement of said valve means from said closed position toward said open position.

10. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when means on said housing and said valve means engageable to limit movement of said valve means from closed toward open position; said valve means is in open position; latch means engageable with said valve extension and said housing for releasably holding said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means; and seal means for sealing between said valve extension and said housing below said one end of said flow passage when said valve means is in closed position.

11. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve extension engageable to limit movement of said valve means from closed toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position and means releasably holding said movable means in an inner position between said shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing.

12. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve means engageable with each other to limit movement of said valve means toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve mean in said open position and means releasably holding said movable means in an inner position between said

shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing, said holding means for said movable means including a cam means engageable with said valve means for holding said movable means in said inner position, and resilient means biasing said cam means toward said movable means.

13. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve means limiting movement of said valve means toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position and means releasably holding said movable means in an inner position between said shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing, said holding means for said movable means including a cam means engageable with said movable means for holding said movable means in said inner position, and resilient means biasing said cam means toward said movable means, said cam means having an upwardly and outwardly facing cam shoulder engageable with said movable means, said shoulders of said latch means on said valve extension and said housing each extending inwardly and upwardly.

14. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve extension co-engageable for limiting movement of said valve means toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position and means releasably holding said movable means in an inner position between said shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing, said holding means for said movable means including a cam means engageable with said movable means for holding said movable means in said inner position, and resilient means biasing said cam means toward said movable means, said resilient means being dis-

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posed in and engaging said housing and biasing said cam means toward said shoulder of said housing.

15. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve means co-engageable to limit movement of said valve means toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve means in said open position and means releasably holding said movable means in an inner position between said shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing, said holding means for said movable means including a cam means engageable with said movable means for holding said movable means in said inner position, and resilient means biasing said cam means toward said movable means, said resilient means being disposed in and engaging said housing and biasing said cam means toward said shoulder of said housing, said movable means being a plurality of balls.

16. A valve including: a tubular housing having a valve seat; a valve means having an extension telescoping into said tubular housing, said valve means being movable in one direction from an open position toward said valve seat to closed position for sealing engagement therewith, said valve extension having a flow passage having one end communicating with the exterior of the housing below said valve seat when said valve means is in open position; means on said housing and said valve extension co-engageable to limit movement of said valve means toward open position; and latch means engageable with said valve extension and said housing for releasably holding said valve means in open position, said latch means releasing said valve means for movement to closed position upon the occurrence of a predetermined pressure differential across said valve means, said latch means including oppositely facing shoulders on said valve extension and said housing, movable means positioned between and engaging said shoulders to hold said valve

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means in said open position and means releasably holding said movable means in an inner position between said shoulders, said movable means moving into an outer position out of engagement with said shoulder of said valve extension upon the occurrence of said predetermined pressure differential across said valve means to permit movement of said valve extension in said one direction in said tubular housing, said holding means for said movable means including a cam means engageable with said movable means for holding said movable means in said inner position, and resilient means biasing said cam means toward said movable means, said resilient means being disposed in and engaging said housing and biasing said cam means toward said shoulder of said housing, said movable means being a plurality of balls, said cam means being an annular member disposed about said valve extension and in said housing.

17. A valve including: a tubular housing having means for releasably securing it within a well flow conductor and having a bore with a valve seat in said bore; a tubular valve member slidable in said housing and having a valve closure means thereon movable in one direction from an open position toward said valve seat to closed position in engagement with said seat for closing off flow therethrough, the bore of said tubular valve member providing a flow passage communicating at one end with the exterior of the housing below said valve seat and at its other end with the bore of the housing above said seat when said valve member is in an open position; means on said housing engageable with said valve member limiting movement of said valve member between open and closed position; latch means engageable with said valve member and said housing for releasably holding said valve member in an open position, said latch means releasing said valve means for movement to closed position upon the application of a predetermined fluid pressure differential across said valve member; and means in the flow passage of said tubular valve member providing for the creation of a fluid pressure differential to said movable valve member as a result of fluids flowing through said valve member to cause actuation of said valve member to move the same from open to closed position.

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