ABSTRACT: The invention relates to adjustable bottom hole flow beads used in petroleum industry, mainly in flow production for controlling the flow of fluid from the hole.

The invention consists in that the hydraulic mechanism for controlling an element serving to vary the bean flow area is arranged directly in the flow bean body and made as a piston with a conduit communicated with the hole space and accommodating a nonreturn valve, and a means adapted to turn the element serving to vary the bean flow area, with which means the piston interacts during its displacement with the closed nonreturn valve.
TOP BOTTOM HOLE FLOW BEAN

The present invention relates to adjustable bottom hole flow beans used in petroleum industry, namely in the course of flow production for controlling the flow of fluid from the hole.

There is known an adjustable bottom hole flow bean mountable on a flow column and comprising a hollow body adapted for the passage of fluid from the hole, an element serving to vary the flow area and a piston-type hydraulic mechanism for controlling the latter element (cf., U.S. Pat. No. 2,033,563).

The adjustable bottom hole flow bean in accordance with the above-cited patent is to be mounted in the hole on two flow columns inserted one into the other. The side surface of the bean body is provided with openings serving to communicate the flow bean with the hole and arranged on a spiral so as to be capable of being successively closed by the element serving to vary the flow area. The latter element is essentially a piston whose position and, consequently, the flow area, are controlled by means of a hydraulic control mechanism arranged below the element and connected thereto, said control mechanism being made as a spring-biased piston of a larger diameter while the chamber below this piston communicates with the circular intercolumn space.

Reservoir fluid is brought up along the inner column communicating with the internal space of the flow bean. The pressure required to keep the spring-biased piston in a fixed position is maintained in the intercolumn space with the aid of a device arranged on the surface.

However, when using the known bottom hole flow bean, one of the flow columns is employed only for forming the intercolumn space and, therefore, to bring the fluid up to the surface a double amount of flow columns is to be used. Also, the operation of said flow bean is insufficiently reliable, for the smallest violation of the intercolumn space sealing impedes the flow bean operation. In addition, when using this type of flow bean, it is impossible to accurately determine the number of exposed openings serving to communicate the flow bean with the hole.

It is an object of the present invention to provide an adjustable bottom hole flow bean whose operation would require a reduced consumption of tubing.

It is another object of the invention to provide a flow bean that would be more reliable in operation.

Other objects and advantages of the invention will become apparent from the following description of an exemplary embodiment thereof.

In order to accomplish said and other objects of the present invention, in a bottom hole flow bean adapted to control the flow of fluid from the hole, mountable on a flow column and comprising a hollow body through which, as well as through the tubing, the hole space communicates with the surface, the element serving to vary the flow area and a piston-type hydraulic mechanism for controlling the latter element, according to the invention, said control mechanism is arranged directly in the flow bean body and is essentially a hollow piston with a conduit communicating with the hole space and closed by a nonreturn valve under the action of a hydraulic pulse, said piston performing progressive movement under the action of said pulse and cooperating with a device adapted to turn the element serving to vary the flow area.

It is expedient that the device adapted to turn the element be made as a spring-biased bushing adapted to be coupled with the piston by means of a ratchet mechanism when the hydraulic pulse is acting thereupon and a casing with the side spiral slots, both said bushing casing being coaxially arranged and interconnected with the aid of a pin secured in the bushing, fitted into side spiral slots of the casing and capable of turning the casing, when the bushing moves under the piston action, through an angle defined by the spiral slot, while the element serving to vary the flow area be made as a disk with calibrated opening, secured on the shank of the casing and turnable together therewith.

The present invention has resulted in the development of an adjustable bottom hole flow bean which features an improved reliability in operation and allows to effect the control over the hydraulic pulse as well as to bring the fluid up to the surface via a single flow column on which said bean is mounted.

Now the present invention will be described in detail by way of a preferred embodiment thereof with reference to the accompanying drawings, wherein:

FIG. 1 is a longitudinal section of an adjustable bottom hole flow bean according to the present invention;
FIG. 2—ditto, bottom view; and
FIG. 3 illustrates diagrammatically the arrangement of the adjustable bottom hole flow bean, according to the present invention, in a field well.

A bushing 2 is press-fitted in a body 1 (FIGS. 1, 2, 3) said bushing accommodating therewithin a piston 3 with sealings 4, said piston and bushing being made as a spring-biased piston of a larger diameter while the chamber below this piston communicates with the circular intercolumn space.

Reservoir fluid is brought up along the inner column communicating with the internal space of the flow bean. The pressure required to keep the spring-biased piston in a fixed position is maintained in the intercolumn space with the aid of a device arranged on the surface.

However, when using the known bottom hole flow bean, one of the flow columns is employed only for forming the intercolumn space and, therefore, to bring the fluid up to the surface a double amount of flow columns is to be used. Also, the operation of said flow bean is insufficiently reliable, for

The piston 3 has a central circuit 5 capable of being closed by a nonreturn valve 6 provided with a plugging member in the form of a ball 7 and the valve seat 8 with respect to which said ball is displaced. The piston 3 is provided with a longitudinally extending groove 9 adapted to receive a pin 10 secured in the bushing 2 and designed to preclude the rotation of the piston 3.

