

Sept. 16, 1969

R. L. ALDER

3,466,754

SIGNALLING DRIFT INDICATOR WITH FLUID BY-PASS

Filed March 22, 1967

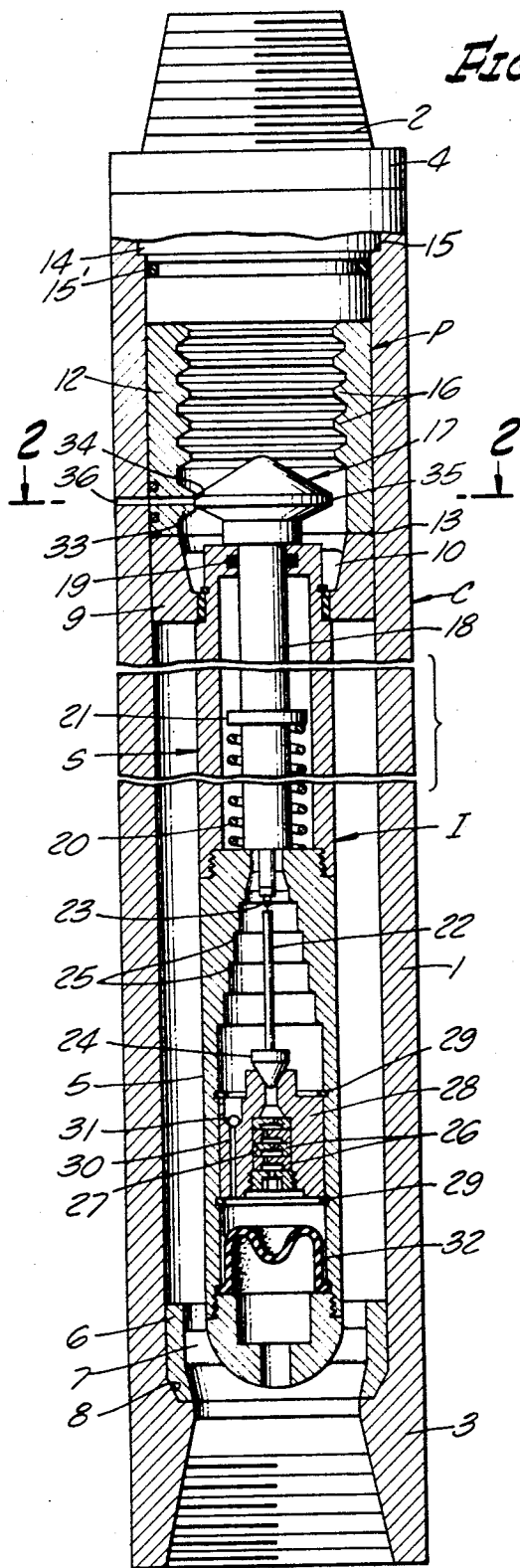


FIG. 1.

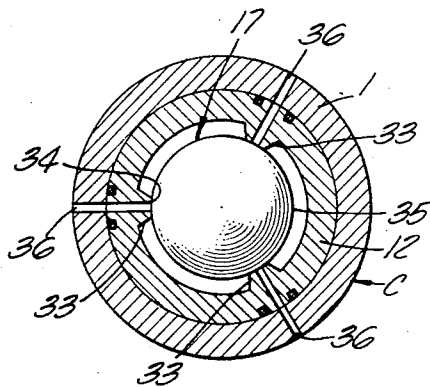


FIG. 2.

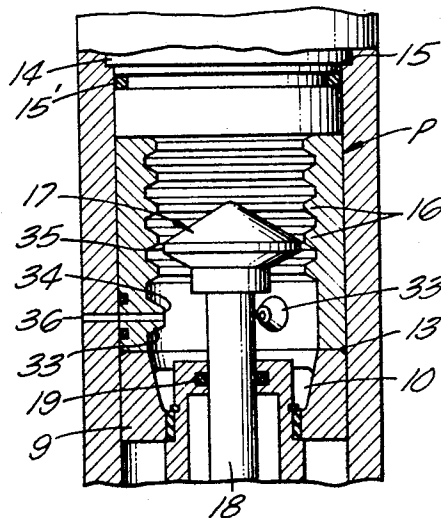


FIG. 3.

