Nov. 18, 1924. 1,516,340

H. H. HOLDAWAY ET AL

ROTARY DRILLING BIT

Filed April 18, 1923

Fig. 1

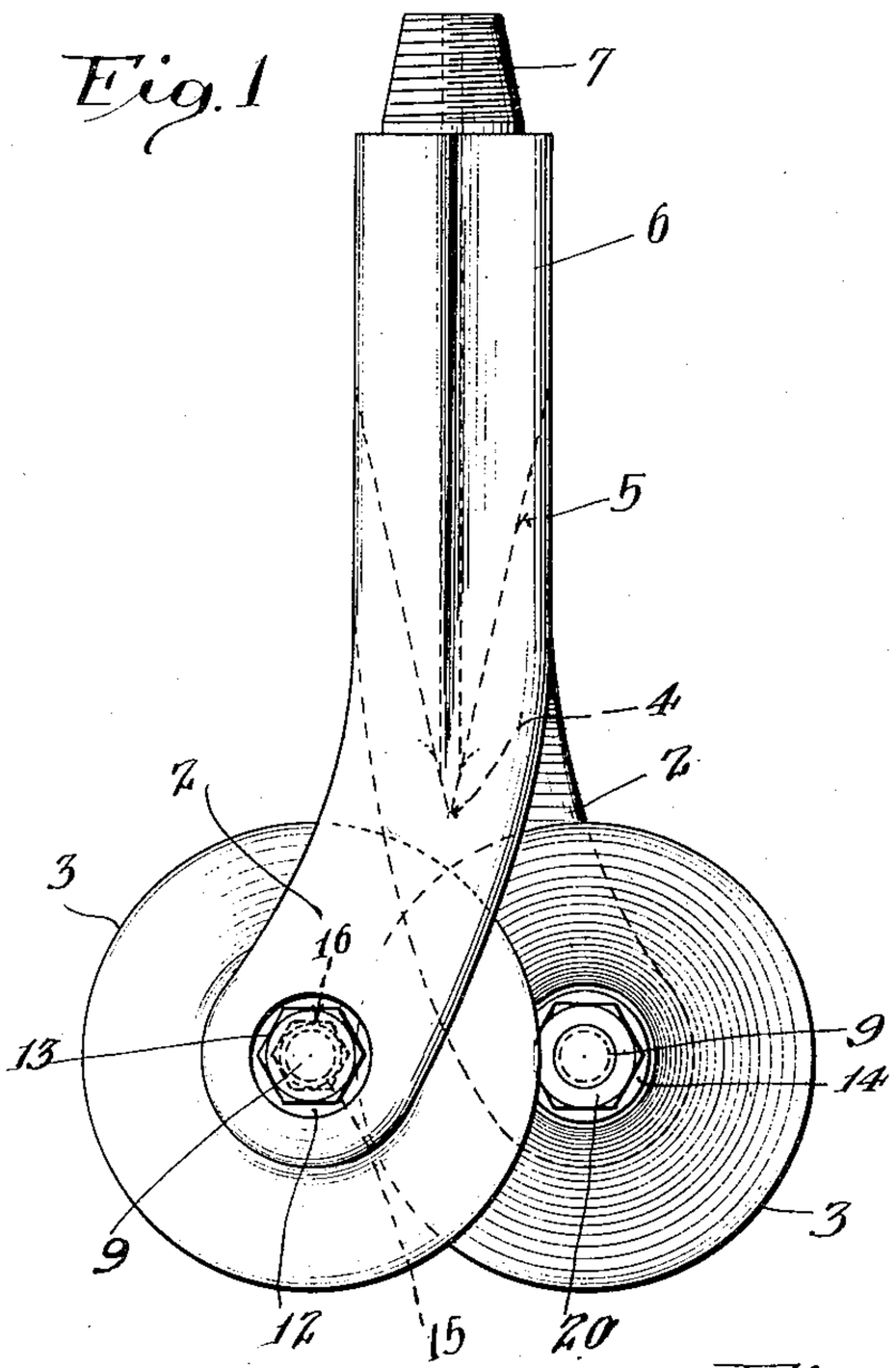


Fig. 2

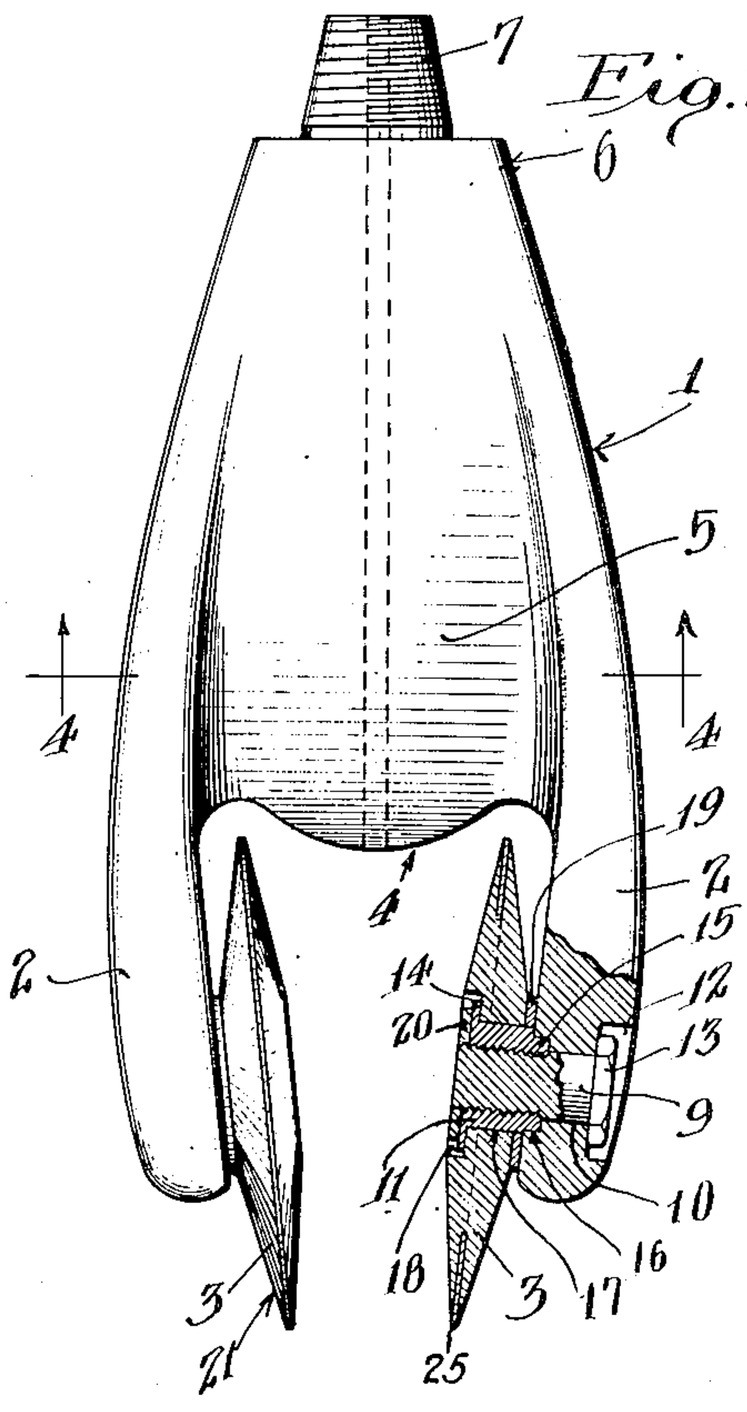


Fig. 3

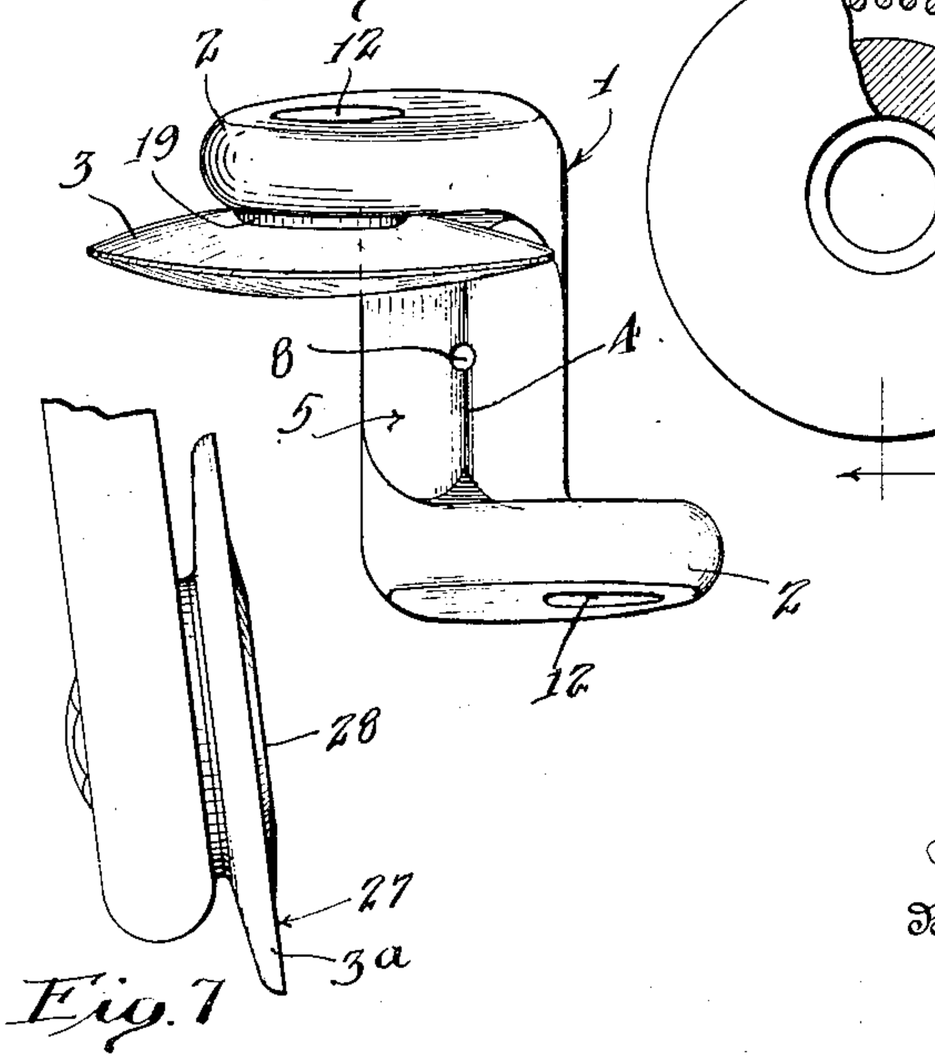


