June 7, 1949. C. C. KOELN 2,472,710

REMOVABLE DRILLING BIT

Filed May 5, 1944

Fig. 1.

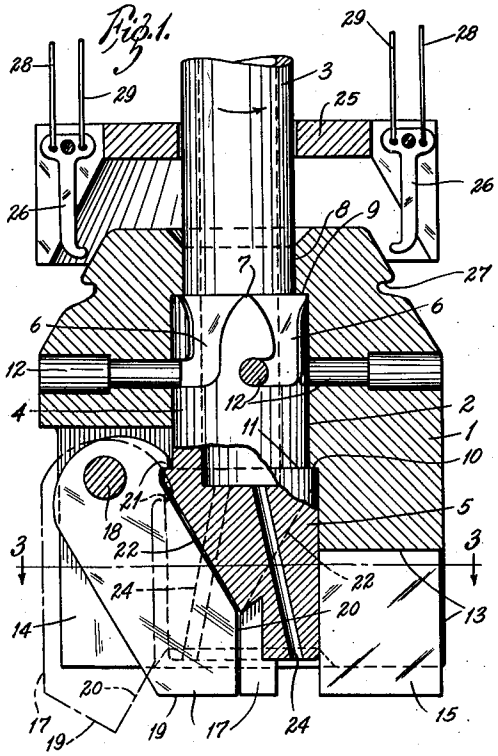


Fig. 5.

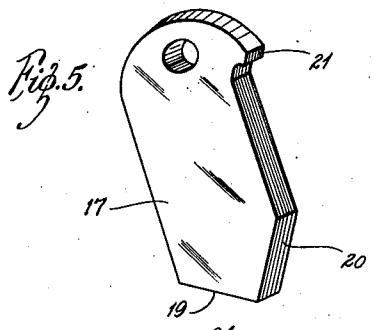


Fig. 3.

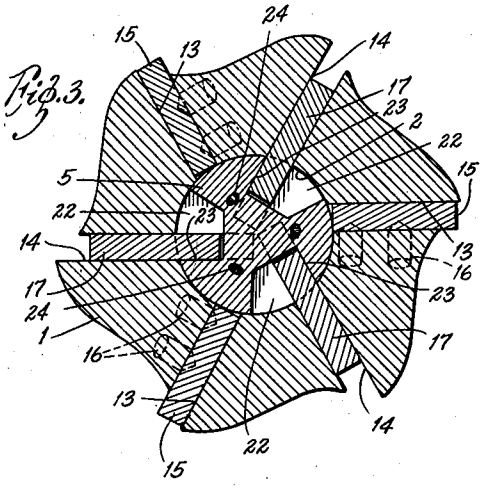


Fig. 2.

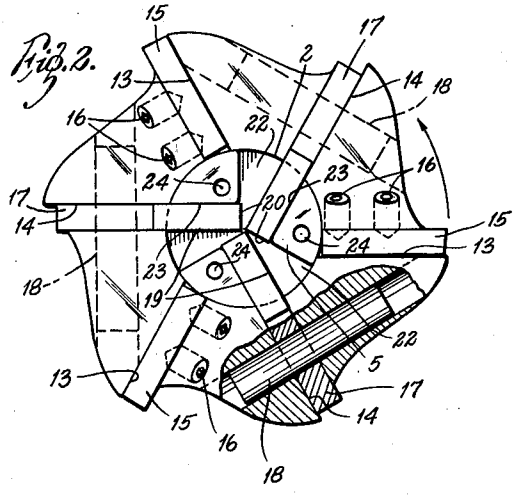
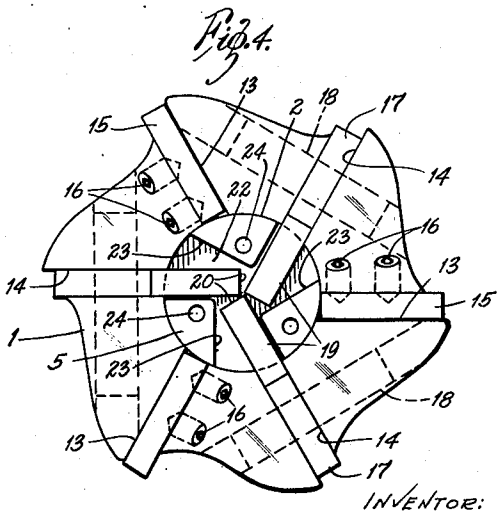


Fig. 4.



