This invention has to do with a deflector post and construction for preventing mud-cutting in a well drilling bit and it is a general object of the invention to provide a simple, practical, and improved means for preventing said mud-cutting in a drill bit structure.

Well drilling bits used in carrying out the rotary drilling method have been subject to destruction by so called "mud-cutting" or erosion caused by the abrasive effect of the materials present in the said drilling method. Fluid circulation is employed primarily to circulate or flush the cuttings from the well bore and in actual practice, or operation, mud and solids from the circulating fluid and from the earth formation pass onto certain portions of the bit structure and this packed material flows or extrudes, and moves relative to certain portions of the bit. Since great pressures are employed in the drilling operations the movement or flow of this packed material has an adverse effect on the bit structure. That is, the bit structure is eaten away in said certain areas by abrasive action and erosion to the end that its mechanism is destroyed.

In drilling with the rotary method and employing the usual type of roller bit, there is always the problem of mud-cutting which adversely affects the bit by abrading certain portions thereof until the bit is useless. Although bits are of substantial construction and are made of durable materials, the working pressures are so high and the abrasive action of the mud so great that wear takes place rapidly. In practice, the legs of roller bits are vulnerable to mud cutting and are cut away rather rapidly, exposing the bearings of the roller and allowing said bearings to drop out of working position. The point of wear on the legs can be determined from experience and I employ the deflector post of the present invention in a manner to substantially eliminate said wear or mud cutting action.

It is a general object of this invention to provide a means for mechanically deflecting mud and fluid material from a path that normally results in wear and destruction of a roller bit. The deflecting post and construction that I provide is extremely simple and effective and has a positive determinable deflecting action that directs the mud to a non-destructive course.

Another object of this invention is to provide a mud deflecting means of the general character referred to which involves primarily but a single easily made part located to oppose the periphery of the roller cutter that it protects, and serving to act on the abrasive materials that move relative to the bit members, to the end that said solids, or mud, move in a substantially harmless manner.

It is another object of this invention to provide means for protecting a bit of the general character referred to wherein fluids and solids are deflected away from the cutters so as to prevent excessive wear on the structure which ordinarily destroys a bit in a relatively short length of time.

The various objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevation and sectional view of a typical roller bit showing the manner of mounting the rollers and the location of the post that I provide. Fig. 2 is a sectional view taken as indicated by line 2—2 on Fig. 1, and showing the deflecting post. Fig. 3 is an enlarged detailed sectional view taken as indicated by line 3—3 on Fig. 2 and indicating the relation of the post and parts of the bit. Fig. 4 is a perspective view of the post per se showing it removed from the bit structure, and Fig. 5 is an enlarged detailed sectional view taken as indicated by line 5—5 on Fig. 2.

In Fig. 1 of the drawings I have shown a typical roller bit adapted to be employed in carrying out the rotary method of drilling, and it is shown carried at the lower end of a drilling string S to be operated by rotation of said string. The drilling string S is tubular and in accordance with conventional practice is supplied at the upper end of the well with fluid under pressure. In Fig. 1 the bit, as provided by the invention, is shown on the lower end of the drilling string and is indicated as being operated to establish or drill a suitable well bore X. The bit includes, generally, a body A, a plurality of roller type cutters B carried by the body, and a means C on or in the body and adapted to handle fluid supplied to the bit by the string S.

The body A of the bit includes, generally, a main or middle portion 10 having a central opening or cavity 11. A coupling pin 12 projects up from the body and is shown as a conventional coupling element in the nature of a threaded pin engaging with the lower end of the string S or a suitable part provided thereon to carry the bit. The pin 12 is tubular in form and has a central flow passage 13 that opens into the cavity 11 in the main portion 10 of the body.

Legs 14 are provided on and depend from the main portion 10 of the body and, in the particular construction illustrated, there are three like legs, two of which are shown, and which are equally spaced from each other around the body. The legs 14 are alike and have the lower inner portions finished so that they have suitably pitched faces or annular shoulders 16 to which the cutters B are opposed and are mounted. The faces 16 of the legs, as shown in the drawings, are normal to the axes of their respective cutters and hence are pitched so that each extends downwardly and outwardly.

The cutters B are carried by the legs 14 at the faces 16 thereof and, in the case illustrated, they are frusto conical, one carried on each leg to oppose the face 16 thereof. The cutters are rotatably mounted on the legs at the faces 16 and, in practice, are rotatably carried on trunnions 20 projecting from the lower end of the leg 14. For purpose of example, it is to be understood that the cutters may be mounted as, for instance, by a cutter mounting means such as is illustrated in Patent No. 2,470,695, issued May 17, 1949. In the particular case illustrated the trunnion 20 is carried at the lower end of the leg 14 and projects downwardly and inwardly on an axis that substantially intersects the central vertical axis of the bit structure.

The trunnion 20 is a bearing element with inner and outer bearing races 21 and 22 and with an intermediate retaining race 23. The cutter B has a flat end face 28 juxtapositioned to the face or shoulder 16 on the leg and is rotatably and anti-frictionally carried on the trunnion 20 with inner and outer bearing rollers 24 and 25 operating between the races of the trunnion and cutter, and with balls 26 operating between the retaining races of the trunnion and cutter. It will be apparent how the balls 26...
retain the cutter B on the trunnion 20 so that it is rotatable, there being a plug 27 secured in an opening in the trunnion to retain the balls 26 in proper working position.

