Dec. 2, 1930. J. P. MILLER 1,783,580

DRILL BIT

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Fig. 1.

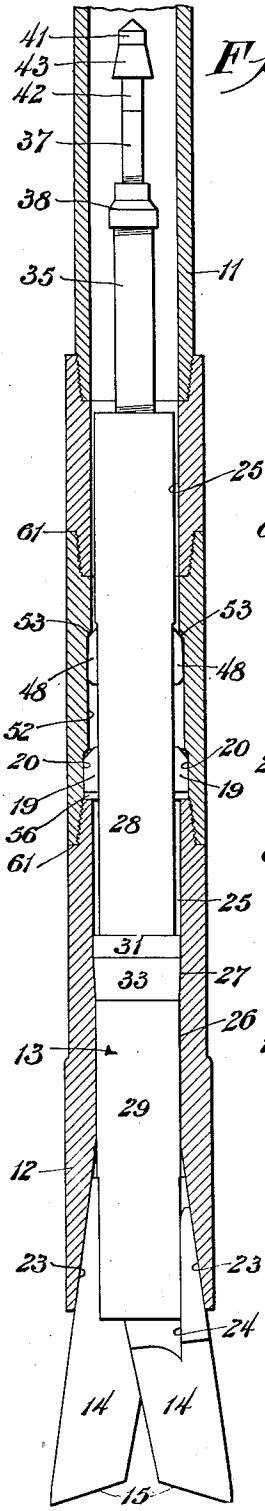


Fig. 2.

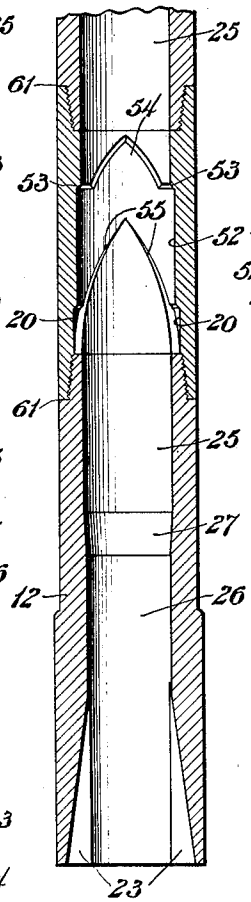


Fig. 3.

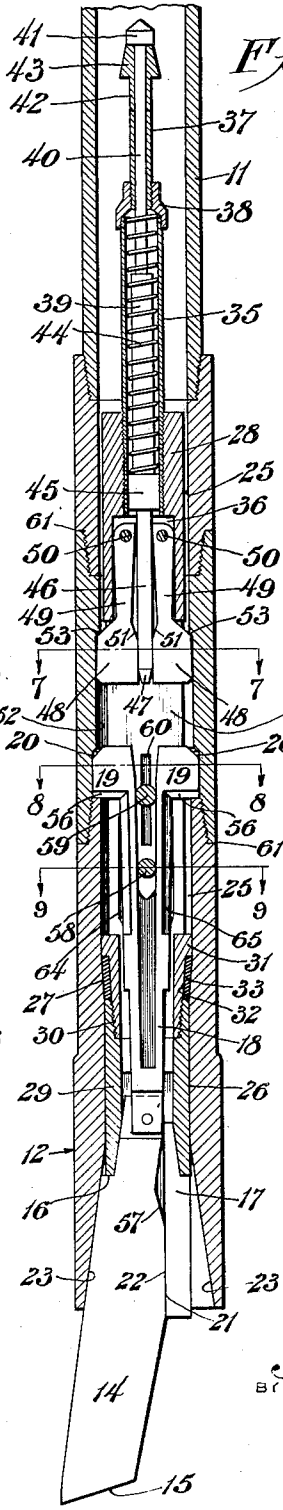
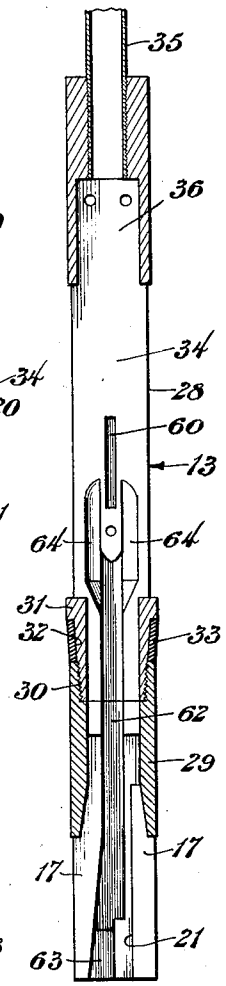