Fig. 5

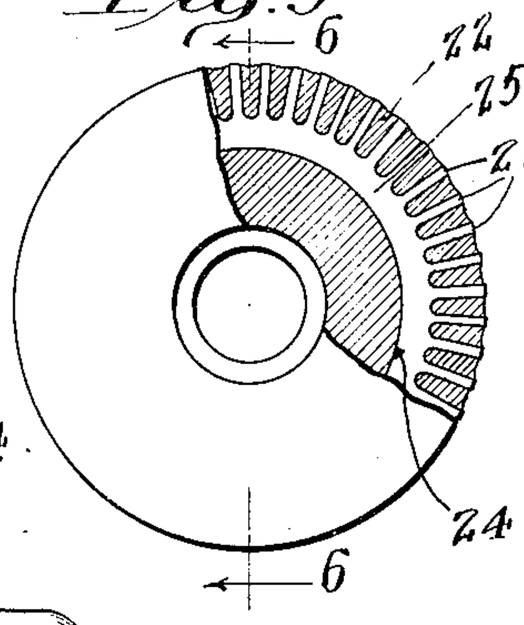
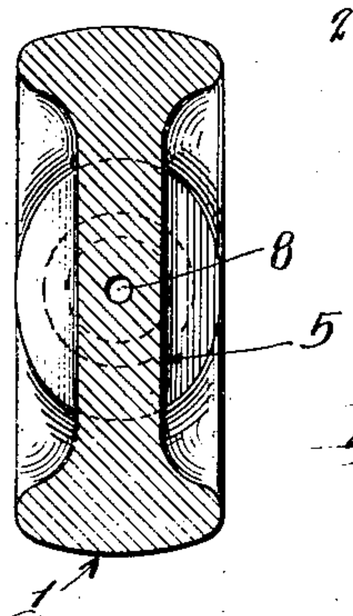


