Sept. 12, 1939. W. G. HURLEY 2,173,018

COLLAPSIBLE DEEP WELL DRILL

Filed Jan. 27, 1938 2 Sheets-Sheet 1

Fig. 1.

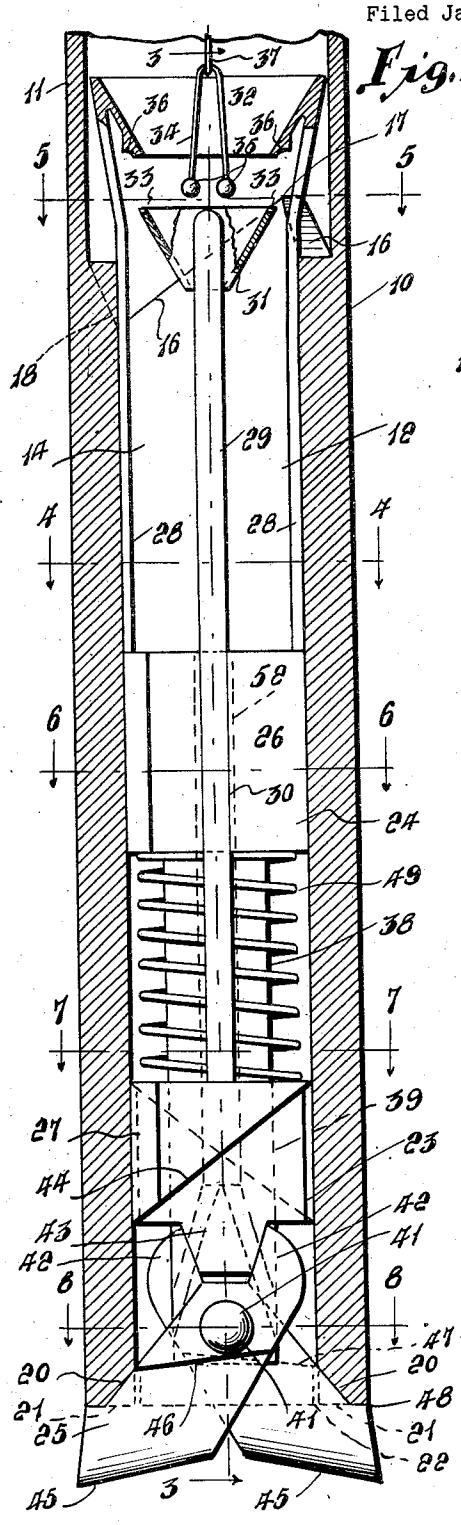


Fig. 2.

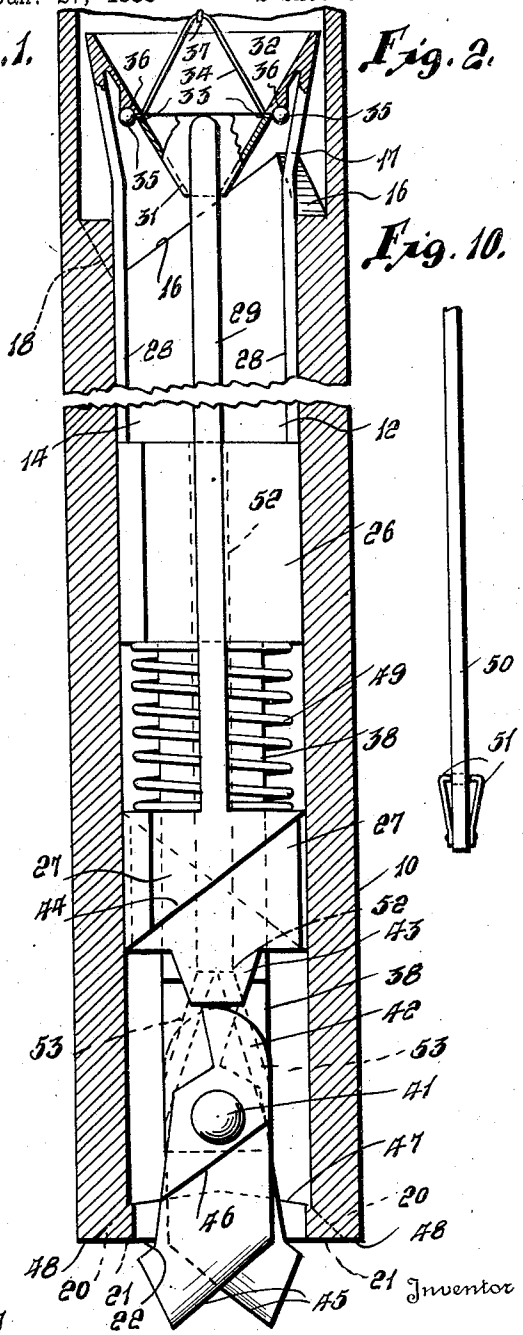


Fig. 10.