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REMOVABLE DRILLING BIT

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18 Claims. (Cl. 255—61)

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This invention relates to drilling apparatus, and more particularly to a removable drilling bit construction, said bit which embodies the invention being an improvement in the drilling bit covered by my Patent No. 2,337,720, issued December 28, 1943.

One of the objects of my invention is to produce an improved drilling bit which can be removed from the bottom of a hole being drilled without the necessity of removing the drilling shaft, said bit being so constructed that the movable cutters thereof are pivotally mounted.

Another object of my invention is to so construct a removable drilling bit embodying movable cutters as to provide means for properly supporting said cutter when in its operative position.

Other objects of my invention will become apparent from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a longitudinal sectional view of my improved drilling bit showing it in operative position on the end of a drilling shaft;

Figure 2 is a bottom view of the drilling bit shown in Figure 1;

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

Figure 4 is another bottom view showing the relation between the bit and arbor port of the shaft prior to turning of the bit to its operative position; and

Figure 5 is a perspective view of one of the pivoted cutters.

Referring to the drawing in detail, numeral 1 indicates the drilling bit body, the peripheral surface of which has an irregular contour as shown in Figures 2 and 4. This body is provided with a central bore 2 which permits it to be slid over the usual hollow drilling shaft (not shown) of the drilling apparatus. The lower end of this drilling shaft has secured to its end by threads a specially constructed short partially hollow shaft or arbor 3 forming part of the means for removably attaching the drilling bit body. The shaft 3 is provided with stepped enlargements 4 and 5 adjacent its lower end. The upper and smaller enlargement 4 has a portion of its surface cut away to form right angle slots 6. The upper ends of these slots have flared open ends with the side wall portions of adjacent slots converging to form apexes 7. The bore 2 is stepped to receive the enlargements 4 and 5 and its upper end 8 is of such diameter as to receive the portion of shaft 3 above the enlarged portion 4. The stepped arrangement of the bore 2 provides a

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shoulder 9 which is adapted to engage the apexes 7 at the top of the enlarged portion 4 on the shaft and a shoulder 10 which is adapted to engage the shoulder 11 at the top of the enlarged portion 5. The angular slots 6 have cooperating therewith the inner ends of pins 12 carried by the body portion. These pins, together with the angular slots, form a bayonet type of joint preventing any relative axial movement between the body of the bit and shaft 3 when the pins are positioned in the lateral legs of the slots. These pins also provide a driving connection between the short shaft 3 and the body of the bit so that the bit can turn with the shaft when the shaft rotates in the direction indicated by the arrow. The shoulders 9 and 11 support the bit body.

The lower end of the body of the drilling bit is provided with alternate short and long radially positioned slots 13 and 14 extending in a longitudinal direction. In the short slots 13 which extend to the bore are positioned cutters 15 in the form of blades which are held in the slots by screws 16. The outer edges of these cutters extend slightly beyond the periphery of the body member and provide a cutting edge for forming the wall of the hole, whereas the bottom edges of the cutters 15 which extend only to the bore of the body provide the cutting means for cutting away the earth substance at the bottom of the hole adjacent the side wall thereof.