Fig. 4



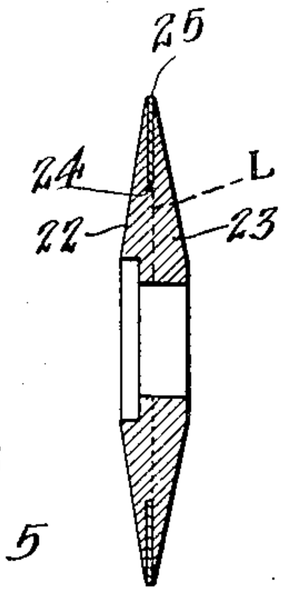


Fig. 6

Fig. 7

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UNITED STATES PATENT OFFICE.

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ROTARY DRILLING BIT.

Application filed April 18, 1923. Serial No. 632,828.

To all whom it may concern:

Be it known that we, HALL H. HOLDAWAY and ROBERT H. CHALLACOMBE, citizens of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Rotary Drilling Bit, of which the following is a specification.

This invention relates to rotary drilling bits and refers particularly to the type of rotary disc bits employed in drilling oil wells and the like.

The disc bits heretofore employed in drilling oil wells have had a marked tendency to clog and become packed with mud during the drilling operation, which clogging seriously interferes with the drilling operation. In drilling oil wells it frequently happens that a shale formation is encountered in which the débris cut by the bit, when wet with the water forced down to the bit, becomes sticky, packing upon the under face of the body of the disc cutters, packing around any recess or against any shoulder on the body of the disc bit, filling the concave surfaces of the customary convex-concave disc cutters, and packing around the bit between the bit and the well hole to such an extent that the disc bit must frequently be removed from the well and some other type of bit inserted in its place which will more thoroughly mix the mud with the water or plaster the mud into the sides of the well and so permit further drilling operations.

An object of this invention is to provide a rotary bit in which the débris cut by the disc cutters when forced upward against the body will be prevented from adhering or packing against the body and will be forced away from the body and mixed with the flushing fluid or packed against the sides of the well.

More specifically one of the objects of this invention is to provide a drilling bit with a body having a wedged edge between the legs which edge will act to divide the débris forced upward between the legs of the body and prevent the débris from packing against the under surface of the main portion of the body.

Another object of this invention is to provide a drilling bit of the disc type with a body having a relatively flat thin shape which will more thoroughly mix the mud with the flushing fluid and which flat thin shape will serve as a paddle to plaster the mud against the sides of the well during the operation of the bit and will materially eliminate the clogging of the bit heretofore encountered.

Another object of this invention is to provide a bit with legs for supporting the disc cutters with a body having a wedged edge between the legs and having a relatively flat stream line paddle shape above the edge, which body is substantially void of shoulders or recesses which might tend to clog or accumulate mud during drilling of the bit.

Another object of this invention is to provide a drilling bit with spaced legs having disc cutters independently mounted therebetween leaving a mud clearing throat between the discs which bit is characterized by having the disc cutters mounted at an angle from the vertical to better insure the free passage of mud leaving the edge of the discs up through the throat between the cutters, thereby aiding the bit in mixing the mud with the flushing fluid.

Another object of this invention is to provide a rotary bit with spaced legs mounting disc cutters therebetween which cutters are substantially free from recesses or concave surfaces or shoulders, which tend to accumulate mud and clog the bit.

Another object of this invention is to provide a drilling bit in which the disc cutters may be more readily mounted on the bit and in which the pins mounting the cutters may be inserted from the outer sides of the legs of the bit. Heretofore, when mounting disc cutters between the spaced legs on a rotary disc bit the disc cutters have been secured to the legs by pins inserted first through the disc cutters and then into the inner sides of the legs. The limited space between the legs makes the assemblage of the disc cutters in this fashion extremely difficult. By the improved disc mounting of this invention the disc cutters may be more readily assembled than the cutters of the prior type of disc bits.

Another object of this invention is to provide a double convex disc cutter having a self sharpening edge (i. e. an edge which

will be maintained sharp during the drilling of the bit) and a more limited object is to provide a self sharpening disc cutter with a serrated cutting edge which serrated cutting edge will be maintained during the drilling of the bit.