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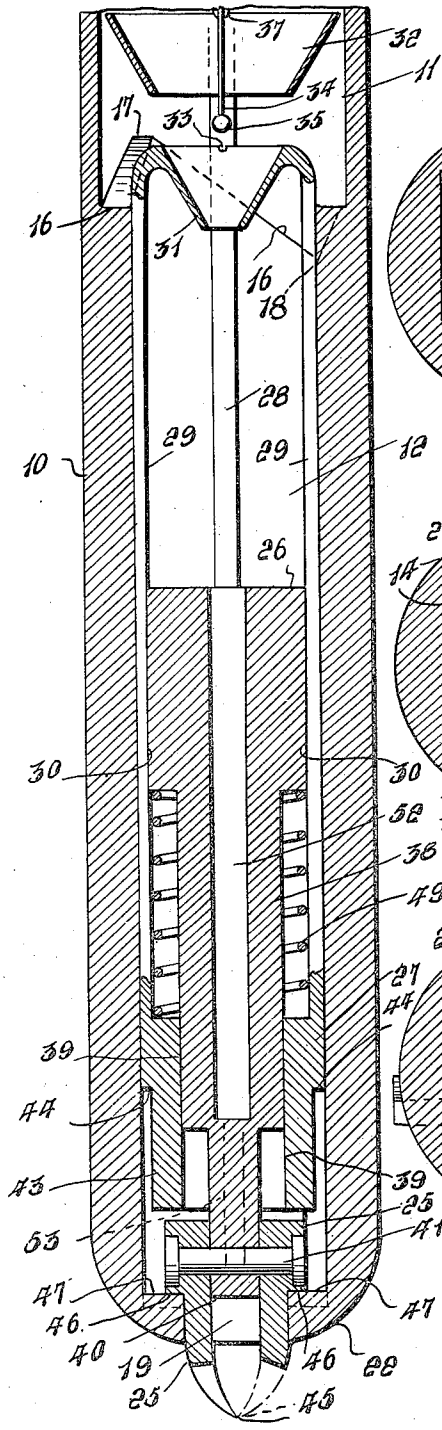


Fig. 3.

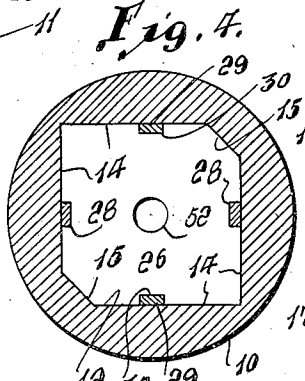


Fig. 4.

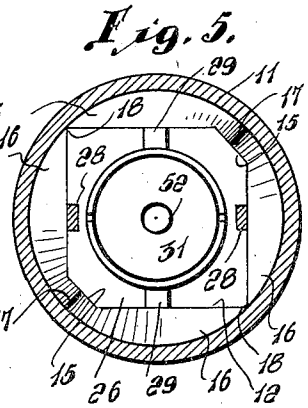


Fig. 5.

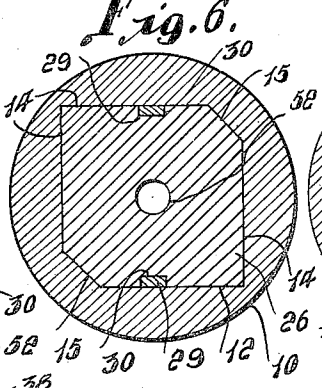


Fig. 6.

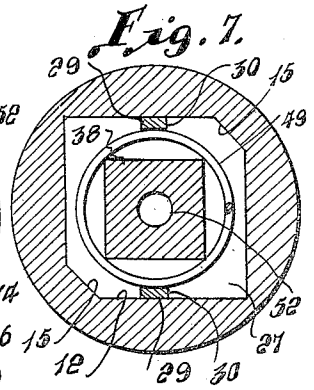


Fig. 7.