Arranged in the lower portion of the body is a device 11 adapted to turn an element in the form of a disk 12 (FIGS. 1, 2) having calibrated openings 13 with a view to varying the flow area of the bean.

The device 11 for turning the disk is fashioned as a coaxially arranged bushing 14 (FIG. 1) engaged with the piston 3 through the intermediary of a ratchet mechanism 15, and a casing 16. The casing is provided with side spiral slots 17 adapted to receive a pin 18 secured in the bushing 14, with ports 19 for the passage of fluid and a shank portion 20 (FIGS. 1, 2). The casing 16 accommodates a spring 21 (FIG. 1) urging the bushing 14. The casing shank portion 20 provided with a sealing 22 passes through a central opening 23 in the flow bean body bottom 24 (FIGS. 1, 2). The disk 12 with the calibrated openings 13 arranged on a circumference whose center coincides with the pivot of disk 12 is set on a square-shaped portion 25 of the shank extending from the body and coaxially therewith. The disk is urged to the bottom 24 by a spring 26 supported by a washer 27 (FIGS. 1, 2) and screwed onto thread 28 (FIG. 1) provided on the shank portion with the aid of nuts 29 (FIGS. 1, 2). The bottom 24 of the body is provided for the passage of fluid with a second opening 30 located from the pivot of the disk 12 at the same distance as the calibrated openings 13 of said disk. The side spiral slots 17 in the casing 16 serve to define the angle 45 (FIG. 2) of one turn of the disk 12. Thus, the number of the calibrated openings 13 of the disk 12 depends upon the value of the angle 45 of one turn of said disk.

The ratchet mechanism instrumental in bringing the spring-biased bushing 14 to engagement with the piston 3 is made as teeth 15 uniformly provided on the contacting end faces of the piston and the bushing, said teeth ensuring that the casing 16 turn in one direction only during the downward movement of the piston 3.

The body 1 is provided on its outer surface with an upper thread 31 (FIG. 1) and lower thread 32 for connecting said body with the flow column.

The adjustable bottom flow hole bean according to the present invention operates in the following manner.

Fluid from a productive stratum, via the opening 13 of the disk 12 which coincides with the opening 36 in the bottom 24 and, further, via the ports 19 of the casing 16, the conduit 5 of the piston 3 and side openings 33 in the valve 6, gets into a flow column 34 (FIG. 3) through which it is brought up to the surface.

It is required to vary the bean flow area the hydraulic pressure above the nonreturn valve 6 is to be increased by transmitting thereto a hydraulic pulse. When so doing, the pulse pressure should be equal to the pressure of the fluid below the calibrated opening 13 of the disk 12, which coincides with the opening 36, plus the pressure of the spring 21. When such a
pressure is reached, the ball 7 closes the conduit 5 of the piston 3 and the latter, under pressure of the fluid, goes down to its lowermost position; at the same time, the bushing 14 together with the pin 17 goes down under the action of the piston 3. Since in the course of its downward movement, the bushing 14 is by means of the ratchet mechanism 15 brought into engagement with the piston 3, while the latter is prevented from turning by a pin 10, the pin 18 serves to turn the casing 16. By the moment the piston 3 reaches the extreme lower position, the disk 12 turns through a present angle $\Phi$. Simultaneously, the next-in-succession calibrated opening of the disk 12 or plugged portion 35 (FIG. 2) thereof comes to the operating position.

After the hydraulic pulse is relieved, the piston 3 and the bushing 14 are returned by the spring 21 to the upper position, the bushing 14 at the same time turning about its own axis. The adjustable bottom hole flow bean is ready for the passage of fluid or for the subsequent variation of the bean flow area.

We claim:

1. A bottom hole flow bean for controlling the flow of fluid from the hole, mountable on a flow column and comprising: a hollow body; an element serving to vary the flow area of said flow bean; a piston with a conduit adapted to communicate with the hole space, said piston accommodated inside said hollow body; a controllable nonreturn valve accommodated in the conduit of said piston; said hollow piston adapted to perform progressive movement under the action of the hydraulic pulse after said nonreturn valve closes its conduit; a device for turning said element, interacting with said hollow piston in the course of progressive movement of the latter and to simultaneously vary the bean flow area when said nonreturn valve is closed.

2. A bottom hole flow bean as set forth in claim 1, wherein said device adapted to turn said element is made as a spring-biased bushing adapted to be coupled with the said piston by means of a ratchet mechanism when the hydraulic pulse is acting thereupon and a casing with side spiral slots, both said bushing and casing being coaxially arranged and interconnected with the aid of a pin secured in said bushing, fitted into said side spiral slots of the casing and capable of turning the casing, when said bushing moves under the action of said piston, through an angle defined by said spiral slot, while said element serving to vary the bean flow area is made as a disk with calibrated openings secured on the shank of the casing and turnable together therewith.