Fig. 4.



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Fig. 5.

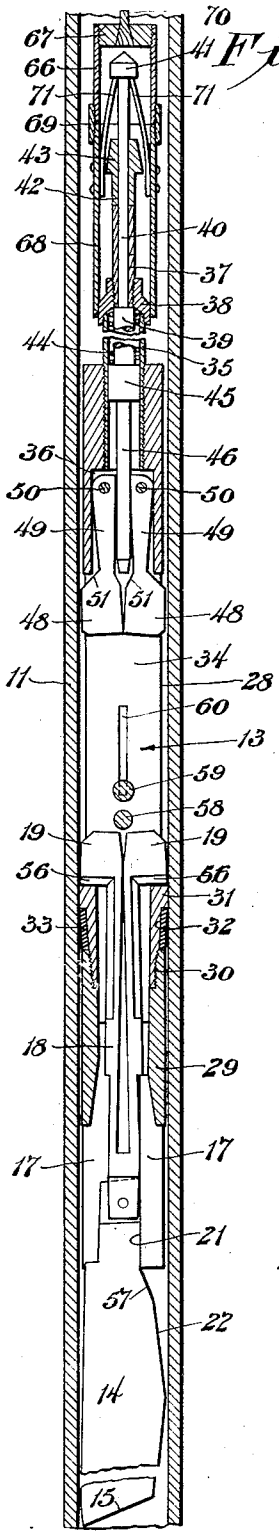


Fig. 6.

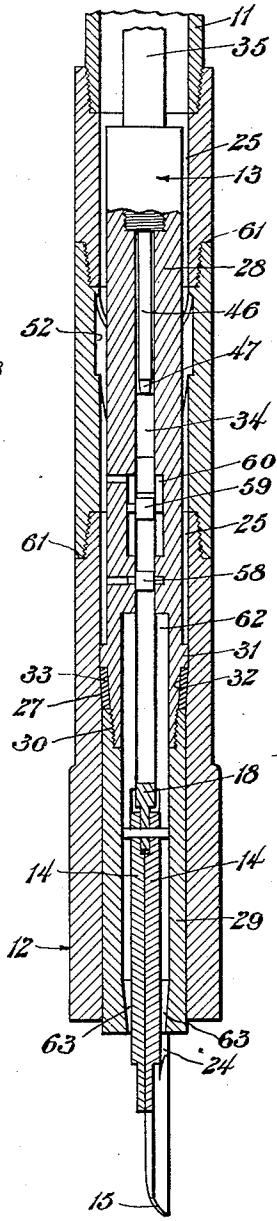


Fig. 7.

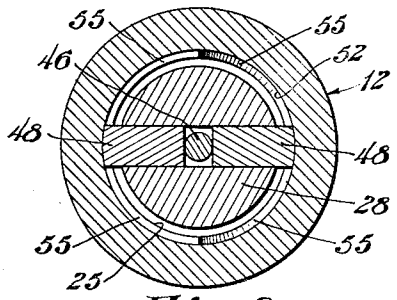


Fig. 8.