In practice, the faces 16 and 28 are juxtapositioned close together as practical without causing drag or excessive rubbing of the two faces, and when the bit is new this closeness keeps foreign material out of the bearings. However, under actual operating conditions pressures are high and mud is, in an ordinary bit, packed between these two faces and into the bearings etc., as later described.

The cutters B are mounted on the legs 14 to have portions that depend a substantial distance below the legs. As a result of this construction, the cutters establish a cutting mechanism operable upon the bottom of the well bore X and having parts at the sides or wall of the well bore to cut to the desired gage or diameter.

The means C for handling the rotary fluid involves one or more nozzles adapted to direct said fluid in suitable jets. I have shown a nozzle 30 located on and depending some what from the main or middle portion 10 of the body A and located midway between adjacent legs 14 and which is spaced from or radially outward relative to the central longitudinal axis of the bit. The nozzle 30 is located so that its lower or discharge end is located closer to the outer peripheral portion of the bit than is the center axis thereof and includes a boss-like manifold portion 31 carried by the body A and with nozzles 30 depending therefrom midway between the legs 14 and located at the outer peripheral portion of the body. The nozzles 30 of the manifold portion 31 depend down between the cutters carried by the legs and each has an opening through it defining a flow passage 32 that is in communication with and which is supplied with fluid from the cavity 11. At the lower end of the passage 32 there is a bushing 33 of hard metal so that the nozzle is wear resisting.

In accordance with the present invention I have provided the deflecting post D that intercepts the flow or movement of mud or like fluids, and any solids, indicated by the arrow Y, to deflect it in the direction indicated by the arrow Z (see Fig. 2). Because of the mode or manner in which bits are constructed, as above set forth, and due to phenomena that occur during operation of bits in a well bore, a relatively rapid cutting action ordinarily occurs at or between the shoulder 16 on the leg 14 and the face 28 on the roller cutter B. This rapid cutting action is started along the following or trailing side 35 (see Fig. 2) of the leg 14 as a result of the outside movement of mud that is tightly packed, and which moves in the path indicated by the arrow Y. In an ordinary bit structure this flow or movement continues upwardly and around the shoulder 16 as indicated by the arrows Y' and Y" and by abrasive action eats or cuts away the shoulder 16 of the leg 14 and eventually enters into the bearings. A usual area affected by mud-cutting extends completely around the face 16, as indicated in Fig. 2 of the drawings.

In addition to said cutting action, said hard packed mud enters the interstices between the trunnion 20 and cutter B and under pressure that causes the cutter to leave the trunnion by hydraulic action. That is, the said movement of mud actually causes the cutter B to move axially inward after partial or complete destruction of the balls 26 that ordinarily retain the cutter B in proper working position. The balls 26 are readily destroyed by the mere presence of the abrasive mud pack.

The deflecting post D is provided to obstruct and cause the mud pack to move in the direction indicated by the arrow Z and is an extremely simple easily made part. The post per se is a cylindrically shaped element round in cross section and elongate in form. The outside wall 40 of the post is smooth and uninterrupted and the ends 41 and 42 of the post are flat smooth ends in parallel planes normal to the axis of the body of the post. The body of the post is of solid material, preferably of tungsten, or similar tungstened material, and it may be understood that any suitable material, such as a ceramic, may be employed, provided it is hard and wear resistant.

The deflecting post D is carried by the leg 14 of the bit structure on an axis spaced from the rotational axis of the cutter B and parallel to said axis of the cutter. As clearly shown in Fig. 2 of the drawings, the post D is carried by the leg 14 to project from the face 16 thereof. That is, the post is on an axis normal to the plane of the face 16. In practice, the above mentioned faces 16 and 28 are initially spaced somewhat in the manufacture of the bit. For example, the faces 16 and 28 are clearance for the little as .005 of an inch apart and in accordance with the invention the face 41 of the post D is installed to be flush with the face 16 while the end 42 of the post D is spaced from the bottom of the bore that carries it (later described).

The deflecting post D is located at one side of the arm 14, and specifically at the trailing side 35 thereof as clearly shown in Fig. 2. The exact position of the post D may vary as circumstances require and generally it is preferred to locate the post directly laterally of the axis of the cutter B, or in the same longitudinal line of said axis of the cutter. Also, the deflecting post is located at or near the periphery of the cutter or hub portion thereof.

In order to carry the post D, the leg 14 is machined by the drilling, or boring, of a simple straight cylindrical opening 36. The bore 36 is substantially longer than its diameter. The bore or opening 36 is on an axis normal to the plane of the face 16 and enters the leg 14 to be parallel with the axis of the cutter B. As the bit is assembled, the deflecting post D is inserted into the bore or opening 36 and projects therefrom as above set forth.

In practice, I prefer to cement the post D into the opening 36 thus eliminating the application of any pressure or heat which would affect the structure or hardness of the material forming the post, to the end that the post maintains maximum strength and hardness.

