April 22, 1941. L. W. KRALL 2,239,106

WELL DRILL

Filed Jan. 28, 1939 2 Sheets-Sheet 1

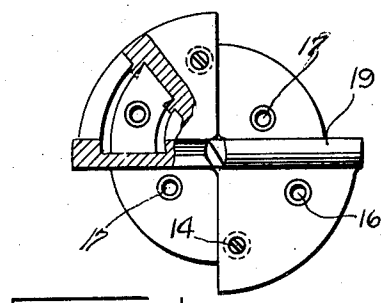

Fig. 1

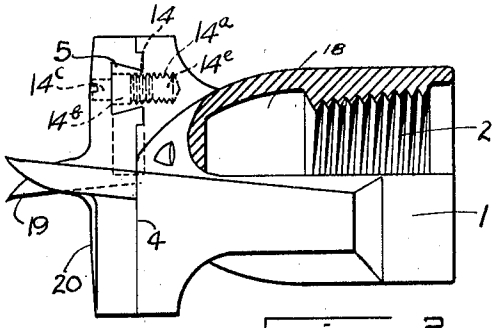

Fig. 2

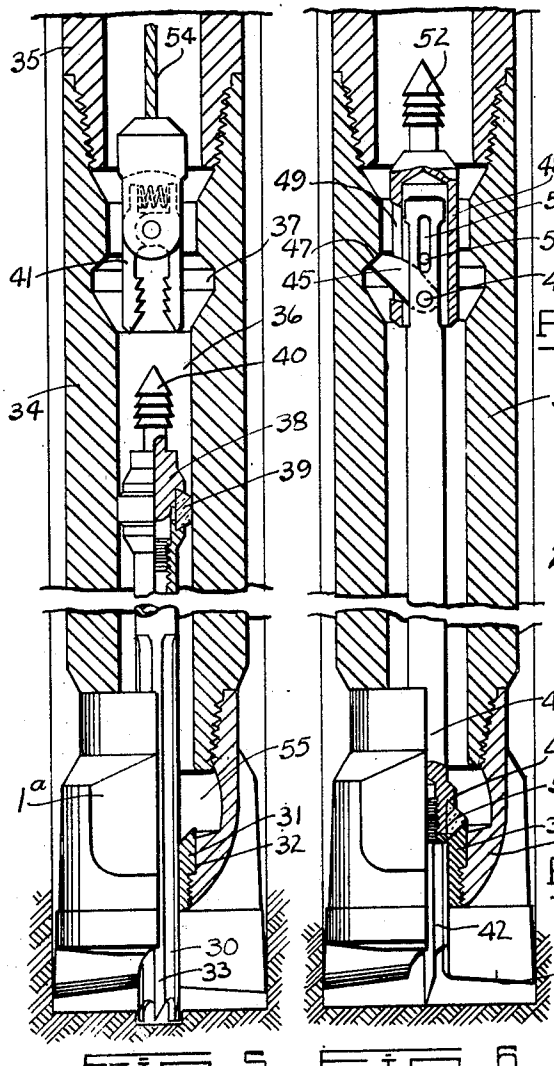

Fig. 5 Fig. 6

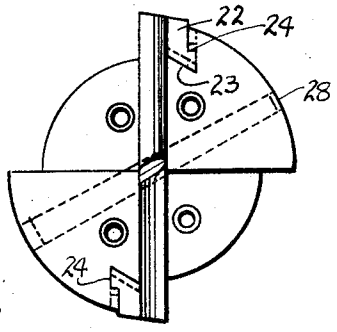

Fig. 3

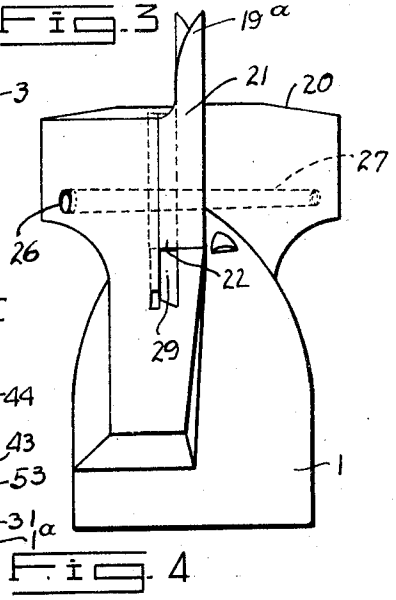

Fig. 4

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WELL DRILL

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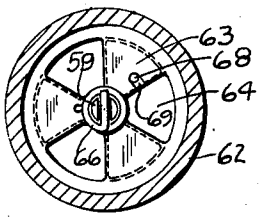

