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2,661,931

HYDRAULIC ROTARY ROCK BIT

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2 Sheets-Sheet 1

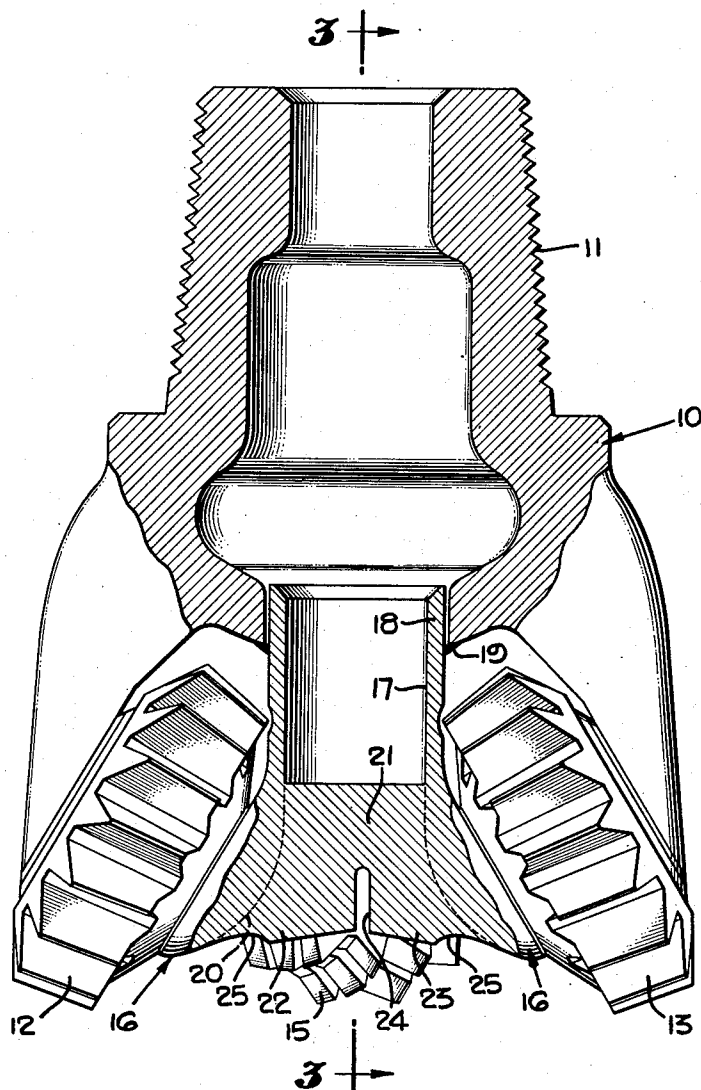


FIG. 1.

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FIG. 2.

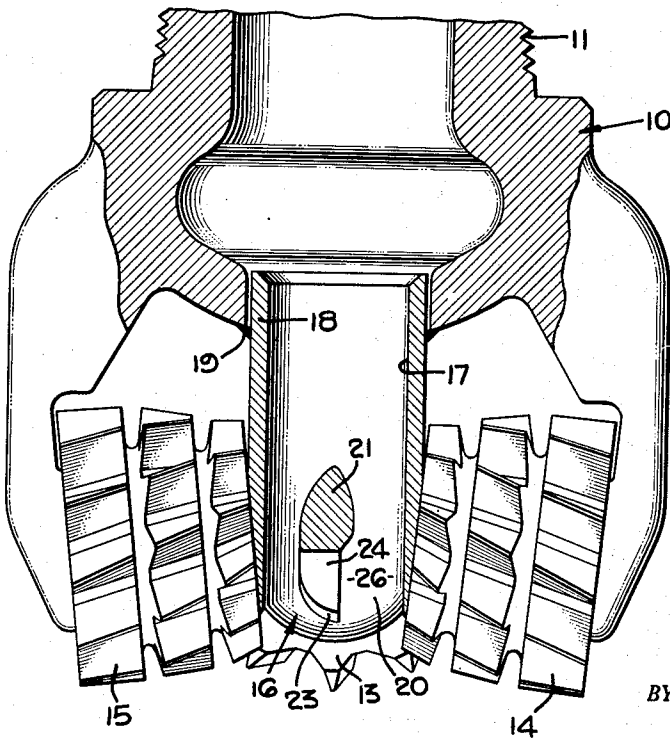
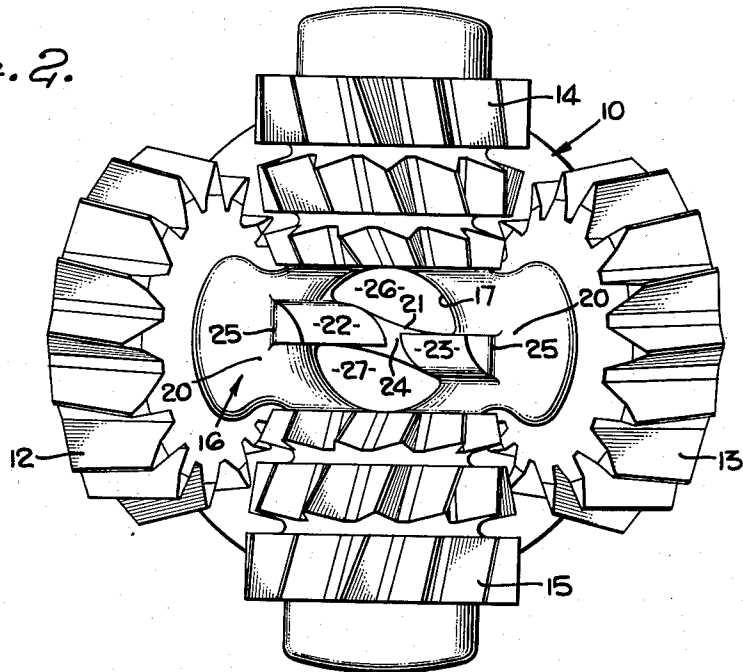