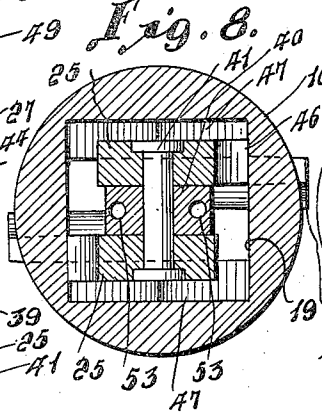


Fig. 8.

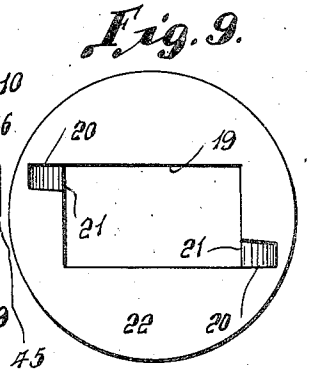


Fig. 9.

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Patented Sept. 12, 1939

2,173,018

UNITED STATES PATENT OFFICE

2,173,018

COLLAPSIBLE DEEP WELL DRILL

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Application January 27, 1938, Serial No. 187,269

10 Claims. (Cl. 255—76)

This invention relates to a collapsible drill especially adapted for drilling oil wells.

It is an important object of this invention to provide a device for use in deep well drilling whereby the drill bit can be readily withdrawn for repairs, and readily replaced when desired. This may be accomplished with the apparatus forming this invention, with much less labor and with much less loss of time.

More particularly, it is an aim of this invention to provide a drill shoe or barrel to be secured to the lower end of a drill casing and shaped to receive the drill bit carrying the blades in a collapsed position, and to open the blades when they have passed through the lower end of the shoe.

A further aim of the invention is to provide a collapsible bit, for use with said drill shoe, and including a carrier to pivotally support the drill blades; said carrier including independently supported parts mounted to be raised or lowered as a unit but releasable when in a lowermost position to permit one of said parts to move into a wedging engagement with the blades to retain them in an open position.

A further object of the invention is to provide means in the upper part of the drill shoe to guide and rotate the carrier so that the blades will be in a proper position in the shoe when they reach its lower end.

Other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, which illustrate a preferred form of the invention, and wherein:

Figure 1 is a vertical central sectional view of the lower part of the drill shoe, showing the collapsible bit, in elevation, mounted therein with the blades in open position,

Figure 2 is a view similar to Figure 1 showing the blades in a closed position being lowered with the bit,

Figure 3 is a vertical sectional view taken on the line 3—3 of Figure 1,

Figures 4, 5, 6, 7 and 8 are cross sectional views taken on the lines 4—4, 5—5, 6—6, 7—7 and 8—8 respectively, of Figure 1,

Figure 9 is a bottom plan view of the drill shoe, and

Figure 10 is a fragmentary elevational view of the lower end of a lifting rod used to withdraw the collapsible bit.

Referring more particularly to the drawings wherein like reference characters designate like or corresponding parts throughout the different views, 10 designates generally the lower part of a drill shoe, barrel or head which is adapted to be secured by any suitable means, not shown, to the lower end of a drill stem with the upper enlarged portion 11 of the bore 12 in alignment with the drill stem bore. As seen in Figure 4, the bore 12 is polygonal shaped in cross section and includes the four relatively wide sides 14 and the two oppositely disposed relatively narrow sides 15. As seen in Figure 5, the portion 11 of bore 12 is cylindrical in shape and of substantially greater diameter than the bore 12. Between the portions 11 and 12 are shoulders 16 which diverge downwardly on opposite sides of the interior of head 10 from the points 17 to the points 18 for a purpose to be hereinafter explained. The lower closed end of head 10 is provided with a rectangular opening communicating with bore 12. On opposite sides and at opposite ends of the rectangular opening 19 are formed the diagonal shoulders 20 which form the slots 21 which communicate with opening 19 for a purpose which will hereinafter be described. The lower end of head 10 is generally rounded as seen at 22.

The collapsible bit which is adapted to be readily lowered through the drill casing, not shown, into the drill head 10 and to be conversely removed, comprises generally the collapsible bit designated 23 and which includes the carrier 24 and the blades 25.