Various other objects of this invention will be apparent from the description hereinafter contained and will present themselves in the practice of the same. In the following description we have set forth a practical method in which our invention may be conveniently practiced and have illustrated the several improvements of our invention embodied in a single rotary drilling bit. We desire to be understood that such description is for the purpose of illustration and by the way of example, and it is not the intention to limit the invention to the specific embodiment or methods of embodiments herein described.

In the drawings—

Figure 1 is a side elevation of a rotary disc bit embodying the invention.

Fig. 2 is an elevation at right angles to Fig. 1.

Fig. 3 is a bottom view of Figure 1 with one of the disc cutters removed.

Fig. 4 is a section on the line 4—4, of Figure 2.

Fig. 5 is an elevation of one of the disc cutters partially in section.

Fig. 6 is a section on the line 6—6 of Figure 5.

Fig. 7 illustrates a modified form of disc cutter and method of mounting the same.

Referring to the drawings, 1 generally indicates the body of the bit which is provided with opposed legs 2 extending below the major portion of the body. The legs are preferably bowed as indicated in Figure 2. Each leg 2 serves to support or mount a disc cutter 3, which cutters are disposed between the legs 2 and mounted thereon at an agle to the vertical. The legs 2 are bent slightly from the center of the bit to maintain the disc cutters in advance of each other as indicated in Figure 3. Between the legs 2 the body 1 of the bit is provided with a wedge edge 4, which edge serves to cut material forced up between the legs and eliminates clogging of material against the body of the bit. Above the bowed legs 2 the body of the bit is relatively flat and wide, as indicated at 5, having substantially a paddle shape with the surfaces of the bit forming this paddle shape having stream lines to provide a minimum clogging or packing tendency of the bit. The upper end of the body 1 is formed with a pin 7 for attachment to a stand of drilling pipe, preferably the pin being of a size so that when the drill pipe is attached thereto the outer surface of the drill pipe will be flush with the stream line surfaces 6 of the paddle shaped portion 5 of the said tool. The bowed legs 2 join the paddle shaped portion 5 of the body with a minimum of recesses or shoulders as indicated in Figures 3 and 4. 8 indicates a water duct preferably joining the lower end of the edge 4 through which water may be flushed against the disc cutters or material cut by the cutters.

To facilitate the assemblage of the discs we have provided a novel form of disc mounting wherein a pin 9 is inserted through an aperture 10 from the outer side of each bowed leg 2 and screwed into a bushing 11 on the inner side of the leg. Preferably a recess 12 is provided in the outer side of the bowed leg 2 in which the head 13 of the pin may seat to eliminate any shoulder or surface to which mud might cling during operation of the bit. The bushing 11 is cylindrical in shape and is provided at its end nearest the drilling axis of the bit with an annular flange 14 and at its opposite end with a protuberance 15 which fits in a complementary recess 16 in the inner side of the bowed leg 2. Said protuberance 15 is shaped to engage the recess 16 and hold the bushing 11 from rotating with respect to the leg, in this case it is illustrated as hexagonal, as shown by dotted lines in Figure 1. The disc cutters 3 are rotatably mounted upon the bushings 11 having a central bore 17 for fitting the cylindrical surface of the bushing and provided with an enlarged bore 18 which fits over the flange 14 so that such disc cutters 3 are held by the flange 14 on the bushing 11. 19 indicates a washer disposed between the disc cutter 3 and the leg 2. In the preferred form of the invention a lock nut 20 is provided on the end of the pin 9 for more securely retaining the bushing on the pin. The legs 2 being bowed, the disc cutters 3 are accordingly mounted at an angle to the drilling axis of the bit. The disc cutters being thus mounted at an angle to the drilling axis of the bit, when the bit is rotated, the tendency of the cutters 3 to rotate during the drilling operation will be materially increased resulting in a more efficient use of the cutting edge of the disc and materially aiding in eliminating the clogging tendency thereof.

The surfaces 21 of the cutters 3 are preferably substantially convex in form or protruding from the plane of the cutting edge of the disc on each side of the plane so that no concavity for accumulating mud is provided. The convex surfaces 21 of the disc may be either spherical shape or frusto-conical, as indicated in the drawings. When employing a frusto-conical surface preferably the element of the surface joining the lower edge of the cutter should be substantially vertical as indicated in Figure 2, so

that the throat between the two disc cutters 3 is at no place of less size than at the lower cutting edges of the disc cutters 3.