In each of the long slots 14 there is positioned a cutter 17 in the form of an elongated blade, said cutter being pivotally mounted in the slot at its upper end by a pin 18, thus permitting the lower part of the cutter to swing back and forth on the pin axis. Each blade 17 is of such width that when it is hanging in a generally vertical position it will be totally within the slot 14 and thus not interfere with the sliding movement of the bit body on the drilling shaft. Each blade 17 is of special shape, being provided with a cutting edge 19 at its lower end which is angularly related to the outer longitudinal edge of the blade. Also on the lower end of the blade is an edge 20 which is substantially at right angles to the cutting edge 19 and angularly related to the inner longitudinal edge. The upper end of each cutter has a projection 21 which is arranged for cooperation with the shoulder 11 at the lower end of the shaft 3 between the enlargements 4 and 5. This projection is arranged to extend into the portion of the bore which receives the enlargement 5 when said cutter is hanging in its vertical position. In place of the cutting edge on the lower end of the cutter, there may be employed rotary cutting

elements similar to those shown in Figure 5 of my Patent No. 2,337,720.

By pivoting the blade 17 on the bit body and constructing it as shown said cutter can be swung inwardly into the bore so as to assume a position where the edge 19 will be at substantially right angles to the axis of the shaft, and thereby be employed to cut the central part of the bottom of the hole being drilled. The projection 21 on the upper end of the cutter insures that the cutter will be swung inwardly to its proper operative position, as shown in Figure 1. When the bit body is lowered and reaches the end of the shaft 3, the extension 21 will be engaged by the shoulder and the cutter 17 will be swung inwardly.

The enlarged portion 5 at the extreme end of the shaft 3 is cut away to provide recesses 22 for receiving the blades 17 when they are swung inwardly to their operative position. These recessses are of such width and shape as to permit the blades to have the necessary relative movement with respect to the shaft, so that the body member can be rotated to bring about its attachment by means of the bayonet type connecting means. When the bit body is attached to the shaft 3, the wall 23 of each slot will become positioned so as to be in abutment with the rear surface of the cutter 17 which is received in the slot, thus providing a backing means on the shaft for the portion of the blade which extends into the bore of the bit body. This backing means or abutment will prevent cutting forces acting on the cutter from being effective to twist or bend the lower part of the cutter relative to the pivotally mounted part. The enlargement 5 is also provided with passages 24 so that the hollow portion of the drilling shaft and the shaft 3 can communicate with the bottom of the hole being drilled, and thus permit fluid which is forced down through the drilling shaft to enter the bottom of the hole and aid in carrying away the cuttings from the drilling bit, as is well known in practice.

In order that the drilling bit may be lowered to the end of the drilling shaft for attachment thereto and removed to permit another drilling bit to be substituted therefor without the necessity of removing the drilling shaft from the hole, there is provided a suitable retrieving ring shown in Figure 1. This ring comprises an annular element 25 carrying pivoted hooks 26. These hooks are adapted to cooperate with an annular ledge 27 provided in the upper end of the bit body. Each hook is controlled by two cords or cables 28 and 29, which also provide means for raising the bit from the bottom of the well and also lowering it into the bottom of the well. When the bit is to be removed, the retrieving ring is lowered from the top of the well to where it is at the top of the body of the bit. The hooks can then be engaged with the ledge 27 by pulling on the cords 29. Any other suitable retrieving tool can be employed in place of the one shown.

When the drilling bit is in operative position on the drilling shaft, it is as shown in Figures 1, 2 and 3. Under these conditions, the pins 12 will be in the lateral legs of the slots where they will be maintained since the drilling shaft will be rotated in the direction of the arrows of Figures 1 and 2. The pivoted cutters 17 will be in positions where they extend into the bore of the bit body being received in the recesses 22 of the enlarged portion 5 on the lower end of the shaft. The back side of the blades will be abutting the walls 23. As the drilling shaft is rotated, the fixed cutters 15 will cut the outer portion of the bottom of the hole and the cutters 17 will cut the central portion of the bottom of the hole.