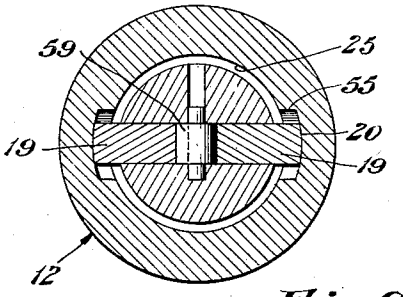


Fig. 9.

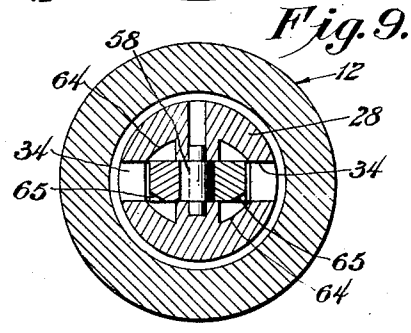
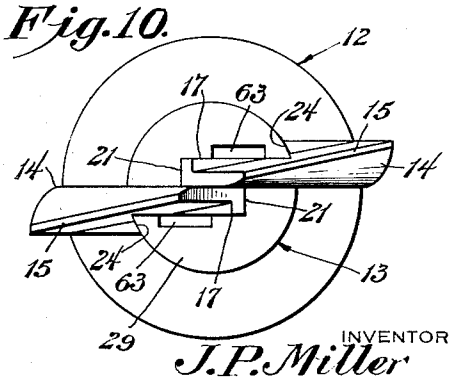


Fig. 10.



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UNITED STATES PATENT OFFICE

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DRILL BIT

Application filed November 18, 1927. Serial No. 234,185.

This invention relates to drill bits and aims among other objects, to provide an improved collapsible bit particularly adapted for boring deep wells.

In the drawings:

Fig. 1 is an elevational view of one embodiment of the bit, the barrel being shown in section;

Fig. 2 is a sectional view of the drill barrel shown in Fig. 1, the bit head being omitted;

Fig. 3 is a sectional view of the entire assembly shown in Fig. 1;

Fig. 4 is a sectional view of the bit head;

Fig. 5 is a longitudinal sectional view showing the bit blades collapsed;

Fig. 6 is a longitudinal sectional view taken at right angles to Fig. 3;

Fig. 7 is a horizontal sectional view taken on the line 7—7 of Fig. 3 and drawn on an enlarged scale;

Fig. 8 is a similar view taken on the line 8—8 of Fig. 3;

Fig. 9 is a similar view taken on the line 9—9 of Fig. 3; and

Fig. 10 is a bottom plan view of the improved drill bit and drawn on the same scale as Figs. 7, 8 and 9.

Referring particularly to the drawings, the improved bit is shown as being supported in a hollow drill stem 11, the lower end of which is threaded for connection to a tubular extension or drill barrel 12 in which a bit head 13 is removably secured. Herein, the head is provided at its lower end with overlapping collapsible blades 14 so arranged that, when the bit is in operative position, they are adapted to be held expanded as shown in Figs. 1, 3 and 10 to cut hole of larger diameter than the barrel 12.

The blades 14 are shown as being formed of elongated heavy plates of hardened steel adapted to fit flat against each other, the abutting faces being in a plane passing through the center of the bit barrel (see Figs. 6 and 10). The lower edges of the blades are inclined inwardly to provide cutting edges 15, and shoulders 16 are provided near the upper ends of the blades to abut the closed ends of slots 17 formed in the lower end of the bit head 13. The upper ends of the blades are pivotally connected to the lower end of a supporting fork 18 having spring arms which extend upwardly through a suitable opening in the head 13, and formed with outwardly extending lugs 19 on their terminals adapted to engage in recesses 20 formed in the barrel 12. As the blades overlap each other, the slots 17 are necessarily made in different parallel planes to receive them (see Fig. 10) and their inner walls 21 engage a bearing surface 22 formed on the inner edge of each blade, and hold the blades expanded with their outer edges bearing against the bottoms of upwardly converging slots 23 formed in the lower end of the collar or barrel 12. The slots 23 are somewhat wider than the slots 17 which necessitate chamfering the upper portions of the blades to provide shoulders 24, against which the outer face of the head 13 adjacent the slots 17 abuts, to assist the walls 21 in holding the blades expanded when the head is moved to its lowermost position as shown in Figs. 1 and 3.

