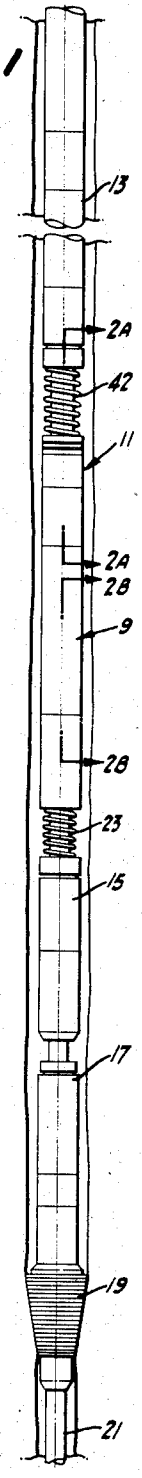
Jan. 12, 1954 M. O. JOHNSTON ET AL 2,665,758

ADJUSTABLE FLOW BEAN

Filed Sept. 11, 1951

2 Sheets-Sheet 1

FIG. 1



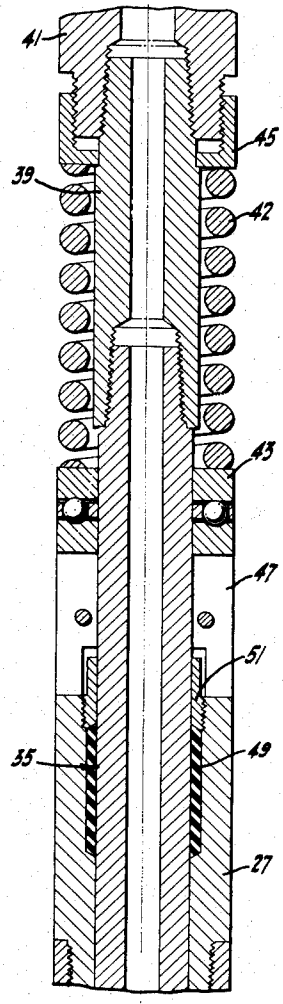


FIG. 2A

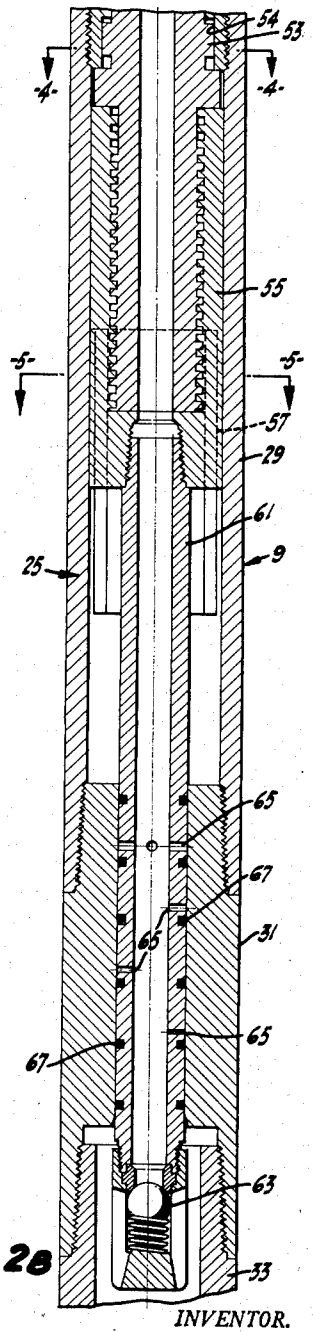


FIG. 2B

INVENTOR.
MORDICA O. JOHNSTON
HARRY C. SKIPPER

BY

Wellin and Hanson

ATTORNEYS

Jan. 12, 1954 M. O. JOHNSTON ET AL 2,665,758

ADJUSTABLE FLOW BEAN

Filed Sept. 11, 1951 2 Sheets-Sheet 2

FIG. 3

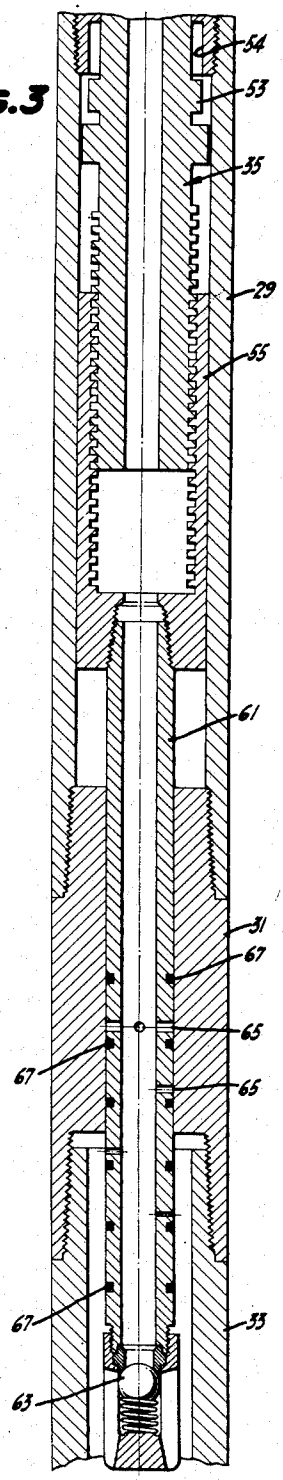
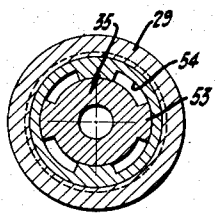