When it is desired to remove the drilling bit, the drilling shaft may be raised a few feet in order to get the bit off the bottom of the hole and to be clear of any sediment which settles in the bottom of the hole if the hole has not been allowed to be cleaned out by the circulation of fluid. The retrieving ring is dropped down to the drilling bit and its hooks connected to the ledge 27. The drilling shaft 3 is now given a slight reverse rotation which will result in the pins 12 being moved to the axial portions of the slots 6. The pivoted cutters will now be in the positions shown in Figure 4, that is, at the sides of the recesses opposite the walls 23. The bit is now free for sliding movement up the drilling shaft which is accomplished by merely pulling on the proper cables. As the bit moves upwardly, the lower end of the shaft 3 will push the pivoted cutters 17 outwardly so that they will assume a vertical hanging position totally within the slots 14, thus not interfering with the free movement of the bit up the shaft.

When a new bit is lowered for attachment to the shaft section or arbor 3 at the lower end of the drilling shaft, the cutters 17 will be hanging in their vertical positions as the bit approaches its lowermost permissible position on the shaft, the extension 21 on the cutters will engage with the shoulder 11 on the shaft 3 and the cutters 17 will be swung inwardly to their operative positions, positions which will be present when the shoulder 10 engages the shoulder 11 and the shoulder 9 engages the apexes 7, these apexes also functioning to guide the pins 12 into the slot 6. The cutters 17 now have positions in the slots 22 as shown in Figure 4. When the drilling shaft is given a rotation in the direction indicated by the arrow of Figure 1, the bit will be properly attached to the shaft and ready for operation. The retrieving ring may then be removed from the bit body or raised up the drilling shaft by proper manipulation of the cables.

Being aware of the possibility of modification in the particular drilling bit construction disclosed without departing from the fundamental principles of my invention, I do not intend that its scope be limited except as set forth by the appended claims.

What is claimed is:

1. In drilling apparatus, a rotary drilling shaft, a drilling bit body having a shaft receiving bore for permitting the bit to be slid on the shaft and attached and removed from the lower end of said shaft without removing the shaft from the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter, means for mounting the cutter on the bit body for movement to an operative position where it will cut the bottom of the hole being drilled below the shaft, and means carried by the shaft for engaging a rear portion of the cutter within the bore when the body is attached to the shaft and the cutter is in its operative position.

2. In a drilling apparatus, a rotary drilling shaft, a drilling bit body having a shaft receiving bore for permitting the bit to be slid on the shaft and attached and removed from the lower end thereof, means for attaching and detaching the body to the lower end of the shaft, a cutter carried by the body and movable into the bore to a position to cut the bottom of the hole beneath

the end of the shaft, and means for supporting the portion of the cutter within the bore comprising an abutment on the shaft engageable by a rear portion of the cutter when the bit body is attached to the shaft.

3. In a drilling apparatus, a rotary drilling shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while said shaft remains in the hole being drilled, means for attaching the bit body to and detaching it from the shaft by a relative rotary movement therebetween, a cutter carried by the bit body and capable of movement into the bore to assume a position for cutting the bottom of the hole beneath the shaft, and means providing an abutment means on the shaft engageable with the cutter to which cutting loads acting laterally on the cutter can be transferred, said abutment means and the portion of the cutter within the bore having engaging relationship when the bit body and shaft have relative movement to bring about the attachment.

4. In a drilling apparatus, a rotary drilling shaft, a drilling bit having a body arranged to be moved up and down the shaft while the shaft remains in the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter pivotally mounted on the body and capable of assuming an inoperative position permitting the body to be moved up and down on the shaft and an operative position by a pivotal movement relative to the body so as to be in a position to cut the bottom of the hole below the shaft, and co-engageable means on the cutter and the shaft for positively moving the cutter to operative position.