Preferably disc cutters 3 should be composed of differential composition with the material forming the cutting edge of the disc of a relatively hard nature and supported at both sides by a relatively soft but tough body, so that in operation the relatively hard material forming the cutting edge of the disc will have a greater resistance to abrasion than the relatively soft material, which soft material will wear more rapidly than material intended to form a cutting edge, thus continually exposing a sharp cutting edge on the disc cutters.

Referring to Figures 5 and 6 of the drawings, a preferred method of so constructing the disc cutters is illustrated. The disc cutter is first formed in two relatively soft, tough body parts 22 and 23, both substantially disc shaped and comprising approximately a half of the body of the disc cutter with the part 22 slightly larger as indicated by the dotted line L in Figure 6, which line L indicates a surface of each part 22 or 23 before the same are joined together. The part 22 is provided with a recess 24 around the periphery in which a circular ring 25 is inserted, which ring is of a relatively hard material adapted to withstand abrasion and is intended to form the cutting edge of the disc. If preferred the edge of said plate 25 may be cut with radially extending teeth 26 which join the cutting edge only at spaced points therealong and the body portion 22 may be so recessed to fill the intervening space between such radially extending teeth 26 and form the remainder of the cutting edge. The parts 22, 23 and 25 are welded together by some suitable method such as spot welding to form an integral disc cutter.

By this construction the cutting edge of the disc is supported at both sides by a soft tough body which prevents fracture of the hard material forming the cutting edge of the disc and will wear away relatively more rapidly than the plate 25 continually exposing a relatively sharp cutting edge. If the preferred form of construction having radial teeth 26 is employed, the resulting cutting edge will be serrated and will be retained serrated during drilling of the bit, since the intervening material between the radial teeth 26 is relatively softer than such teeth 26.

By this construction of a rotary drilling bit the disc cutters 3 may be more readily assembled on the legs 2. The cutting edge of the disc will be less affected by abrasion and a sharp edge continually presented to the formation. The relatively flat paddle shape of the body will enable the body of the bit to more thoroughly mix the mud with the flushing water sent down through the duct 8 and plaster the same against the sides of the well. This plastering of the same against the sides of the well is commonly known to the art as "puddling" and hitherto has not been accomplished by a disc type of bit but could only be accomplished by a "fish tailed" bit. The edge 4 of the bit will divide the débris forced upward from the disc cutters 3 preventing packing of the débris against the body, and the surfaces of the body of the bit being curving and substantially stream line, will eliminate packing of the mud or débris on the bit.

The opposed disc cutters 3, being mounted on bushings 11, which bushings are held to the body 1 of the bit by pins or bolts 7 inserted through the outer sides of the legs 2 of the bit, permit the bit being designed to bring the disc cutters close together. It should be apparent that, with those types of rotary disc bits, which employ pins inserted through the discs and into the leg from the space between the discs, the discs must be mounted a sufficient distance apart to leave room for the insertion of the pins, whereas with the disc bit of this invention, the pins being inserted from the outer sides of the legs, it is not necessary to leave a considerable space between the discs for the assembly operations. Thus, if desired, the bit may be designed to bring the legs close together and in such position larger cutters may be employed on the bit for drilling a given size well hole, as when the discs are brought closer to the center of the bit they can be made more nearly of a size corresponding to the diameter of the well hole. It is not intended, however, to limit the invention to a disc bit so designed.

Referring to Figure 7, a somewhat modified form of disc cutter 3^a is shown. This disc cutter has a convex back face and the front of the disc is provided with an annular face 27 joining the cutting edge of the cutter, which annular face 27 is flat, i. e.—lies in a plane parallel to the plane of rotation of the disc, and joining the annular face 27 is a frustro-conical face 28 providing an enlarged hub for the disc. The surfaces of this frustro-conical face are angled or tapered so that the element of the frustro-conical surface adjoining the lower point of the disc is always vertical, thus in passing by such face 28 the mud has a straight passage and thus maintains the low clogging tendency of the disc shown in the previous forms of the invention.

