

Oct. 13, 1953

E. W. BAGNELL

2,655,217

FLOW REGULATING DEVICE

Filed Sept. 4, 1951

2 Sheets-Sheet 1

FIG. 1

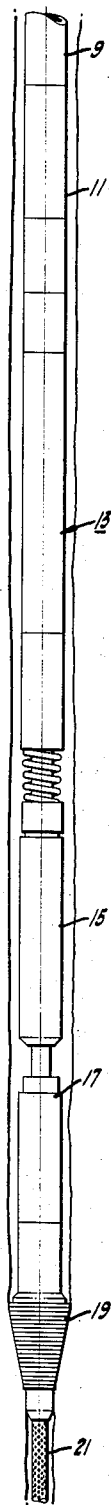
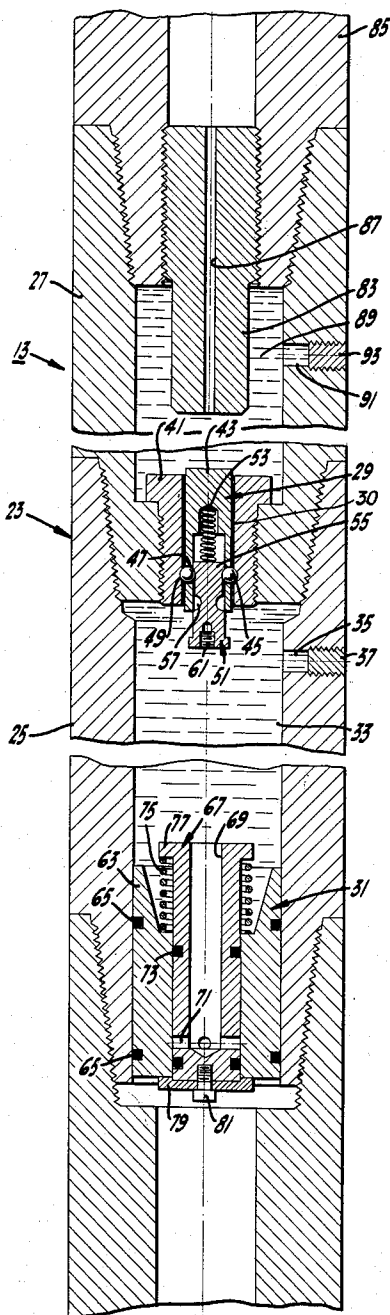


FIG. 2



INVENTOR.
EDGAR W. BAGNELL

BY

Mellin and Hausman
ATTORNEYS

Oct. 13, 1953

E. W. BAGNELL

2,655,217

FLOW REGULATING DEVICE

Filed Sept. 4, 1951

2 Sheets-Sheet 2



INVENTOR.
EDGAR W. BAGNELL

BY

Mellin and Houscorn
ATTORNEYS

UNITED STATES PATENT OFFICE

2,655,217

FLOW REGULATING DEVICE

Edgar W. Bagnell, Glendale, Calif., assignor, by
mesne assignments, to Johnston Testers, Inc.,
Houston, Tex., a corporation of Delaware

Application September 4, 1951, Serial No. 244,922

10 Claims. (Cl. 166—1)

1

This invention relates to an oil well tool and particularly to a flow regulator device adapted to be incorporated in a drill string or the like.

A main object of the present invention is to provide an improved flow regulator device.

Another object of the present invention is to provide a flow regulator device adapted to be incorporated in a formation tester to retard the flow of formation fluid upwardly through the formation tester, when making a test, to avoid the harmful effects of uncontrolled and unregulated flow, well known to those skilled in the art.

A more particular object of the present invention is to provide a flow regulator device having a tubular housing within which is disposed a floating piston closing the housing at one end, and which housing has a knockout valve closing its opposite end adapted to be knocked out by the piston when the piston is forced toward the knockout valve by the pressure of the formation fluid.

Various other objects of the present invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 shows a formation tester having the flow regulator device of the present invention incorporated therein.

Fig. 2 is an enlarged cross-sectional view through the flow regulator device and showing the parts in the positions they assume when the formation tester is run into the well.

Fig. 3 is a view similar to Fig. 2 and showing the floating piston as having been moved into engagement with the knockout valve.

Fig. 4 is a view similar to Fig. 3 and showing a further stage in the operation of the device, particularly showing the knockout valve as having been knocked out and the valve in the piston as being open.