The carrier 24 comprises the blocks 26 and 27 having the upwardly projecting, oppositely disposed straps 28 and 29 respectively arranged in pairs at right angles to each other. The block 27 which is mounted beneath block 26 has its straps 29 extending through slots 30 in the opposite sides of the block 26.

As seen in Figure 3 the upper ends of the straps 29 are secured to the funnel shaped member 31, while the upper ends of the straps 28, as seen in Figure 1 are secured to the funnel shaped member 32 which is disposed above member 31.

As seen in Figure 1 funnel 31 is provided with slots 33 formed in opposite sides of its upper edge to receive the ends of a line 34. In lowering the bit 23 into the head 10 funnel 31 is in a raised position so that its upper end engages the lower end of the funnel 32. When in this position the balls 35 on the opposite ends of the line 34 will engage the outer side of funnel 31 and the flanges 36 on the lower end of the outer edge of the outer side of the funnel 32 to retain the line 34 in the slots 33. The line 34 is con-

nected to a cable 37 by which the bit 23 is lowered.

Block 26 is provided with a depending reduced shank 38 which projects through an opening 39 in the block 27. Extending through the lower reduced end 40 of the shank 38 is a bolt 41 on which is pivotally mounted the blades 25.

Blades 25 are pivotally mounted intermediate of their ends, and as seen in Figure 2 the upper ends 42 of the blades will engage the depending wedge portions 43 of the block 27 when in a collapsed position, to hold block 27 in its raised position to cause the funnel 31 to engage the funnel 32 to retain the line 34 between the funnels for lowering the bit 23.

The blocks 26 and 27 are shaped to correspond to the shape of the bore 12 in which they are adapted to slide, and the block 27 is provided with downwardly facing inclined shoulders 44 on its four long sides which are formed at an angle corresponding to the angle of the shoulders 16 with which they are adapted to engage, as the bit 23 is lowered. The 90° angled corners in bore 12 begin at the points 18, and the lower ends of the shoulders 44 terminate and converge at the lower ends of the 90° angled sides of the block 27 so that these sides are guided by shoulders 16 and 44 to the points 18 to align block 27 and bore 12. Block 26 is held in alignment with block 27 by straps 28 and will follow the latter into bore 12, so that blades 25 will be properly positioned for their cutting edges 45 to pass through opening 19.

Blades 25 are provided with the shoulders 46 formed on their outer sides and inclined upwardly to engage the upwardly projecting cam surfaces 47 on opposite sides of the opening 19 as best seen in Figure 8, to cause the ends 45 of the blades to be swung outwardly. As shoulders 46 engage the cam surfaces 47, the upper ends 42 of the blades 25 will be likewise swung outwardly from beneath the lower edge of the wedge portions 43 to release the block 27 to allow it to slide downwardly on stem 38 so that the wedge members 43 will engage the inner face of the ends 42 as seen in Figure 1 to retain the blades 25 in an open position. As seen in Figure 1 the blades 25 are shaped to fit flush with the wedges 43, shoulders 20 and with the faces 48 when in an open position. As the block 27 moves downwardly the balls 35 will be released from between the funnels 31 and 32 so that the cable 37 can be withdrawn from the drill casing.

A coil spring 49 is shown mounted on shank 38 between blocks 26 and 27 to urge the latter downwardly when released by the ends 42 of blades 25, but this may be dispensed with if desired since the weight of the block 27 will ordinarily be sufficient to cause it to move downwardly to a wedging engagement with the ends 42.

When for any reason it is necessary to remove the bit 23 a rod 50 may be lowered into the drill casing. The rod 50 is provided with a compressible spring at its lower end adapted to be compressed by the funel 31 to allow it to pass through the opening in the lower end of the funnel, so that the spring 51 will move outwardly to engage the outer side of the funnel and to permit it to be raised into engagement with funnel 32. This will raise block 27 against the action of spring 49 to the position seen in Figure 2, and further upward movement will raise the block 26 and shank 38 so that the lower ends of the blades 25 will be swung inwardly by engagement with the shoulders 20 until they are again in a collapsed position as seen in Figure 2. The raising of the block 27 will have drawn the wedge portions 43 to a position above the ends 42 so that the blades 25 are free to collapse and to remain thus while the bit 23 is being lifted out of the head 10 and drill stem for replacement or repair.