INVENTOR.
ROBERT L. ALDER
BY *C. H. Stelling*
ATTORNEY

1

2

SIGNALLING DRIFT INDICATOR WITH FLUID BY-PASS

Robert L. Alder, Pasadena, Calif., assignor to Byron Jackson, Inc., Long Beach, Calif., a corporation of Delaware

Filed Mar. 22, 1967, Ser. No. 625,084

Int. Cl. E21b 47/02

U.S. Cl. 33—205

7 Claims

ABSTRACT OF THE DISCLOSURE

A signalling drift indicator of the type in which a knob moves through pulse rings to produce pressure signals in a stream of drilling fluid indicative of the disposition of the drill string and in which a by-pass for drilling fluid, open only while signals are being produced, is provided.

The present invention relates to signalling drift indicators for use in the drilling of bore holes or wells through or into the earth, and more particularly to improvements whereby fluid is allowed to bypass the drilling bit while the drift indicator is being operated to generate signals in the drilling fluid.

Signalling drift indicators of the general type here involved are disclosed in U.S. Patents Nos. 2,435,934, issued Sept. 10, 1948, to F. M. Varney et al., and 2,762,132, issued Feb. 11, 1956, to J. A. Varney, as well as in U.S. Patent No. 3,176,407, issued Apr. 6, 1965, to R. L. Alder et al. In these prior inventions pressure pulses or signals are produced in the stream of drilling fluid adjacent the drill bit and are detectable at the surface of the earth as an indication of the angle of the lower end of the drill string from vertical, such signals being generated in a number which is either directly or inversely related to the angularity of the drill string adjacent the bit.

Such devices are of substantial benefit to the driller in determining whether he is maintaining desired or proper control of the weight applied to the bit with resultant control of the progression of the hole relative to a selected angle or relative to vertical, as well as being of substantial benefit to the driller in determining relative bit efficiency, i.e., whether the bit should be changed to enable increased penetration rate at a given depth in the light of the time required to make a "round trip" of the drill pipe to change bits, all as is now well known in the art.

Heretofore, in the use of devices of the general type described above, it has been the practice to cause operation of the signal producing means in response to the cessation and resumption of the circulation of drilling fluid. In such devices, cessation of drilling fluid circulation allows the upward travel of a flow pressure responsive head or knob through a series of restrictions, and resumption of drilling fluid circulation causes the downward travel of the knob through a number of the restrictions related to the angle of the drill string, or more precisely the drill collar sub, in which the knob is disposed. Means are included in such devices which are operative in response to gravity to limit upward travel of the knob in a particular relation, direct or inverse, to the angle of the sub. However, under some circumstances, restriction in the flow of drilling fluid may interfere with operation of the drift indicator signal production. For example, if the bit has small orifices through which the drilling fluid is flowing or when the bit orifices are plugged up, the flow rate through the signal

producing means may be slow or may be erratic, resulting in loss of signal amplitude or erratic spacing of the signals due to the fact that the knob may pass too slowly or erratically through the restrictions.

Accordingly, an object of the present invention is to provide a signalling producing apparatus by which signals or pressure pulses will be generated in the stream of drilling fluid as an indication of the disposition of the lower end of the drill string, and which, as an improvement, includes means whereby at least a portion of the drilling fluid bypasses the bit so as to assure adequate and constant flow of fluid for the purpose of causing the knob to move properly through the restrictions, whereby signals will be produced of sufficient amplitude and regularity as to be readily detectable at the earth's surface even though the bit orifices may be plugged or of small size.

More specifically, an object is to provide by-pass valve means in a signalling drift indicator having a knob movable through pulse rings or restrictions, said valve means being closed during drilling operations so that the full volume of drilling fluid will pass through the bit orifices to flush cuttings upwardly in the annulus outside the drill string, and said valve means being open to allow the drilling fluid, or at least a substantial portion thereof, to pass into the annulus above the bit without flowing through the bit.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art and the novel features of the invention will be defined in the appended claims.

In the drawing:

FIG. 1 is a view in longitudinal section, with certain of the parts shown in elevation, illustrating a signalling drift indicator made in accordance with the invention, with the by-pass valve closed;

FIG. 2 is a transverse sectional view as taken on the line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary view showing the by-pass valve of FIG. 1 in an open position.

Like reference characters in the drawing and in the following description designate corresponding parts.