The particular embodiment of the present invention shown in the drawings will be described as being incorporated in a standard formation tester of the type set out in the patent to M. O. Johnston—2,073,107, granted March 9, 1937. However, the invention is not intended to be limited by this description which is only intended to show a practical application of the flow regulator device of the present invention.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, Fig. 1 shows a formation tester connected to the lower end of a drill string 9, the formation tester including a trip valve assembly 11, a flow regulator device em-

2

bodily the concepts of the present invention generally entitled 13, a retaining valve assembly 15, an equalizer valve assembly 17, and a packer 19. Below the packer 19 is an anchor 21 into which the formation fluid flows into the formation tester. Packer 19 is effective, when seated in the well bore, to close off the well bore so that the selected formation zone is isolated and separated from the space above the packer. The formation tester will be normally operated as follows. The formation tester, with the equalizer valve open, is run into the well and the packer 19 set to seal off the formation zone from the space above the packer and thereafter the equalizer valve is first closed and then the retaining and trip valves are opened to allow the formation fluid to flow upwardly and be effective against the flow regulator device 13. The flow regulator device 13 retards the flow of the formation fluid which may be under considerable pressure and therefore the harmful effects of uncontrolled and unretarded flowing fluid is avoided. The trip valve 11 is then tripped by dropping a go-devil down the drill string to allow formation fluid to flow upwardly into the drill string.

The flow regulator device 13, which is best disclosed in Figs. 2, 3 and 4, comprises a housing generally entitled 23 composed of a tubular housing member 25 threadedly connected at its upper end to the lower end of sub 27. In general terms, the flow regulator device includes a knockout valve assembly, generally entitled 29, closing housing 23 adjacent the upper end thereof and a floating piston assembly 31 closing housing 23 adjacent the lower end thereof. The space between the knockout valve assembly 29 and the floating piston assembly 31 is filled with a suitable fluid such as water or the like 33 through an opening 35 closed by a pipe plug 37.

The knockout valve assembly 29 includes an orifice or bleed passageway to be described more in detail hereinafter to permit fluid 33 to be slowly forced through the knockout valve assembly when the floating piston assembly is forced toward the knockout valve assembly 29 under the influence of formation fluid pressure made effective thereagainst by opening of the trip valve. Such slow leakage of fluid obviously retards the movement of the piston and therefore retards the flow of the formation fluid. As will be explained hereinafter, after contact of the floating piston assembly with the knockout valve assembly, a more generous but still restricted passage is provided for the upward flow of formation fluid through the knockout valve assembly.

More in particular, the knockout valve assembly

29 comprises a nipple 41 threadedly received within the lower end of sub 27 and having a central bore within which is received a hollow knockout valve 43 which has an external diameter slightly less than the internal diameter of the central bore of nipple 41 to provide a bleed passageway between the knockout valve 43 and the nipple 41.

The knockout valve 43 is releasably held in closed position, the position shown in Fig. 2, by a plurality of balls 45 receivable within openings 47 provided in the walls of valve 43 and within an annular groove 49 provided around the central bore of nipple 41. Balls 45 are of such dimensions that they protrude inwardly beyond the central bore of valve 43 to serve to retain and suspend a spring-loaded plug 51 within valve 43. Spring-loaded plug 51 is urged downwardly by a compression spring 53 and has an enlarged end 55 fitting the bore of valve 43 and engaging the inwardly protruding portions of balls 45, whereby the spring loaded plug is prevented from being forced out of the knockout valve 43 under the influence of spring 53.

Plug 51 has an annular groove 57 therearound to receive balls 55 when the plug is forced upwardly and therefore unlock the valve 43 from the nipple 41 and allow the valve to be knocked out of the nipple and to thereby clear the nipple for the passage of fluid therethrough.

In order to permit assemblage of the knockout valve assembly 29, the plug 51 is provided with a threaded bore 61 to enable a pull-out tool to be inserted into the plug. When the knockout valve assembly is being initially assembled, the balls 45 are positioned within the annular groove 57 to allow the plug and balls to be moved into the nipple 41 and to register the balls with the annular groove 49 on nipple 41. Thereafter, through the medium of the pull-out tool, plug 51 is pulled outwardly to cam the balls into the annular groove 49, the balls as previously mentioned still protruding slightly inwardly of the central bore of the valve 43 to retain the knockout plug against complete withdrawal movement from the valve.

The floating piston assembly 31 includes a floating piston 63 having O rings 65 thereabouts disposed in sealing engagement with the interior of tubular housing member 25 to prevent the leakage of fluid past the exterior of the piston 63. Piston 63 is centrally bored to receive a piston valve 67 which in turn is provided with a central bore 69 and radial ports 71 to permit passage of fluid through the floating piston when the valve is moved downwardly to project the lower end of valve 67 beyond the lower end of the floating piston and expose radial ports 71.