FIG. 7

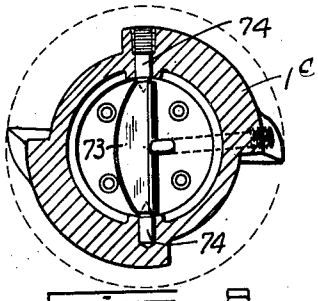

FIG. 8

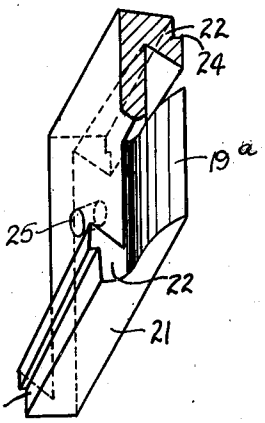

FIG. 9

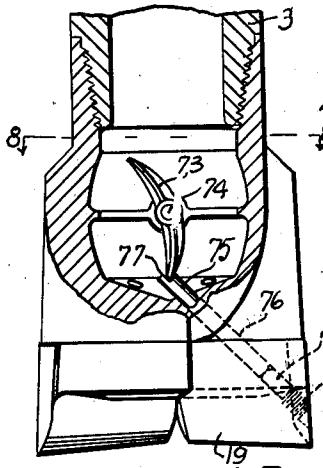

FIG. 10

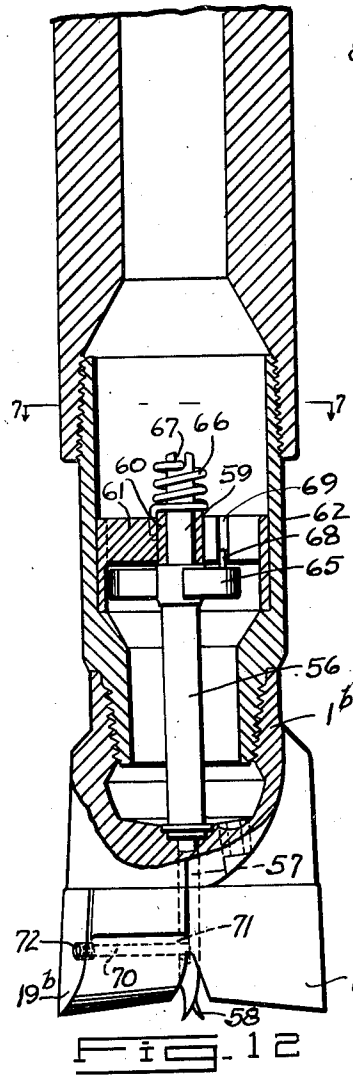

FIG. 12

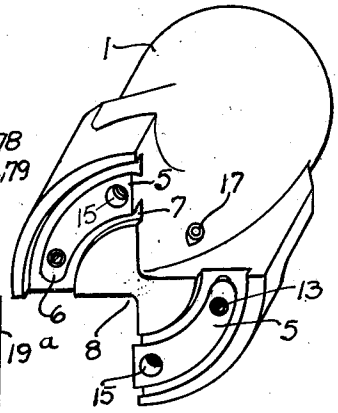

FIG. 13

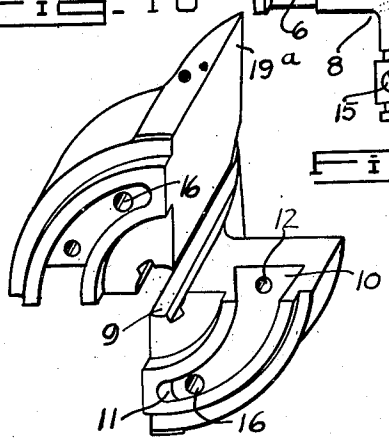

FIG. 11

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UNITED STATES PATENT OFFICE

2,239,106

WELL DRILL

Leo W. Krall, Houston, Tex., assignor of one-half to W. M. Mercer, Houston, Tex.

Application January 28, 1939, Serial No. 253,266

4 Claims. (Cl. 255—61)

My invention relates to well drills such as are employed in drilling deep wells for water, oil, sulphur and the like. It pertains more particularly to drag bits of the fish tail type whereby the cutting is performed by scraping blades.