FIG. 4



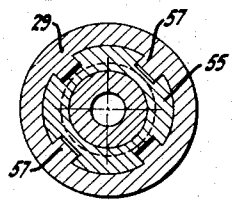


FIG. 5

INVENTORS
MORDICA O. JOHNSTON
HARRY C. SKIPPER

BY

Mellin and Hanscom
ATTORNEYS

Patented Jan. 12, 1954

2,665,758

UNITED STATES PATENT OFFICE

2,665,758

ADJUSTABLE FLOW BEAN

Mordica O. Johnston, Glendale, and Harry C. Skipper, Montrose, Calif., assignors, by mesne assignments, to Johnston Testers, Inc., Houston, Tex., a corporation of Delaware

Application September 11, 1951, Serial No. 246,086

3 Claims. (Cl. 166—1)

1

This invention relates to an adjustable flow bean.

The adjustable flow bean of the present invention will be described as being incorporated in a formation tester, but this reference is not intended to limit the invention but only to show a practical application of the present invention.

Adjustable flow beans are utilized to adjustably retard or resist the flow of fluid, frequently formation fluid from a formation zone, into a drill string or equivalent device, and usually from below a packer sealing off the bore at a point above the formation. This restricting and retarding effect eliminates the detrimental effects on the formation accompanying the sudden release of high pressure formation fluid from below a packer into a low pressure zone such as the interior of a drill string or the like, and also reduces wear and erosion on the formation tester or drill string or equivalent device.

A main object of the present invention is to provide an adjustable flow bean which can be incorporated in a formation tester or other suitable oil well tool or drill string, and which adjustable flow bean, though being operated by relative rotation between the drill string carrying the upper part of the flow bean assembly and the lower fixed part of the flow bean assembly, is releasably locked against rotative movement so that a rotative drive may be established through the adjustable flow bean before or after the flow bean is put into operation.

Another object of the present invention is to provide an adjustable flow bean comprising a housing formed interiorly with an upper small bore and a lower large bore, there being a tubular mandrel slidably received within the small bore and having a plurality of vertically spaced ports formed in the walls thereof increasing in size from the lowermost to the uppermost and sealingly separated from one another by O rings carried by the mandrel and sealingly engaging the walls of the small bore, and which flow bean includes means for causing the tubular mandrel to be progressively projected into the large bore to progressively expose the ports from the lowermost to the uppermost.

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

Fig. 1 shows a formation tester having an adjustable flow bean of the present invention incorporated therein.

Figs. 2A and 2B are enlarged vertical mid-sectional views taken along lines 2A—2A and 2B—2B and showing the upper and lower portions of the flow bean shown in Fig. 1.

2

Fig. 3 is a view similar to Fig. 2B but showing the flow bean as having two of its flow bean passages or ports exposed.

Fig. 4 is a horizontal sectional view taken along line 4—4 of Fig. 2B showing the releasable keying connection between the upper tubular mandrel and the housing.

Fig. 5 is a horizontal sectional view taken along line 5—5 of Fig. 2B and showing the spline connection between the traveling nut and the housing.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, Fig. 1 discloses an adjustable flow bean assembly generally entitled 9 incorporated in a standard formation tester 11, such as disclosed in U. S. Letters Patent No. 2,073,107 entitled, "Well Testing Method and Apparatus Therefor," issued to Mordica O. Johnston, March 9, 1937, and also disclosed on pages 2571 and 2573 of the Composite Catalog of Oil Well and Pipe Line Equipment, 1950 edition. The formation tester 11 includes a trip valve assembly 13, a retaining valve assembly 15, an equalizing valve assembly 17, a packer assembly 19, and an anchor 21, all suitably connected together. The adjustable flow bean 9 of the present invention is interposed between the trip valve assembly 13 and the retaining valve assembly 15.