As seen in Figure 3 block 26 is provided with a bore 52 which extends into the shank 38 to communicate with the two outwardly and downwardly extending bores 53 which open outwardly in the lower end 40 as best seen in Figure 8. The bore 52 is intended to convey the cleaning fluid which is pumped from above through the drill casing to the head 10, and which is forced through bore 52 and through bores 53 which direct the fluid onto the cutting edges 45 of the blades 25 to keep the blades cool and to carry off the dirt in a conventional manner.

From the foregoing description and explanation of operation, it will be seen that a collapsible drill bit 23 has been provided including the collapsible blades 25 which may be readily raised from or lowered into the drill head 10, and including means formed in the blades 25 to engage means in the drill head to cause the blades to open into an operative position when they reach the bottom of the head 10. The head 10 is also provided with the shoulders 20 to collapse the blades when the bit 23 is raised for removal. The wedge portions 43 of the sliding block 27 insure the retention of the blades 25 in an open position when the bit 23 is left unsupported in the lower end of the head 10. It will thus be seen that the reaming operation may be accomplished as efficiently as if the blades were permanently secured to the lower end of the head 10, while at the same time by simply engaging the funnel 31 and lifting it the blades are released and collapsed so that they can be quickly and easily removed.

Only a preferred embodiment of the invention has been shown in the drawings and described, and various modifications and changes in the apparatus may obviously be made and are contemplated, and the right is expressly reserved to make such changes and modifications as fall within the spirit and scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A collapsible bit comprising a drill barrel shaped to receive the bit, a bit including a carrier and blades, the carrier being formed of a plurality of blocks mounted one above the other, said lower block being provided with an opening, a shank depending from the upper block and extending through said opening, the blades being pivotally secured to the lower end of said shank and beneath said lower block, means in said barrel, adjacent its lower end, for engaging and partially opening the blades, and spring means mounted between said blocks to cause said lower block to engage the blades to move them to a fully opened position when said carrier reaches the lower end of the drill barrel.

2. A well drill comprising a barrel provided with a polygonal shaped bore, a collapsible bit shaped to slidably engage said bore, said bit comprising a plurality of weighted members disposed one above the other and having upwardly extending supporting straps connected to supporting frames, the frame for said lower member being shaped to engage the underside of the other frame, a cable having portions at its lower

end to be engaged between said frames to support the carrier as a unit from above, a shank depending from the upper member and extending through the lower member, and blades pivotally connected intermediate of their ends to the lower end of said shank and normally held in a collapsed position by their weight, and engaging said lower member to hold it retracted, means in said barrel to engage and partially open the blades to release said lower member to move downwardly to engage said blades and force them outwardly to a fully opened position.

3. A deep well drill apparatus comprising a drill barrel secured to the lower end of a drill casing and provided with a restricted rectangular opening in its lower end, a collapsible bit adapted to be lowered through said casing and into said drill barrel, said bit comprising a plurality of weighted members, one of said members having a depending shank extending through the other member, blades pivotally connected intermediate of their ends to said shank, at its lower end, said blades being mounted to normally hang in a collapsed position, means formed in said drill barrel to engage shoulders on one of said weighted members to guide said bit to cause the blades to pass through the opening in the lower end of the barrel, and cam surfaces in said barrel to engage and partially open said blades, said lower weighted member being released by said blades to slide downwardly on said shank when the bit reaches the lower end of the barrel to engage said blades to swing them outwardly into a fully operative position.

4. A deep well drill comprising a barrel having a polygonal shaped bore communicating with a reduced opening in the bottom of the barrel, cam surfaces formed in the barrel on opposite sides of the opening, a collapsible bit shaped to be lowered into said barrel and including a pair of independently supported, weighted blocks, disposed one above the other, said upper block being provided with a depending shank extending through the lower block, blades pivotally connected to the lower end of said shank, intermediate of their ends to be normally held by their weight in a collapsed position, engaging and supporting the lower block, shoulders on said blades to engage said cams to partially open the blades as their lower ends pass through the barrel opening, and spring means mounted between said blocks to urge said lower block downwardly when released by the blades to engage the upper inner edges of said blades to swing their lower ends outwardly into a fully operative position.