It is an object of the invention to provide a removable shoe or plate to be secured on the forward end of the bit and to which the cutting blades are secured.

It is a further object of the invention to provide a connection between the removable cutting portion of the bit and the head upon which it is mounted which will permit the parts to be secured together firmly with a minimum of difficulty.

It is a further object to provide means for preventing removal of the cutting portion from the head which can not be detached or loosened in the operation of the drill.

A further object of the invention is to provide a connection between the cutting blades and the head of the bit which will remain in tight engagement and in which the spreading of the head relative to the blades is prevented.

It is also an object of the invention to provide a wedging fit between the blade and the head which will remain in tight engagement during the operation of the device.

It is a further object of the invention to provide an indicator in the head of the drill which will operate to give an indication to the operator at the surface when the cutting blades have been worn so that the gauge of the well will not be materially reduced.

It is desired to form an indicator which will influence the flow of flushing fluid through the drill in response to the wearing down of the cutting portion of the head to a critical point.

It is a further object of the invention to provide a core drill to be employed with the well drill previously referred to which may be moved forward into the formation in response to the pressure of flushing fluid in the drill stem.

It is a further object of the invention to provide means for closing the passage into which the core bit is inserted during the period when the core bit is not in operation.

Referring to the drawings herewith, Fig. 1 is a bottom plan view of a drill bit embodying the invention, a certain portion of the cutting element being broken away for purposes of clearness.

Fig. 2 is a similar view taken in side elevation with certain parts being broken away.

Fig. 3 is a bottom plan view of a different embodiment of the invention from that disclosed in Fig. 1.

Fig. 4 is a side elevation of the drill disclosed in Fig. 3.

Fig. 5 is a central longitudinal section through a drill collar and drill with my improved core barrel shown therewith, certain parts of the structure being shown in elevation.

Fig. 6 is a view similar to that disclosed in Fig. 5 but showing the use of a bit plug in place of the core barrel.

Fig. 7 is a transverse section taken on the plane 7—7 of Fig. 12.

Fig. 8 is a similar view taken on the plane 8—8 of Fig. 10.

Fig. 9 is a perspective view of the cutting blade to be employed with the embodiment of the drill shown in Figs. 3 and 4 and with certain parts shown in section.

Fig. 10 is a side view partly in section showing one form of indicator which may be employed in signaling to the operator when the drill has become worn.

Fig. 11 is a perspective view of the cutting blade employed with the head disclosed in Figs. 5 and 6.

Fig. 12 is a side view partly in central vertical section indicating a second form of indicator to signal to the operator when the cutting blades have become worn sufficiently to necessitate withdrawal of the bit.

Fig. 13 is a perspective view showing the structure of the head employed with the cutting element disclosed in Fig. 2.

With reference to the drill bit disclosed in Figs. 1, 2, 11 and 13, I have shown a head 1 which has a threaded socket 2 for connection with the drill collar or tool joint 3. The lower end of the head is flattened off on the plane indicated at 4 and is provided with a tenon 5 projecting therefrom to engage with the cutting element. With reference particularly to Fig. 13 this tenon 5 is extended around the lower portion of the bit in the arc of a circle, said tenon decreasing in width toward the advancing end 6 thereof, as it is screwed or inserted into the cutting portion. On each side of the tenon 5 are mortised recesses 7 to cooperate with the blade of the drill.

As will be seen from Fig. 13, the lower end of the head is recessed on opposite sides, as shown at 8, to provide for the passage of the cuttings and the flushing fluid. The blade supporting portion is formed upon two forward projections having the mortises thereon as previously referred to.

The cutting element, shown in Fig. 11, is shaped to engage with the forward end of the head. The forward cutting member may be in one piece or if a core barrel is to be employed it may be made in two pieces with a central opening channeled between the two portions as shown at 9 through which the core drill may be inserted. Each half of the cutting element has a mortise 10 cut therein grooved to engage over the tenon 5 on the head and dovetailed as shown in Fig. 11 so that it may be mounted on the head by a screw or rotative movement over the tenons 5 which are received within the mortises 10. The mortises also are formed with walls converging inwardly, the inner end of each mortise being closed by a wall at 11. Thus it will be understood that the blade may be mounted on the head by inserting the mortise 10 over the tenon 5 on the head and by a partial rotation the tenon will be wedged in the mortise so that it will fit securely in position when the forward end of the tenon has engaged the wall 10.