The barrel 12 is provided with an upper bore 25, of the same diameter as that of the drill stem 11, and a lower bore 26 of smaller diameter, which bores are connected by a tapered portion 27, constituting a conical seat for the bit head 13 herein shown as comprising an upper section 28 and an extension 29, connected together by screw-threads 30 or the like. This construction is preferably such that the extension 29 may be removed from the upper section and be replaced by other extensions to cooperate with different sized bits or when the tool is used for other purposes, such as core taking and sand testing and other tools are put in the drill head.

The extension 29 is of such size as to fit snugly in the lower bore 26 of the collar 12, while the upper section 28, which is smaller in diameter than the upper bore 25 to provide a water space, is formed with a circumferential enlargement 31 near its lower end to fit the bore 25. Between the enlargement 31 and the upper end of the extension 29, a tapered seat 32 is provided in which a packing ring 33 is located to form a water tight joint in the conical seat 27 when the parts are in operative position. Above the enlarge-

ment 31, a slot or opening 34 extends through upper section from side to side, and is of such size as to permit the lugs 19 of the fork 18 and other parts to be described, to work freely therein.

To provide means for manipulating the head 13, there is shown a tube 35 which communicates with a chamber 36 forming an extension of the slot 34, and a smaller tube 37 is connected to the upper end of the tube 35 by a reducing coupling 38 or the like. A lifting and lowering rod 39 is slidably mounted within the tube 35 and is provided with a stem 40 which extends upwardly through the tube 37 and somewhat above the upper end of the same, and terminates in a head 41. Interposed between the upper end of the tube 37 and the head 41 is a short tube 42 bearing beneath the head 41 to support the stem 40 and rod 39. The tube 42 is provided at its upper end with a conical head 43 for a purpose to be later explained. The rod 39 is adapted to be forced downwardly by an expansible coiled spring 44, surrounding the rod and extending between the coupling 38 and an enlargement 45 on the rod 39 to lock some of the parts in the barrel when the rod is urged downwardly.

Herein, the locking means for the head 13 comprises a plunger 46 having a tapered end 47 which extends below the upper end of the slot 34 and co-operates with a pair of dogs 48, mounted at either side of the plunger 46. The dogs have hanger arms 49 pivoted as at 50 near the upper end of the chamber 36, said arms being so shaped as to permit the dogs to rock inwardly when the plunger is elevated, (see Fig. 5) and to rock outwardly when said plunger is forced downwardly by the spring 44, (see Fig. 3), positively forcing the dogs outwardly. They are provided on their inner edges with inclined portions 51 which are engaged by the aforesaid tapered end 47 of the plunger in its downward movement (see Figs. 3 and 5).

When the bit head is located in operative position within the barrel 12, as shown in Fig. 3, with the blades 14 expanded, the latter are prevented from moving inwardly by the abutting edges 21 and 22. Such contact also holds the outer edges of the blades in abutting relation with the bottom walls of the converging slots 23, with the result that the bit head may not move upwardly within the barrel. The dogs 48 serve to further lock the upper section 28 of bit head within the barrel when the bits are expanded in the manner aforesaid. For this purpose the collar is provided in its bore with a circumferential enlargement 52 intermediate of its length to provide upper, diametrically opposite beveled shoulders 53, adapted to be engaged by the upper ends of the dogs when they are expanded, with the result that such positive contact effectually prevents the upward movement of the bit head within the collar.

When introducing the bit head into the barrel, by lowering the same through the drill stem the parts are in the positions illustrated in Fig. 5 the dogs 48, the lugs 19 of the spring fork 18, as well as the blades 14 being retracted so as to be confined within the drill stem.