Referring first to FIG. 1, there is shown an instrument I made in accordance with the invention and disposed in a drill collar sub C, having a body 1, pin end 2, and a box end 3 for threaded connection in the drill string. Pin end 2 is formed on a cap 4 which is suitably removably connected to the body 1 as by a thread (not shown) whereby the instrument may be installed in the body 1. This instrument includes a pulse or signal producing section P and a shaft and pendulum section S. The latter section S includes a housing 5 at the lower end of which is a bottom support 6 in the form of a spider providing flow passages 7, this bottom support seating on a shoulder 8 at the bottom of drill collar body 1. Housing 5 of section S is connected by a spider 9 having flow passages 10, to the pulse section P.

Pulse section P includes a pulse ring fitting 12 which is a tubular member welded at 13 to, or otherwise made a part of, the spider 9. This fitting 12 fits within drill collar body 1 and has an upper flange 14 which seats on a shoulder 15. Means are provided to form a seal between the fitting 12 and drill collar body 1, and illustratively such means includes a resilient seal ring carried by fitting 12 and engaged in body 1. Within the fitting 12 is a vertically spaced series of pulse rings 16 providing successive restrictions and enlarged flow areas whereby to produce pressure pulses in the stream of drilling fluid as a knob 17 passes downwardly therethrough in a manner hereinafter to be described.

The knob 17 is supported at the upper end of a shaft 18 which extends vertically through a seal 19 carried at the upper end of shaft section S of the instrument I. Within the instrument housing 5, a main spring 20 acts on a flange 21 of shaft 18 to normally bias the shaft and knob upwardly when the circulation of drilling fluid is interrupted. Means are provided within the housing 5 for limiting upward movement of shaft 18 a distance related to the angle of drift of the drill collar C and the well from vertical, so that upward movement of knob 17 will be correspondingly limited. As seen in FIG. 1, this means comprises a pendulum 22 pivotally supported beneath shaft 18 by bail means 23 and having a head 24 providing a shoulder which is selectively engageable with one of a plurality of axially spaced annular stops 25 of progressively diminishing diameter. It will be recognized that the angular disposition of the drill collar C relative to the pendulum 22, which, being gravity responsive will depend vertically from its pivot, will determine which stop 25 will be engaged by pendulum head 24, and that, while in the structure shown the permitted upward travel of the pendulum and the shaft is inversely related to the angular disposition of the body, i.e., the greater the angle the less the travel, the assembly may include a coding system for enabling a direct relationship between angle and extent of shaft travel, as disclosed in the aforesaid U.S. Patent No. 3,176,407.

In either event, downward movement of the knob 17 from the position shown in FIG. 3 to the original position shown in FIG. 1 responsive to flow of drilling fluid through the pulse rings 16 will cause the production of pressure signals in the fluid stream which are detectable at the earth's surface for purposes of indicating the angle of the drill collar C. In order that the pulses will be of sufficient duration as to be easily discriminated from normal pressure variations in the fluid stream, a clean body of oil in the pendulum section S is displaced through an orifice assembly including a number of orifice discs 26, which are disposed in a passage 27 in a combined disc support and pendulum seat 28 which is mounted in the section 5 between rings 29. A by-pass passage 30 and a downwardly closing check valve 31 are provided in the support 28 for allowing relative freedom of upward movement of instrument fluid in section S through support 28 during upward movement of shaft 17.

This clean oil or instrument fluid is retained in the body 5 of section S by means of seal ring 19 at the upper end of body 5 and by a pressure equalizing divider below the support 28. The divider in the illustrative embodiment is in the form of a diaphragm 32, but a free piston may also be employed.

The instrument as thus far described is substantially conventional, and in accordance with the objectives of the invention is provided with valve means which is closed when the knob 17 is down, as shown in FIG. 1, and which is open when the knob moves upwardly, so as to allow fluid to bypass the instrument during downward movement of the knob.

This valve means in the illustrative embodiment includes in the lower end of the pulse ring fitting a number of circumferentially spaced inward projections 33 having arcuate inner walls 34, cooperative with an annular surface 35 on knob 17, and radial ports 36 which extend through the projections 33 and outwardly through drill collar body 1. With such a construction, the knob 17 effectively is a valve for closing the ports 36 when the knob is down, as seen in FIG. 1, and for opening the ports 36 when the knob moves upwardly.