Openings are provided through the mortise and tenon connection to receive screws or bolts through which the parts are held in position. Thus openings 12 in the mortises and 15 in the tenons are arranged to receive screws 14 whereby an unscrewing movement of the cutter on the head is prevented. At the other end of the tenon is an opening 13 through which flushing fluid from the head may be discharged upon the formation. Said openings 13 will register with similar openings 16 in the cutting element and will issue, as shown at 16 in Fig. 1, in the downward direction.

Additional openings for the discharge of flushing fluid are formed in the lower tapered portion of the head at 17. There are two of these openings one on each side and it will be understood from Fig. 2 that these openings connect upwardly into the passage 18 through which the flushing fluid passes.

Attention is directed to the manner in which the screws 14 are mounted in position to hold the cutter head assembled upon the drill head. In Fig. 2 it will be understood that the inner threaded portion 14^a of each screw is extended into the head of the bit leaving an outer unthreaded portion 14^b. The diameter of the screw is reduced to form an outer projection 13^c thereon which engages through the opening in the cutter head. When this screw is to be loosened it is screwed downwardly in the openings 12 and 15 so that the projection 14^c is moved inwardly beyond the dividing line between the drill head and the cutter member. This will enable the cutting element to be rotated and removed from the head and a new cutting element inserted in position. The screw driver is then inserted to engage in the end of the screw and the screw is unscrewed from its seat so as to bring the reduced portion 14^c back into the recess in the cutting portion. In this manner it is impossible to lose the screw from the drill head during operations and I am still enabled to securely lock the parts together. As will be seen in Figs. 1 and 2 the shoe having the blades thereon may be formed in a single member which may be fixed upon the head in the manner described or the cutting element may be formed in two parts as shown in Fig. 11. In such cases at each side of the shoe or cutting element are forwardly directed cutting edges 19 and 19^a. It will be seen that when the cutting blades are worn down to approximately the level of the forward face of the cutting shoe, as indicated at 20, the drill will not progress any further and an indication will be given to the driller that the blades have become dulled and that it is time to remove the bit from the hole.

In Figs. 3 and 4 the blade which is employed is not formed upon a cutting shoe as in the previous embodiment but the blades are preferably formed in one piece and adapted to be inserted upwardly into a slot in the head. As will be seen from Fig. 4 the cutting blade 21 is formed with forward cutting edges 19^a as in the previous embodiment but the upper end of the blade is formed to be inserted into a slot in the head. This blade has at each side of the head a laterally extending tenon 22. Said tenon has a flat inclined surface 23 inclined toward the inner portion of the head. The lateral face of the tenon is stepped backwardly, as shown at 24 in Fig. 3, to engage a shoulder on the head. The blade thus formed is indicated in Fig. 9 wherein the tenon 22 is shown projecting from the outer edge of the blade 19^a. This tenon, which is in effect a compound tenon, tapers from the lower end adjacent the blades 19^a in an upward direction, as will be noted along the plane 23 in Fig. 9. Thus the tenon may be inserted into a complementary mortise in the head and will wedge upwardly in position as it is inserted into the head. When wedged tightly, there is a transverse opening 25 through the blade which will register with a transverse opening 26 in the head. This opening through the head is tapered as shown at 27 in Fig. 4 to receive a pin driven therein, thus locking the blade firmly in position. This pin, as seen particularly in Fig. 3, is not extended entirely through the head when wedged in position but it will be possible to insert a drift pin into the smaller end of the opening at 28 to drive the pin from its seat when the blade is to be again removed. There is a recess 29 in the head adjacent the upper end of the blade which makes it possible to exert pressure on the upper end of the blade to remove it from its seat when the pin has been withdrawn.

This blade operates as does the previous embodiment to stop the advance of the bit when the cutting blades have been worn to a point near the lower end of the bit head. Said lower end being flattened off will not advance after the blades have been sufficiently worn and will give an indication to the operator that the bit may be withdrawn.

A core bit may be employed with my type of bit, as shown in Fig. 5. In this type of bit there is a passage centrally through the bit head 1^a through which a core barrel 30 may pass. I further provide a bushing 31, which is screwed within a recess 32 on the inner portion of the head. Said bushing is provided with longitudinal grooves which are adapted to receive longitudinal ridges or splines 33 upon the core barrel.