5. A deep well drill comprising a drill shoe secured to the lower end of a drill casing, said shoe having a polygonal shaped bore at its lower end communicating with a reduced opening in the bottom of the shoe, a collapsible bit adapted to be lowered through the casing, and shaped to engage the bore of said shoe, and blades pivotally mounted intermediate of their ends, on the lower end of said bit, and forming a part thereof, said blades being positioned to project through the opening in the lower end of the shoe and being provided with inclined shoulders, and said shoe being provided with upwardly extending cam surfaces adapted to engage said shoulders to cause the blades to swing to an open position.

6. A deep well drill comprising a drill barrel, adapted to be mounted on the lower end of a drill casing, and having a polygonal shaped bore in its lower part communicating with a restricted opening in its lower end, cam surfaces formed in said bore above and on opposite sides of said opening, a collapsible bit shaped to be lowered through the drill casing, and to engage the bore in said barrel, and blades pivotally connected intermediate of their ends to the lower end of said bit, and forming a part thereof, said blades being provided with inclined shoulders on their outer sides to engage said cam surfaces to swing the lower ends of said blades outwardly as they pass through the opening in the lower end of the barrel, and said bit being provided with a slidably mounted wedge member released by the opening of said blades to move downwardly between the upper ends of the blades to prevent collapsing of said blades while the bit is in the lower end of said barrel.

7. A drill apparatus comprising a cylindrical drill shoe having a polygonal shaped bore in its lower part communicating with a reduced opening in its lower end, shoulders projecting upwardly, at an angle, adjacent opposite sides of said opening, a collapsible bit adapted to be lowered through a drill casing and shaped to engage the bore, said bit including independently supported blocks mounted one above the other, a shank depending from the upper block and extending through the lower block, blades pivotally connected intermediate of their ends to the lower end of said shank and normally held in a collapsed position by engagement with said lower block, means in the upper part of said shoe to guide the bit into said bore and to cause the blades to pass through the opening in the lower end of the bit, inclined shoulders on the outer sides of said blades to engage said aforementioned shoulders to swing said blades to an operative position, and spring means to urge said lower block downwardly when released by said blades to wedge the blades in an open position.

8. A deep well drill apparatus comprising a cylindrical drill shoe having a polygonal shaped bore communicating with a reduced opening in the lower end of the shoe, upwardly extending cam surfaces formed on opposite sides of said opening, a collapsible bit adapted to be raised or lowered through a drill casing and shaped to engage the bore of said shoe, blades pivotally mounted, intermediate of their ends, on the lower end of said bit, inclined shoulders formed on said blades to engage said cam surfaces when the lower ends of the blades are projecting through the shoe opening to swing said ends outwardly into an operative position, and a wedge member slidably mounted to engage the upper ends of said blades to retain them in an open position.

9. In a collapsible bit, a drill casing having a drill barrel at its lower end provided with an opening in its bottom, a pair of blocks having means for independently supporting them from above, said blocks being shaped to slidably engage the bore of said drill barrel, a stem depending from one of said blocks and extending through the other block, blades pivotally connected intermediate of their ends to the lower end of said stem, said blades being normally disposed in a collapsible position with their upper ends engaging and supporting the lower block, and cam surfaces formed in the bottom of said drill barrel to engage the blades to partially open them, as they move through the open bottom of the drill barrel, said lower block being released thereby to move downwardly on the stem, be-

tween the upper ends of the blades, to swing the blades outwardly to a fully opened position.

10. A collapsible drill bit comprising a drill barrel having a bore provided with a polygonal shaped portion at its lower end communicating with a restricted opening in its bottom, said polygonal shaped portion terminating in sloping guide shoulders at its top, a collapsible drill bit comprising weighted blocks, one of said blocks having a depending stem extending through the other block and slidably mounted therein, blades pivotally mounted intermediate of their ends on the lower end of said stem, the upper ends of said blades engaging and supporting the lower block, when in a collapsed position, shoulders formed on the outer sides of said blades, cam surfaces formed above and on opposite sides of said opening to engage said shoulders, inclined shoulders formed on the sides of said lower block to engage said guide shoulders to turn the bit relatively to the drill barrel to position the shoulders on the blades for engagement with the cam surfaces, and said blades being partially opened by said cam surfaces to release the lower block so that it can move downwardly, between the upper ends of the blades, to fully open the blades and to retain them in a fully opened position projecting through said opening.

WALTER G. HURLEY.