Thus, in operation, so long as the circulation of drilling fluid downwardly through drill collar C is maintained, the knob 17 will remain down and the entire volume of fluid will flow downwardly through the usual bit orifices. However, when circulation is interrupted to allow the addition of a further length of drill pipe or to enable, at any time, the taking of a deviation reading, the knob

will be moved upwardly by mainspring 15, limited by engagement of pendulum head 24 with one of the stops 25. Thereafter, upon resumption of circulation of the drilling fluid, the knob 17 will be forced downwardly by the drilling fluid, causing the generation of a pressure pulse or signal at each pulse ring restriction.

Since the ports 36 are open when the knob 17 is up, a portion, at least, of the fluid being pumped down the drill string will bypass the instrument below the ports and will flow directly into the annulus outside the drill collar C. Therefore, if the usual bit orifices are small or are plugged so as to impede downward flow of the drilling fluid, sufficient fluid will bypass through ports 36 so as to enable adequate fluid velocity through the pulse ring fitting to cause well defined pressure pulses at the rings 16 as knob 17 passes therethrough. After the pulses have been generated and the knob 17 reaches the down position the cooperative valve surfaces 34 on projections 33 and 35 on knob 17 will close ports 36, so that again the entire volume of circulating drilling fluid will pass through the bit orifices to assure efficient removal of cuttings.

While the specific details of an illustrative embodiment of the invention have been herein shown and described, changes and alterations may be resorted to without departing from the spirit of the invention.

I claim:

1. In a signalling apparatus adapted to be installed in a well drilling string for producing pressure signals in a stream of well drilling fluid indicative of the angular disposition of the drilling string, said apparatus comprising: a tubular elongated body adapted to be installed in the drilling string, an instrument in said body having means for producing pressure pulses in the drilling fluid stream following interruption of the flow of fluid through said body and responsive to resumption of flow of fluid through said body, and bypass means openable for allowing the flow of fluid laterally from said body to the exterior thereof during the production of said pulses and closeable following the production of said pulses for causing the entire fluid stream to flow axially through said body.

2. Signalling apparatus as defined in claim 1, wherein said instrument includes a movable member having a fluid flow responsive surface for holding the same in a first position during flow of fluid through said body, means for biasing said member to a second position upon interruption of the flow of fluid through said body, and said bypass means includes port means leading to the exterior of said body, and valve surfaces for closing said port means when said member is in said first position.

3. Signalling apparatus as defined in claim 2, wherein said valve surfaces include surfaces on said movable member for closing said port means.

4. In a signalling apparatus adapted to be installed in a well drilling string for producing pressure signals in a stream of well drilling fluid indicative of the angular disposition of the drilling string, said apparatus comprising: a tubular body adapted to be installed in the drilling string, a housing in said body, a member projecting from said housing and movable between a first position and a second position determined by the disposition of said body relative to vertical, said member having a surface responsive to flow of drilling fluid to move said member to and hold said member in said first position, means in said housing for moving said member to said second position upon interruption of the flow of drilling fluid, means cooperative with said member for producing pressure pulses in the stream of drilling fluid upon resumption of the flow of drilling fluid and movement of said member toward said first position, and bypass means closeable when said member is in said first position and openable when said member is spaced from said first position to allow drilling fluid to bypass said body.

5

5. Signalling apparatus as defined in claim 4, wherein said bypass means includes port means leading to the exterior of said body and a surface on said member for closing said port means when said member is in said first position.

6. Signalling apparatus as defined in claim 4, wherein said bypass means includes a plurality of angularly spaced projections in said body through which said member extends, a port leading from the exterior of said body through a projection into said body, and valve means engageable with said projection having said port.

7. Signalling apparatus as defined in claim 4, wherein said means for moving said member to said second position includes a spring in said housing and pendulum and spaced stop means responsive to the disposition of said

6

body relative to vertical to limit movement of said member under the influence of said spring.

References Cited

UNITED STATES PATENTS

3,176,407	4/1965	Alder et al.
2,762,132	9/1956	Varney.
2,435,934	9/1948	Varney et al.
1,905,299	4/1933	McLaughlin et al. ----- 33—205

LEONARD FORMAN, Primary Examiner

F. J. D'AMBROSIO, Assistant Examiner

U.S. Cl. X.R.

175—45