Above the end of the bit is a drill collar or sub 34, which is secured at its upper end to the tool joint or drill stem 35. There is a longitudinal passage 36 through the drill collar through which the core barrel may be inserted. Adjacent the upper end of the passage 36 is a recess 37 formed by enlarging the passage to provide a chamber or space into which the latching members on the plug bit may engage. Said plug bit will be later described.

The core barrel has a threaded engagement adjacent its upper end with a head 38. Said head has in its outer periphery a packing ring 39 of

rubber or similar packing material which engages tightly against the inner wall of the drill collar. This head closes the upper end of the barrel and has an upper extension 40 which is serrated to provide engagement for an overshot or grab member 41.

In Fig. 6 I have shown how the opening through the drill bit may be closed when the core barrel is not being employed. In this device there is a small bit or cutting member 42 which fits within the bushing 31 and has a driving connection therewith. Said bit is screwed at 43 within the lower end of a rod or shaft 44 which extends upwardly in the head and has at its upper end one or more pivoted dogs or latches 45, which are pivoted on a cross pin 46 and are movable laterally within a slot in said rod. When said latching dogs are moved to their outer position the end of the dog will engage against a shoulder 47 within the recess 37 thus holding the plug bit in position during the drilling operation.

There is a latch control member formed by a sleeve 48 which fits over the upper end of the rod and has a lateral slot 49 therein to allow the outward movement therethrough of the latching dog 45. This sleeve has a transverse pin 50 which engages within a slot 51 in the rod, thus allowing the sleeve a limited longitudinal movement relative to the rod. At the upper end of the sleeve is a serrated head 52 to be engaged by the overshot which may be employed.

In the operation of the device the plug bit may be dropped downwardly through the drill stem to engage within the bushing 31, a packing member 53 thereon forming a seal with the upper tapered end of the bushing. In this position the sleeve 48 will drop downward'y and allow the latching dog to move outwardly away from its retracted position and engage against the shoulder 47. When it is desired to remove the plug, however, a grab or overshot, such as is shown at 41 (Fig. 5), may be lowered into the well with a cable 54 to engage the extension 52 and thus pull upwardly upon the sleeve 48 and withdraw the latch dog 45 and thus enable the plug bit to be removed upwardly to the surface.

The core barrel then may be dropped downwardly into position projecting through the opening in the drill head. The upper end of the core barrel will then extend upwardly into the drill collar and will close the passage therethrough of flushing fluid. The drill bit may be suspended from the surface slightly off the bottom of the hole and the drill stem may be then rotated and the pressure of the flushing fluid exerted upon the upper end of the core barrel will force it downwardly into the formation as the drill stem is rotated until finally the head 38 will move into the recess 55 in the drill head. In this position the flushing fluid may pass around the head 38 and outwardly in the channels around the core barrel and an indication will be given to the operator that it is time to withdraw the core barrel and the core therein from the well.

In Figs. 7, 8, 10 and 12 I have disclosed other forms of indicators which may be employed to show when the blades of the cutting member have been worn sufficiently to warrant the drill bit being removed from the well. In Figs. 7 and 12, the indicator includes a central shaft 56 which has at its lower end a reduced section 57 which projects through an opening, such as is shown at 9 in Fig. 11, so as to extend approximately on a level with the blades 19b of the bit. The forward end is formed with cutting members 58 which act to cut the small portion at the center of the hole. The shaft 56 extends upwardly and a bearing member 59 is formed thereon to fit within a sleeve 60 formed within a spider or supporting member 61 in the sub 62.

It will be noted that in this case the drill head 1b is formed with a socket to receive the lower threaded end of the sub 62 and that the shaft 56 projects from the head upwardly into the interior chamber in the sub. The spider in which the shaft bearing 59 is journaled is shown in Fig. 7 as having three sector shaped arms 63 thereon with similar shaped openings 64 between them, the said openings forming a passage for the flushing fluid. Below the spider 61 I form upon the shaft 3 sector shaped arms 65 which are held normally out of registration with the opening 64 by means of a spring 66, one end of which is mounted within a slot 67 in the end of the bearing member and the other end of which is fixed within the spider. This spring serves to exert a torque upon the bearing member 59 moving the arms in a direction to bring a pin 68 upon one of the arms 65 into a recess 69 in the spider, as shown in Fig. 7.