Piston valve 67 on the exterior thereof carries O rings 73 disposed in sealing engagement with the interior of floating piston 63 to prevent the passage of fluid through the floating piston until the valve is moved to an open position.

As shown in Fig. 2, the piston valve 67 is urged to closed position by a compression spring 75 disposed between piston 63 and a flange 77 formed on the upper end of piston valve 67, said piston valve being limited in its upward movement by a cap 79 secured to the lower end of the piston valve by a screw 81 or equivalent means.

Above the knockout valve assembly there is preferably provided a flow bean valve 83 threadedly received by a sub 85 and having a central restricted passageway 87 through which fluid is adapted to flow in a regulated manner. The

space between the trip valve 11 and the knockout valve assembly 29 is filled with a fluid 89 through an aperture 91 closed by a pipe plug 93.

The operation of the device is as follows: After the packer 19 has been set, retaining valve 15 and trip valve 11 are opened and the formation fluid entering anchor 21 flows up into the formation tester, through the retaining valve 15 to the flow regulator device 13. Prior to the opening of retaining valve 15, it is obvious that the floating piston assembly 31 will remain in its lower position adjacent the lower end of housing 23. When subjected to the pressure of the formation fluid, however, the floating piston assembly 31, having its piston valve 67 closed, moves upwardly under the influence of the formation fluid pressure thereby forcing the fluid 33 between the floating piston assembly 31 and the knockout valve assembly 29 through the orifice or bleed passageway 30 between the valve 43 and the nipple 41. This obviously results in a relatively slow upward movement of floating piston assembly 31.

When the floating piston has been moved to the position shown in Fig. 3, valve 67 will strike the spring loaded plug 51, moving the plug upwardly, compressing spring 53, spring 75 being stronger than spring 53, to register the annular groove 57 in spring loaded plug 43 with balls 45, balls 45 moving into the annular groove and therefore releasing knockout valve 43. The continued upward force of the floating piston assembly 31 serves to knock out valve 43 as shown in Fig. 4.

As is obvious from Fig. 2, the piston valve 67 protrudes beyond the upper end of the floating piston 63. Therefore, upon continued further upward movement of the piston assembly 31, valve 67 is moved downwardly by its engagement with the arrested plug 51, compressing spring 75 and causing the lower end of piston valve 67 to project below piston 63 to expose ports 71, therefore opening the valve. The ports 71 are somewhat of a restricted nature so that uncontrolled and unregulated flow of the formation fluid is still not allowed but a substantial flow is permitted.

The flow bean valve 83 additionally serves to retard, control and regulate the upward flow of fluid.

By the present invention, it will be appreciated that a flow regulator device has been provided wherein the accurate control and regulation of fluid and/or gas under pressure can be achieved.

While I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. An oil well regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe or the like, a floating piston means slidably mounted within said housing and adapted to be forced in one direction along the housing, and means carried by the housing spaced from said piston means in said one direction, closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve openable upon engagement of the piston means and said second named means to allow free flow of fluid through said second named means, said piston

5

means including a valve openable upon engagement between said piston means and said second named means to allow free flow of fluid through said piston means.

2. An oil well regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe or the like, a floating piston means slidably mounted within said housing and adapted to be forced in one direction along the housing, and means carried by the housing spaced from said piston means in said one direction, closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve openable upon engagement of the piston means and said second named means to allow free flow of fluid through said second named means, a restricted passageway communicating with the space between the piston means and the second named means permitting the slow escape of fluid from said space during movement of the piston means toward second said means to retard movement of said piston means, said piston means including a valve openable upon engagement between the piston means and said second named means to allow free flow of fluid through said piston means.

3. An oil well regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe or the like, a floating piston means slidably mounted within said housing and adapted to be forced in one direction along the housing, and means carried by the housing spaced from said piston means in said one direction, closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve openable upon engagement of the piston means and said second named means to allow free flow of fluid through said second named means, a body of liquid in the space between the piston means and said second named means, a restricted passageway communicating with said space permitting the slow escape of liquid therefrom during movement of the piston means toward said second named means, said piston means including a valve openable upon engagement between said piston means and said second named means to allow free flow of fluid through said piston means.