Retaining valve assembly 15 is adapted to be opened upon a downward movement of the upper portion of the formation tester relative to the lower portion thereof to compress a compression spring 23 which is provided for returning the formation tester to a position with the retaining valve closed when the weight of the drill string is relieved. During such downward movement of the upper portion of the formation tester, equalizing valve assembly 17 is adapted to be closed. Trip valve 13 is adapted to be permanently opened by dropping a go-devil down the drill string to allow formation fluid or the like to flow upwardly into the drill string for a drill stem sample.

The adjustable flow bean assembly, embodying the present invention, is best shown in the enlarged Figures 2A and 2B. This adjustable flow bean apparatus comprises a housing generally entitled 25 formed of a plurality of parts including an upper sub 27, a nut housing 29, a lower sub 31 and a bottom sub 33 all suitably threadedly connected together as shown, the bottom sub being connected to the lower portion of the forma-

tion tester 11. The flow bean assembly is non-rotatably connected by the lower portion of the formation tester to the packer 19 so that the housing 25 is effectively fixed or stationary when the packer 19 is set in the well bore.

Telescopically received within housing 25 is an upper mandrel generally entitled 35 having connected to its upper end an extension section 39 which is threadedly connected to a top sub 41 which in turn is connected to the upper portion of the formation tester 11. A compression spring 42 surrounds the upper part of upper mandrel 35 and bears at its lower end against a thrust bearing 43 and at its upper end against the lower face of an internally threaded adjustment collar 45, threadedly received by top sub 41. Below thrust bearing 43 is a split ring 47 upon which the thrust bearing is mounted, said split ring bearing against the upper sub 27. There is suitable packing 49 surrounding upper mandrel 35 and retained in operative position by a packing gland 51.

Mandrel 35 and housing 25 are releasably locked against relative rotative movement by keys 53 and keyways 54 formed respectively on mandrel 35 and upper sub 27.

At its lower end, upper mandrel 35 operatively threadedly engages a traveling nut 55 which is slidably but non-rotatably received within nut housing 29 by a spline connection shown at 57. Threadedly secured to the lower end of traveling nut 55 is a lower tubular mandrel 61 which is slidably received through lower sub 31. A spring-loaded downwardly opening check valve 63 closes the lower end of lower tubular mandrel 61.

Lower mandrel 61 has a plurality of vertically spaced flow bean passages or ports 65 formed in the walls thereof which ports are normally closed as shown in Fig. 2B by the walls of the central bore of sub 31. As is clearly apparent from Fig. 2B, the passages or ports progressively increase in size from the lowermost to the uppermost thereof. Between vertically adjacent passages or ports, and above the upper set of passages and below the lower passage, there are provided O rings 67 carried by the lower mandrel 61 in suitable annular grooves formed thereon.

As is obvious from Figs. 2 and 3, the internal diameter of bottom sub 33 is considerably larger than the internal diameter of lower sub 31 so that an enlarged bore is provided into which the lower end of lower mandrel 61 extends and into which the ported portion of lower mandrel 61 is adapted to be projected to expose one or several ports.

The operation of the apparatus is as follows: The formation tester 9 with the flow bean assembly incorporated therein is lowered into a well bore and the packer 19 set, closing off the formation zone below the packer from the portion of the well bore above the packer. The interior of the drill string will be at approximately atmospheric pressure and, therefore, constitutes a low pressure zone relative to the high pressure in the formation zone. After the packer 19 is set, the upper portion of the drill string above compression spring 23 can be lowered, compressing spring 23 and first closing equalizing valve 17 and then subsequently opening retaining valve 15 while simultaneously compressing spring 42 and clearing keys 53 of keyways 54. This downward movement is such as to clear the keys and keyways but not to expose the lowermost port 65, compression spring 42 permitting only sufficient downward telescoping movement to clear the keys and keyways. In this condition, upon rotation of the drill string, upper mandrel 35 is rotated to cause traveling nut 55 to move downwardly carrying lower mandrel 61 downwardly to progressively expose ports 65. It is contemplated that only one port may be opened if desired, that is, the lowermost port or passage, or more ports can be opened where additional fluid flow is desired and the formation pressure permits. The flow bean passages serve to restrict the flow of the high pressure formation fluid into the low pressure zone existing within the drill string and therefore avoid the detrimental effects which would otherwise occur in the formation zone from suddenly exposing the formation zone to a low pressure area. Furthermore, the detrimental effects to the formation tester or other equivalent tool will be avoided since the formation fluid normally contains sand or other abrasive particles which erode or badly wear the formation tool if uncontrolled flow of the formation fluid into the low pressure string is permitted.