In the rotation of the bit the engagement of the points 58 upon the shaft 56 tends to rotate the said shaft to move the pin 68 out of the recess 69. This rotation of the shaft 56 is prevented, however, by a pin 70, which is extended through an opening in the blade 19b in a radial direction so that the inner end of the said pin engages within an opening 71 in the portion 57 of the shaft. The pin 70 is held into latching position in the member 57 by a short plug indicated at 72 screwed within the outer end of the opening in which the pin 70 is inserted.

It will be understood that when the edge of the blade 19b is worn inwardly or upwardly a sufficient distance to wear away the plug 72 the pressure of the spring 66 tending to rotate the shaft 56 will move the pin 70 outwardly in the opening so as to allow the shaft 56 to rotate. Thus when the bit has been worn sufficiently to warrant removal of the bit from the hole the operator will note that the pressure fluid is choked downwardly so as to throttle the pumps. This will be accomplished because of the rotation of the shaft 56 as soon as the latch pin is allowed to move outwardly, thus bringing the sector shaped arm 65 into position to close the opening 64 and choke off the flow of flushing fluid.

In Figs. 8 and 10 I have a similar construction but in the head 1c of the drill bit I have a valve member 73 which is pivoted at its two ends upon pins 74 which are extended through the wall of the head and fitted within recesses in the end of the valve member. This will be understood from Fig. 8. The valve is thus pivoted for rotation in the head. It is normally held against rotation by a latch pin 75, which is extended upwardly through an opening 76 in the blade and the head of the bit so that the notched end 77 thereon will engage with one edge of the valve member. This pin 75 is held in the passage 76 by a soft metal plug 78, which is in turn held in place by threaded plug 79. Thus when the bit is operating the valve will be held in the position shown in Fig. 10 so that it will not interfere with the flow of flushing fluid through the bit. When the blade becomes worn a certain amount, however, the plug 78 may be enabled to drop out of its position and allow the pin 75 to be moved out

of latching position. It will be understood that due to the position of the valve member 13 there will be a pressure exerted upon the valve by the flushing fluid to cause it to rotate from that position, and such pressure will be sufficient to move the pin 15 as soon as the lower end of the bit is worn sufficiently to allow the pin to slide downwardly and outwardly. As soon as the valve 13 is allowed to rotate it will close the passage for fluid through the head, or at least cause a rotation of the valve, which will interfere with the passage of fluid, and thus indicate to the operator that the bit has been sufficiently worn to warrant its removal from the well.

It will be understood that I have thus provided a drill bit which has an easily removable cutting end thereon and in which the entire cutting surface subjected to wear may be removed from the head of the bit and a new similar cutting end mounted thereon and the drilling continued. The head of the drill will itself sustain but little wear and the drill may thus be operated with economy and the changes in the cutting element upon the head may be made with the consumption of the minimum of time.

It will also be seen that I have provided an indicator which will give a signal to the operator at the surface when it is desirable to withdraw the bit from the hole to replace the cutting element.

The advantages of my core barrel which has been described reside in the fact that the core may be cut without the operation of the main drill, thus enabling an uncontaminated core to be obtained. The core barrel is driven into the formation entirely by the force of the flushing fluid during a period when the main drill bit is not advancing. This is a feature of importance in obtaining a core uncontaminated by the flushing fluid and retaining the original composition of the core without contamination.

What is claimed is:

1. A drill head, cutters thereon, a passage for flushing fluid through said head, a valve plate mounted transversely of said passage and pivoted to rotate therein, means engaging said plate to hold it in open position, said holding means being releasable in response to a predetermined amount of wear upon said cutters, whereupon said valve plate may be moved by said flushing fluid to partially close said passage.

2. A well drill including a head, cutters on the forward end thereof, a member adapted to be worn as the cutters are worn, a passage through said head for flushing fluid, and means in said passage acted upon by the fluid therein to close off the flow of fluid through said head when said member is worn a predetermined amount.

3. A well drill including a head, cutters on the forward end thereof, a passage for flushing fluid in said head, an indicator channel from said passage to one of said cutters, a plug in said channel and fluid-operated means in said passage acting in response to a predetermined wear upon said plug to close off said passage.

4. A well drill including a head, cutters at the forward end thereof, a fluid passage in said head, a closure for said passage and means normally holding said closure in open position but operating in response to a predetermined wear upon one of said cutters to release said holding means and permit said closure means to check the flow of fluid in said head.

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