A feature of the roller bit construction of the present invention is the provision of a step or recess 45 in the face 16 thereof. The recess 45 is a peripheral recess turned in the face 16 concentric with the axis of the trunnion 20 and cutter B, and cooperates with the end face 16 to form a circumferential groove. The offset surface 45 joins the face 16 through a curved surface or fillet 46 (see Fig. 5) the fillet 46 intersecting the axis of the bore 36 and the post D. In practice, the fillet intersects the post D slightly outside of the axis of the post as indicated in Fig. 2. The groove that I employ provides for the deflection of fluid mud and abrasive solids by the post D. The groove actually follows the course usually taken by mud in an ordinary bit construction as indicated by the arrows Y' and Y". However, with the presence of the post D with its outer wall 40 exposed to the groove, abrasive materials are deflected in the direction indicated by the arrow Z. That is, the radially outward inclined wall 40 of the post D has a cam effect that deflects the said materials from their ordinarily destructive course.

It is to be understood, however, that the drill bit can be made without the step or offset surface 45 in which case the end 41 of the post D is installed flush with the face 16. In this case the face 16 is worn away to the post D forming the equivalent of the recess 45, and at the post D mud is deflected to the end that further mud-cutting is prevented.

From the foregoing it will be apparent how the deflecting post D is formed and how it is installed in working position. With the face of the post D flush with the shoulder 16 and with the wall 40 thereof exposed radially there is presented a cam element that deflects materials radially outward. The cylindrical wall 40 has deflecting action on any material flowing in the direction of the arrow Y. Note that
the post D is located inwardly toward the axis of the cutter B a sufficient distance so that the flow of mud acts or reacts from the outside half of the post D. In this way the post D, that is round in cross section, acts as a cam in order to deflect the mud outwardly only and in a radial direction as indicated by the arrow Z.

It will be apparent that as a result of the provision of the deflecting post and the particular location thereof, the flow of mud, hard packed mud, is interrupted and deflected in a direction away from the area 35 of the leg 14, which area would ordinarily be cut away by said flow. Therefore, the relatively inexpensive addition of the deflecting post D results in a bit that is not susceptible to "mud-suiting" and destruction thereby. In actual practice, said cutting action is so materially reduced as to substantially increase the effective working life of the roller bit.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

Having described my invention, I claim:

1. In an earth boring drill bit of the character described, the combination of: a body having a downward extending leg, said leg having an outer surface, a trunnion formed integrally with the leg and projecting inward therefrom, there being an annular shoulder formed at the juncture of the trunnion and the leg, a cutter rotatably mounted on the trunnion and having an annular end face confronting said shoulder, said shoulder and said end face being normal to the rotary axis of the cutter and having clearance space therebetween, said leg having a cylindrical bore of greater length than diameter and laterally spaced from said outer surface, said bore being normal to and intersecting said shoulder, and a cylindrical deflecting post of wear resisting material fixed in said bore and having an exposed end substantially flush with said shoulder and laterally spaced from said outer surface, whereby foreign material carried by said rotatable cutter into said clearance space between said shoulder and said end face and acting to enlarge said clearance space by erosion of said shoulder is deflected outward from said clearance space by a portion of the post exposed by such erosion, and thereby minimize further erosion of said shoulder.

2. In an earth boring drill bit of the character described, the combination of: a body having a downward extending leg, a trunnion formed integrally with the leg and projecting inward therefrom, there being an annular shoulder and an adjacent offset surface formed at the juncture of the trunnion and the leg, a cutter rotatably mounted on the trunnion and having an annular end face confronting said shoulder, said shoulder and said end face having clearance space therebetween and being coaxial with the rotary axis of the cutter, said offset surface cooperating with said end face to define a circumferentially extending groove therebetween, said leg having a bore of greater depth than width intersecting said shoulder and said offset surface, said bore having a longitudinal axis located radially inwardly of said offset surface, and a deflecting post of wear resisting material fixed in said bore and having an exposed end portion substantially flush with said shoulder and projecting from said offset surface, whereby foreign material carried by said rotatable cutter into said groove is deflected outward from said groove by said post to minimize erosion of said shoulder.

3. In an earth boring drill bit of the character described, the combination of: a body having a downward extending leg, a trunnion formed integrally with the leg and projecting inward therefrom, there being an annular shoulder and an adjacent offset surface formed at the juncture of the trunnion and the leg, a cutter rotatably mounted on the trunnion and having an annular end face confronting said shoulder, said shoulder and said end face being normal to the rotary axis of the cutter and having clearance space therebetween, said offset surface cooperating with said end face to define a circumferentially extending groove therebetween, said leg having a cylindrical bore of greater length than diameter and being normal to and intersecting said shoulder and said offset surface, said bore having a longitudinal axis located radially inwardly of said offset surface, and a cylindrical deflecting post of wear resisting material fixed in said bore and having an exposed end portion substantially flush with said shoulder and projecting from said offset surface, whereby foreign material carried by said rotatable cutter into said groove is deflected outward from said groove by said post to minimize erosion of said shoulder.

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