It will be appreciated that prior to the disengagement of keys 53 from keyways 54, a rotatable drive is provided through the flow bean assembly, therefore allowing rotative movement to be imparted to devices below the flow bean. It is further pointed out that by the provision of O rings 67 the fluid flow along the exterior of lower tubular mandrel 61 between the lower tubular mandrel and sub 31 is prohibited at all times whether one, or several, or no parts are exposed. If such fluid flow were allowed, the erosion and wear on the lower tubular mandrel and sub 31 would be considerable since the formation fluid under high pressure would jet at high velocity through the very narrow annular passage.

After the formation test or drill string test is made, it may be desired to circulate fluid down through the drill string and this is permitted by the spring-loaded downwardly opening check valve 63.

While we have shown the preferred form of our 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 our invention, what we claim and desire to secure by Letters Patent is:

1. A device of the class described, comprising an upper tubular mandrel formed at its upper end for securement to the lower end of a drill string or the like to be rotatable therewith, a housing telescopically and rotatably receiving the upper mandrel and connected at its lower end to a packer assembly adapted to be set in a well bore or casing, a nut threadedly engaging the upper mandrel and slidably but non-rotatably engaging the housing, adapted upon rotation of the upper mandrel to be forced downwardly, a lower tubular mandrel carried by the nut and slidably received by a small bore formed in the housing, said lower mandrel having a plurality of vertically spaced passages formed in the walls thereof and normally closed by the walls of the small bore, said passages progressively increasing in size from the lowermost to the uppermost thereof, said housing having an enlarged bore therein into which the lower mandrel is adapted to be progressively projected to progressively expose the passages from the lowermost to the uppermost as the drill string is rotated, and means for releasably locking the upper mandrel and housing against relative rotation, including a

key on the upper mandrel engaging a keyway formed on the housing and movable out of alignment with the keyway upon downward movement of the upper mandrel relative to the housing.

2. A device of the class described, comprising an upper tubular mandrel formed at its upper end for securement to the lower end of a drill string or the like to be rotatable therewith, a housing telescopically and rotatably receiving the upper mandrel and connected at its lower end to a packer assembly adapted to be set in a well bore or casing, a nut threadedly engaging the upper mandrel and slidably but non-rotatably engaging the housing, adapted upon rotation of the upper mandred to be forced downwardly, a lower tubular mandrel carried by the nut and slidably received by a small bore formed in the housing, said lower mandrel having a plurality of vertically spaced passages formed in the walls thereof and normally closed by the walls of the small bore, said passages progressively increasing in size from the lowermost to the uppermost thereof, said housing having an enlarged bore therein into which the lower mandrel is adapted to be progressively projected to progressively expose the passages from the lowermost to the uppermost as the drill string is rotated, said lower mandrel having O rings carried thereby between vertically adjacent passages, below the lowermost passage and above the uppermost passage, for sealing engagement with the walls of the small bore to prevent passage of fluid along the exterior of the lower mandrel between the lower mandrel and said walls, and means for releasably locking the upper mandrel and housing against relative rotation, including a key on the upper mandrel engaging a keyway formed on the housing and movable out of alignment with the keyway upon downward movement of the upper mandrel relative to the housing.

3. A device of the class described, comprising an upper tubular mandrel formed at its upper end for securement to the lower end of a drill string or the like to be rotatable therewith, a

housing telescopically and rotatably receiving the upper mandrel and connected at its lower end to a packer assembly adapted to be set in a well bore or casing, a nut threadedly engaging the upper mandrel and slidably but non-rotatably engaging the housing, adapted upon rotation of the upper mandrel to be forced downwardly, a lower tubular mandrel carried by the nut and slidably received by a small bore formed in the housing, said lower mandrel having a plurality of vertically spaced passages formed in the walls thereof and normally closed by the walls of the small bore, said passages progressively increasing in size from the lowermost to the uppermost thereof, said housing having an enlarged bore therein into which the lower mandrel is adapted to be progressively projected to progressively expose the passages from the lowermost to the uppermost as the drill string is rotated, a downwardly opening spring-loaded check valve closing the lower end of the lower mandrel, said lower mandrel having O rings carried thereby and disposed between vertically adjacent passages, below the lowermost passage, and above the uppermost passage for sealing engagement with the walls of said small bore to prevent passage of fluid along the exterior of the lower mandrel between the lower mandrel and said walls, and means for releasably locking the upper mandrel and housing against relative rotation, including a key on the upper mandrel engaging a keyway formed on the housing and movable out of alignment with the keyway upon downward movement of the mandrel relative to the housing.

MORDICA O. JOHNSTON.
HARRY C. SKIPPER.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,790,625	Kent	Jan. 27. 1931
2,121,268	Shaffer	June 21, 1938
2,132,199	Yancey	Oct. 4, 1938
2,186,488	Johnston et al.	June 9, 1940
2,210,375	Mueller	Aug. 6, 1940