FIG. 3.

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HYDRAULIC ROTARY ROCK BIT

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3 Claims. (Cl. 255—302)

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This invention relates to improvements in roller type rotary rock bits, and particularly to that type of rotary rock bit commonly referred to as the cross-section type.

Heretofore roller rotary rock bits of the cross-section type have been constructed with two opposed rotary cutters commonly referred to as the gauge cutters, and two opposed inner cutters commonly referred to as the cross cutters or the cross-section cutters. Between the four cutters constituting this group there has been usually a bridge which cooperates with the body of the bit and particularly the arms thereof in rotatably supporting the cutters under the extremely heavy loads to which they are subjected in the course of drilling. In rotary rock bits of this character circulation ports have been provided in the body of the bit arranged to discharge the circulation fluid upon or adjacent the upper surfaces of the roller cutters on the theory that this particular location and the direction of the discharging stream of circulation fluid is necessary in order that the spaces between the cutter teeth can be properly cleaned. I have found that superior results can be obtained in a rock bit of this character by discharging either all or the major portion of the circulation fluid downwardly in an axial direction at the center of the bit so that the fluid discharged will be caused to impinge upon the bottom of the well bore and spread therefrom over the bottom of the well bore and across the bottoms of the roller cutters. In this way, the circulation fluid not only flushes the bottom of the well bore clean of cuttings, but will also clean the spaces between the cutter teeth on the individual rollers.

It is, therefore, a primary object of the invention to provide an improved roller rock bit of the cross-section type wherein there is a circulation port through which all or at least the major portion of the circulation fluid is discharged downwardly through the bridge that is arranged between the cutters of the bit.

Another object of the invention is to provide a rock bit having the above-mentioned characteristics, and wherein provision is made for breaking up or drilling up the core of formation vertically beneath the circulation port.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Figure 1 is a view in elevation of a roller rock

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bit embodying the present invention, parts being broken away and shown in vertical section on a plane extending between the gauge cutters of the bit;

Fig. 2 is a bottom plane view of the bit shown in Fig. 1; and

Fig. 3 is a sectional view taken substantially upon the line 3—3 upon Fig. 1 in the direction indicated.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, the body of the improved bit may be constructed in any conventional or preferred manner, the body being generally indicated at 10 and having a threaded pin 11 for its attachment to a drill collar on a rotary drill stem. In the bit illustrated, there are opposed gauge cutters 12 and 13 and opposed inner or cross-section cutters 14 and 15. All of these cutters are rotatably mounted against the inner sides of legs on the body of the bit and in the usual construction there is a bridge 16 disposed between the cutters extending in a longitudinal direction between the gauge cutters 12 and 13. The particular manner in which the ends of the bridge are connected to or are mounted upon the body of the bit is immaterial insofar as the present invention is concerned, and consequently, the mounting for the ends of the bridge has not been illustrated. In accordance with the present invention, this bridge has a relatively large vertical central aperture 17 formed therein which conducts the major portion, if not all, of the circulation fluid from the interior of the body 10 and discharges it centrally against the bottom of the well bore. The bridge has an upwardly extending tubular extension 18 which may be welded as at 19 to the body of the bit and provides the upper end of the aperture 17. Near the bottom of the bridge the aperture 17 is flared out toward the gauge cutters 12 and 13 as indicated at 20 and a web 21 extends across this flared portion of the aperture. This web has its ends 22 and 23 offset with relation to each other and shaped to provide two cutters of a drag bit separated from each other by a vertical slot 24. One of the blades extends to the axis of the bit but the other blade may terminate a short distance therefrom as illustrated in Fig. 2.