5. In a rotary drilling apparatus, a rotary drill shaft, a drilling bit having a body arranged to be moved up and down the shaft while the shaft remains in the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter pivotally mounted on the body and capable of assuming an inoperative position permitting the body to be moved up and down on the shaft and an operative position to project laterally from the body by a pivotal movement relative to the body so as to be in a position to cut the bottom of the hole below the shaft, co-engageable means on the cutter and the shaft for moving the cutter, and means on the shaft cooperating with a rear part of the projecting portion of the cutter and providing backing support therefor.

6. In a rotary drilling apparatus, a rotary drill shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while said shaft remains in the hole being drilled, means for attaching and detaching the bit body to the lower end of the shaft, a cutter carried by the body and mounted for movement in a single plane into the bore, co-engageable means carried by the cutter and the shaft for moving the cutter into the bore when the body assumes a position at the lower end of the shaft, and abutment means carried by the shaft and engageable with a rear part of the portion of the cutter within the bore to aid in taking the cutting load acting laterally on the cutter when the bit is attached to the shaft.

7. In a rotary drilling apparatus, a rotary drill shaft, a drilling bit body, means associated with the end of the drill shaft and with the bit body for attaching said body to the lower end of the shaft so as to be rotated therewith and while the lower end of the shaft remains in the lower part of the hole being drilled and for so detaching the body that it will be free to be moved relatively axially of the shaft to the top of the hole, a cutter pivotally mounted on the body to swing inwardly into the bore in a single plane, and means engageable by a part of the shaft for positively rotating the cutter to a position to operate on the bottom of the hole below the shaft when the body is attached to the shaft and for maintaining said cutter in such position.

8. In a drilling apparatus, a rotary drilling shaft, a drilling bit body having a shaft receiving bore for permitting the bit to be slid on the shaft and attached to and removed from the lower end thereof, means for attaching and detaching the body to the lower end of the shaft, a blade type of cutter pivoted to the body and movable in a single plane into the bore to a position to cut the bottom of the hole beneath the end of the shaft, and means for supporting a rear part of the portion of the cutter within the bore comprising an abutment on the shaft for engagement by the cutter when the bit body is attached to the shaft.

9. In a drilling apparatus, a drill shaft, a drilling bit having a body arranged to be slid up and down the shaft while the shaft remains in the hole being drilled, the lower end of the shaft being provided with shoulder means, means for attaching the bit body to and detaching it from the lower end of the shaft, a cutter pivotally mounted in the body for movement inwardly in a single plane to assume a position to cut the bottom of the hole below the shaft, and means on the cutter for engaging with the said shoulder means for causing the pivoting of the cutter to its cutting position.

10. In a drilling apparatus, a drill shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while the shaft remains in the hole being drilled and also provided with a cutter receiving slot extending in a general radial direction, the lower end of the shaft being provided with shoulder means for holding the body on the shaft and a recess below the shoulder means, means for attaching the bit body to and detaching it from the lower end of the shaft by a relative rotary movement between the body and shaft, and a cutter mounted in the body slot for movement into the body bore and the shaft recess to thereby assume a position to cut the bottom of the hole below the shaft when the bit is lowered to an attaching position, said shaft recess being of such size and so related to the cutter that the attaching relative rotary movement is not interfered with and upon completion of said attaching movement the cutter will be engaged on its rear side by a side wall of the said recess.

11. In a drilling apparatus, a rotary drilling shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while said shaft remains in the hole being drilled and also provided with a longitudinally extending cutter receiving slot, the lower end of the shaft being provided with shoulder means, means for attaching the bit body to and detaching it from the lower end of the shaft, and a cutter positioned in the slot and pivoted to the body, said cutter being provided with a projection extending into the bore for engagement by the shaft shoulder means as the bit is lowered to an attaching position to thereby cause a rotation of the cutter on its pivot and to a position where it projects into the bore of the

body and is capable of cutting the bottom surface of the hole below the shaft.