4. An oil well regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe or the like, a floating piston means slidably mounted within said housing and adapted to be forced in one direction along the housing, and means carried by the housing spaced from said piston means in said one direction, closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve openable upon engagement of the piston means and said second named means to allow free flow of fluid through said second named means, a restricted passage way through said second named means permitting the slow escape of fluid from the space between the piston means and said second named means during the movement of the piston means, said piston means including a valve openable upon engagement between the piston means and said second named means to allow free flow of fluid through said piston means.

5. An oil well regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe or the like, a floating piston means slidably mounted within said housing and adapted to be forced in one direction along the housing, and means carried by the

6

housing spaced from said piston means in said one direction, closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve openable upon engagement of the piston means and said second named means to allow free flow of fluid through said second named means, a body of liquid in the space between said piston means and said second named means, a restricted passageway through said second named means permitting the slow escape of liquid from said space during movement of the piston means toward the second named means to retard movement of said piston means, said piston means including a valve openable upon engagement between the piston means and said second named means to allow the free flow of fluid through said piston means.

6. An oil well flow regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe, a floating piston means slidably mounted within said housing and adapted to be forced in one direction therealong, and means carried by said housing, spaced from said piston means in one direction, and closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve arranged to engage the piston means upon engagement between the piston means and said second named means and openable upon its engagement with said piston means to allow the free flow of fluid through said second named means, said piston means including a valve arranged to be engaged by the second named means upon engagement between the piston means and said second named means and openable upon its engagement with said second named means to allow the free flow of fluid through said piston means.

7. An oil well flow regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe, a floating piston means slidably mounted within said housing and adapted to be forced in one direction therealong, and means carried by said housing, spaced from said piston means in said one direction, and closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve arranged to engage the piston means upon engagement between the piston means and said second named means and openable upon its engagement with said piston means to allow the free flow of fluid through said second named means, a restricted passageway communicating with the space between the piston means and the second named means permitting the slow escape of fluid from said space during movement of the piston means toward the second named means to retard movement of the piston means, said piston means including a valve arranged to engage the second named means upon engagement between the piston means and the second named means and openable upon its engagement with the second named means to allow the free flow of fluid through said piston means.

8. An oil well flow regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe, a floating piston means slidably mounted within said housing and adapted to be forced in one direction therealong, and means carried by said housing, spaced from said piston means in said one direction, and closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve arranged to engage the

piston means upon engagement between the piston means and said second named means and openable upon its engagement with said piston means to allow the free flow of fluid through said second named means, a body of liquid in the space between said piston means and said second named means, a restricted passageway communicating with said space permitting the slow escape of the liquid therefrom during movement of the piston means toward the second named means to retard movement of the piston means, said piston means including a valve arranged to engage the second named means upon engagement between the piston means and the second named means and openable by its engagement with said second named means to allow free flow of fluid through said piston means.

9. An oil well flow regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe, a floating piston means slidably mounted within said housing and adapted to be forced in one direction therealong, and means carried by said housing, spaced from said piston means in said one direction, and closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve arranged to engage the piston means upon engagement between the piston means and said second named means and openable upon its engagement with said piston means to allow the free flow of fluid through said second named means, a restricted passageway through said second named means permitting the slow escape of fluid from the space between the piston means and said second named means during movement of the piston means toward the second named means to retard movement of the piston means, said piston means including a valve arranged to engage the second named means upon engagement between the piston means and the

second named means and openable by its engagement with the second named means to allow free flow of fluid through said piston means.

10. An oil well flow regulator device, comprising a tubular housing adapted to be incorporated in a supporting string of pipe, a floating piston means slidably mounted within said housing and adapted to be forced in one direction therealong, and means carried by said housing, spaced from said piston means in said one direction, and closing the interior of the housing at its location to the passage of fluid thereby, the second named means including a valve arranged to engage the piston means upon engagement between the piston means and said second named means and openable upon its engagement with said piston means to allow the free flow of fluid through said second named means, a body of liquid in the space between the piston means and said second named means, a restricted passageway through said second named means permitting the slow escape of liquid from said space during movement of the piston means toward the second named means to retard movement of the piston means, said piston means including a valve arranged to engage the second named means upon engagement between the piston means and said second named means and openable upon its engagement with said second named means to allow free flow of fluid through said piston means.

EDGAR W. BAGNELL.

References Cited in the file of this patent UNITED STATES PATENTS

Number	Name	Date
2,034,768	O'Neill	Mar. 24, 1936
2,092,062	Halliburton	Sept. 7, 1937
2,227,192	Losey, Jr.	Dec. 31, 1940
2,489,397	Brummer	Nov. 29, 1949