A feature of the invention concerns the relationship of the cutting edges of the blades with relation to the roots of the teeth of the cross-section cutters 14 and 15. The cutting edges of these blades that form a small drag bit at the bottom of the aperture 17 are preferably hori-

zontally even with the roots of the teeth on the cross-section cutters. While this relationship may vary somewhat it should be maintained as close as is reasonably practical. If the cutting edges of the blades of the drag bit are located more than a reasonable amount below the roots of the teeth on the cross-section cutters 14 and 15 at the bottoms of these cutters, the drag bit is in effect required to cut a pilot hole in the formation and excessive wear occurs at 25 where the outer ends of the blades join with the flared ends of the aperture 17 in the bridge 16. On the other hand, if the cutting edges of the drag bit are located more than a reasonable amount above the roots of the bottom teeth on the cutters 14 and 15 a restriction in the circulation passages 26 and 27 results and there is excessive fluid cutting of adjacent metal surfaces.

It is not essential that all of the circulation fluid be discharged through the passage 17, and if desired, there may be some additional small ports in the bit arranged to discharge on top of the cutters or adjacent them. However, a major portion of the circulation fluid should be directed downwardly through the passage 17 in order to obtain optimum drilling characteristics.

In relatively soft and sticky formations, bits made in accordance with the present invention have given outstanding performance in contrast with the conventional cross-section bit which tends to "ball up" and to stop drilling due to the accumulation of cuttings in and around the cutter teeth. The discharging circulation fluid which impinges against the bottom of the well bore at the center thereof is diverted by the bottom of the well bore outwardly across the bottom, thus flushing cuttings away from the bit and as the fluid traverses between the teeth on the inner and outer cutters, it tends to wash these teeth clean. In this manner, the bottom of the well bore is maintained relatively free of cuttings and as the cutter teeth are kept in a clean condition the penetrating ability of the bit is not retarded.

In the usual construction, the bridge and its associated extension 18 are made of a single piece of metal, and while the blades of the drag bit might be made integral therewith, the simplest method of construction is to make the web that provides these blades of a separate piece and welded in place in the flared opening in the bottom of the bridge, thus in effect making it integral with the bridge.

From the above described construction it will be appreciated that an improved rotary rock bit is provided wherein the major portion of the circulation fluid is discharged downwardly centrally of the bit and on impinging against the bottom of the well bore, it is caused to flow outwardly across the bottoms of the cutters, thus flushing cuttings away from the bottom of the well bore and keeping the teeth of the cutters relatively clean. The fact that the bottom of the aperture 17 is flared as at 20 facilitates the flow of circulation fluid across the bottoms of the gauge cutters even though these cutters may be more remotely located from the axis of the bit than the cross-section cutters 14 and 15.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A rock bit comprising a hollow body attachable to a drill stem and having legs extending downwardly therefrom, toothed roller cutters rotatably mounted against the inner sides of the legs, a bridge between the cutters having a vertically extending central aperture therethrough, a tubular extension on the bridge forming a continuation of said aperture leading up to the interior of the body so as to conduct circulation fluid therefrom downwardly through the bridge, and drag bit cutters extending inwardly from the sides of the aperture having their lower edges terminating approximately horizontally even with the roots of the teeth on the roller cutters.

2. A rock bit of the cross-section type comprising a hollow body attachable to a drill stem, legs extending downwardly from the body, gauge cutters rotatably mounted against the inner sides of two opposed legs, cross-section cutters rotatably mounted against the inner sides of two other legs, a bridge extending from gauge cutter to gauge cutter and disposed between the inner ends of the cross-section cutters, means providing a passage for the discharge of circulation fluid extending from the interior of the body downwardly through the bridge, and drag bit cutters extending inwardly from the sides of the passage adjacent the lower end thereof the bottom edges of the drag bit cutters terminating approximately even with the roots of the teeth on the cross-section cutters.

3. A rock bit of the cross-section type comprising a hollow body attachable to a drill stem, legs extending downwardly from the body, gauge cutters rotatably mounted against the inner sides of two opposed legs, cross-section cutters rotatably mounted against the inner sides of two other legs, a bridge extending from gauge cutter to gauge cutter and disposed between the inner ends of the cross-section cutters, means providing a passage for the discharge of circulation fluid extending from the interior of the body downwardly through the bridge, the bottom of the passage flaring laterally toward the gauge cutters, and drag bit cutters extending inwardly from the laterally flared portion of the passage.

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