12. In a drilling apparatus, a rotary drilling shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while said shaft remains in the hole being drilled, the lower end of the shaft being provided with shoulder means, means for attaching the bit body to and detaching it from the lower end of the shaft, a cutter positioned in the slot and pivoted to the body, said cutter being provided with a projection extending into the bore for engagement by the shaft shoulder means as the bit is lowered to an attaching position to thereby cause a rotation of the cutter on its pivot and to a position where it projects into the bore of the body and is capable of cutting the bottom surface of the hole below the shaft, and means comprising abutment means on the shaft for engagement by a rear part of the portion of the cutter within the bore and to which lateral cutting loads on the cutter can be transferred when the bit is attached to the shaft.

13. In a drilling apparatus, a drill shaft, a drilling bit having a body provided with a bore for receiving the shaft to thereby permit the bit to be slid over the shaft while the shaft remains in the hole being drilled and also provided with a cutter receiving slot, the lower end of the shaft being provided with shoulder means and a recess below the shoulder means, means for attaching the bit body to and detaching it from the lower end of the shaft by a relative rotary movement between the body and shaft, and a blade type cutter positioned in the body slot and pivotally mounted to the body, said cutter being provided with a projection extending into the bore for engagement by the shaft shoulder means as the bit is lowered to an attaching position to thereby swing the cutter into the bore and the shaft recess where it is capable of cutting the bottom surface of the hole below the shaft, said shaft recess being of such size and so related to the cutter that the attaching relative rotary movement is not interfered with and upon completion of said attaching movement the cutter will be engaged on its rear side by a side wall of the recess.

14. In rotary drilling apparatus, a rotary drill shaft, a drilling bit having a body provided with a shaft receiving bore and arranged to be moved up and down the shaft while the shaft remains in the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter member pivotally mounted on the body for inward swinging movement into an operative position in a portion of the bore to thereby cut the hole below the drill shaft, the pivotal axis of said cutter being in a plane at a right angle to the plane in which the axis of the bit body lies, and means for positively preventing swinging movement of the cutter member relative to the body when the body is attached to the drill shaft.

15. In a rotary drilling apparatus, a rotary drill shaft, a drilling bit having a body provided with a shaft receiving bore and arranged to be moved up and down the shaft while the shaft remains in the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter member pivotally mounted on the body for inward swinging movement in a single plane into an operative position in a portion of the bore, and cooperating means associated with the cutter member and the shaft for positively preventing swinging of the cutter member from its operative position when the bit body is attached to the shaft and notwithstanding any unitary movement of the shaft and bit body in the axial direction of the shaft.

16. In a rotary drilling apparatus, a rotary drill shaft, a drilling bit having a body provided with a shaft receiving bore and arranged to be moved up and down the shaft while the shaft remains in the hole being drilled, means for attaching and detaching the body to the lower end of the shaft, a cutter member pivotally mounted on the body for inward swinging movement in a single plane into an operative position in a portion of the bore and co-engageable means on the shaft and the cutter for positively causing said movement by a relative longitudinal movement between the shaft and body.

17. A pivoted cutter for mounting on a removable drilling bit body having a slot and for cooperation with a drilling stem provided with shoulder means, said cutter comprising a flat body portion for reception in the slot and having a pivot pin receiving opening at its upper end whereby the body portion can be mounted to have pivotal swinging in the slot, said cutter also being provided with shoulder means at its upper end adjacent its inner edge for engagement with the stem shoulder means to thereby cause swinging of the cutter inwardly.

18. A pivoted cutter for mounting on a removable drilling bit body having a slot and for cooperation with a drilling stem provided with shoulder means and a beveled surface, said cutter comprising a flat body portion for reception in the slot and having a pivot pin receiving opening at its upper end whereby the body portion can be mounted to have pivotal swinging in the slot, said cutter also being provided with shoulder means at its upper end adjacent its inner edge for engagement with the stem shoulder means to thereby cause swinging of the cutter inwardly, and with such an inner edge surface as to fully engage the said beveled surface when the cutter moves inwardly.

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