While the drilling bit herein described is well suited for the purposes of this invention, it is not intended to limit the invention to the particular embodiment herein described, but the same is capable of various modifications.

This invention is of the scope set forth in the accompanying claims.

We claim:

1. A drilling bit having a body with bowed legs extending below the body, said body having a wedge edge between the legs and having a relatively flat stream-lined paddle shape above the edge, and disc cutters mounted on the legs with the plane of their cutting edges at an angle with the drilling axis of the bit, said cutters having both surfaces substantially convex in form.

2. A drilling bit having a body with legs extending below the body, said body having a wedge edge between the legs and having a relatively flat paddle shape above the edge, with stream-lined surfaces forming the paddle shape, whereby in operation mud forced upwardly between the legs will be divided by the edge and prevented by the stream lined surfaces thereabove from packing against the body and forced outward by the paddle shape of the body and plastered against the sides of the well.

3. A drilling bit having a body with legs extending below the body and a mud dividing edge between the legs with the body having stream lined surfaces and having a relatively flat and wide paddle shape, and disc cutters mounted on the legs.

4. A rotary drilling bit having a body, a pin passing through the body and locked to a bushing and a disc cutter rotably mounted on said bushing, said bushing having an annular flange retaining the cutter thereon and having a protuberance engaging the body for locking the bushing from rotation with respect to the body.

5. A rotary drilling bit having a body with spaced converging legs, and inclined disc cutters rotably mounted by the legs in advance of the drilling axis of the bit, the surface of said cutters extending each side of the plane of the peripheral cutting edge of the cutters.

6. A rotary drilling bit having a body with spaced converging legs, and inclined disc cutters rotably mounted by the legs in advance of the drilling axis of the bit, each cutter having an inner conical surface with the element of said conical surface joining the lower edge of the cutter substantially vertical to provide a minimum clogging tendency in the bit.

7. A rotary drilling bit of differential composition having a relatively thin hard cutting face reinforced at both sides by a relatively soft but tough body, said cutting face forming a plurality of cutting teeth on the disc cutter with the soft body substantially filling the intervening space between said teeth.

8. A drilling bit having a body with legs extending below the body and a mud dividing edge between the legs, the body being tapered upwardly from the edge, and disc cutters mounted on and between the legs.

9. A drilling bit having a body with spaced legs extending below the body and inclined inwardly, said body having a wedge edge between the legs and disc cutters mounted on the legs and positioned between the legs, there being a mud clearing throat between the disc cutters.

10. A rotary bit comprising a body having a plurality of legs extending therebelow, a pin inserted through each leg from the outer side, a bushing carried by each pin and having a protuberance engaging the body for locking the bushing from rotation relative to the body, and a disc cutter rotably mounted on each bushing, each bushing having an annular flange on its end spaced from the supporting leg, said flange engaging the cutter for retaining the same on the bushing.

11. A rotary drilling bit comprising a body with spaced legs extending below the body, pins carried by the legs, bushings carried by the pins and having cylindrical bearing sections and annular protuberances fitted into the legs, said annular protuberances being locked to the legs, and a rotable cutter mounted upon the bushing.

12. A rotary disc bit comprising a body having a plurality of legs spaced apart and extending therebelow, a pin inserted through each leg from the outer side and having a free end extending beyond the inner side of the leg, a bushing carried by each pin and having an end extending entirely around the pin and fitted to a recess on the inner side of the leg, said extension being locked from rotation with respect to the leg, annular flanges on the ends of the bushings spaced from the legs, and a disc cutter mounted on each bushing.

13. A rotary drilling bit comprising a body having spaced legs extending below the body, and disc cutters rotably mounted by the legs, said cutters being disposed in planes converging below the bit, there being an expanding mud passage between the discs.

14. A rotary drilling bit comprising a body having spaced legs extending below the body and disc cutters mounted on and between legs, the cutters being disposed in planes converging below the body and in advance of the drilling axis of the bit, the inner surfaces of the discs extending beyond the plane of the peripheral cutting edges of the discs and leaving an expanding mud throat between the discs.

Signed at Los Angeles, California, this 7th day of April, 1923.

HALL H. HOLDAWAY.
ROBERT H. CHALLACOMBE.