It is necessary that the blades shall be alined with their seats when they are lowered to operative position in the barrel. To this end the aforesaid enlargement 52 is shown as having upstanding portions 54 arranged at right angles to the shoulders 53 and the lower edge of the upstanding portion constitutes opposite, steeply inclined cams 55 against which the lower beveled edges 56 of the aforesaid lugs 19 engage. When said lugs have expanded into the upstanding portion 54 of the enlargement, the entire bit head turns or rotates guiding the lugs 19 into the pockets 20 with the result that the blades are in position to enter the slots 23. Also, the dogs 48 are rotated so that they engage the shoulders 53.

When the lugs 19 have come opposite to the pockets 20 they automatically expand by means of the spring fork and rest upon the bottom wall of said pockets which prevents any further downward movement of the aforesaid fork 18 and the connected blades, which are now free to be expanded into their slots 23. As the bit head descends further, the corner provided at the lower end of the walls 21 contacts with a beveled surface 57 at the upper inner edge of the blades 14 and causes the blades to be forced outwardly into active position and be held therein by the contact of the walls 21 with the edges 22 when the head descends to its lowermost position, at which time the packing ring 32 is fully seated.

To positively hold the lugs 19 in the pockets 20, the bit head section 28 is provided with a rigidly mounted roller 58, which is forced down between the arms of the fork, to a position below the lugs 19 (as shown in Fig. 3). An additional roller 59 of larger diameter than the roller 58 is loosely journaled in slots 60 in the bit head and is then free to fall between the lugs 19 where it stops and positively holds them in expanded position, the inner edges of the lugs being slightly flared to facilitate the entrance of both rollers.

The formation of the interior enlargement 52 in the collar 12 having the peculiar offset or upstanding portion 54, is of such nature as to require more or less machining and therefore, it is preferable to make the barrel sectional, so as to facilitate such machining, the joints between such sections being indicated at 61.

In order to direct the customary flow of

water on the blades, diametrically opposed grooves 62 are arranged longitudinally of the head and in the walls formed by the slot 34. These grooves extend from a point below the roller 58 nearly to the bottom of the head, where the grooves are offset and tapered inwardly as at 63. The upper portions of the grooves 62 are formed with offset beveled portions 64 flanking each side of the roller 58 and the outer edges of the arms of the fork 18 are beveled as at 65. The water entering the drill stem from above may pass between the upper part of the head 28 and the wall of the collar 12 down to the water tight joint, through the slot 34 and the space between the bevels 64 and 65 and into the slots 62 down to the tapered offset portions 63, where it is directed against the blades.

In lowering the head 13 into the barrel 12 a grapple is provided which is automatically released from the head when the said head has been operatively connected to the barrel. Referring to Fig. 5, the grapple is shown as comprising an upper sleeve 66 having a head 67 and a lower sleeve 68, connected together by a suitable coupling 69. The lower end of a cable 70 is secured in the head 67 in any approved manner and has its upper end connected to a suitable lowering and hoisting machanism (not shown). A pair of spring arms 71 are secured to the lower sleeve 68 and extend upwardly into the sleeve 66 and toward each other. These arms are adapted to engage the underside of the head 41 with the result that the bit head 13 moves downwardly relative to the head 41 and, overcoming the resistance of the spring 44, is supported on the shoulder formed between the rod 39 and the stem 40. After the bit head 13 has reached its lowermost position. the head 41 of the stem 40, under tension of the spring 44, descends as the cable 70 is paid out and when the arms 71 engage the tapered head 43, they are forced outwardly from under the head 41. Then upon upward movement of the cable, the arms pass the head 41 and the grapple may be hoisted up to the top of the drill stem. The length of the arms 71 and the sleeves 68 are such that the lower end of the sleeve engages the top of the bit head 13 and prevents the top of the arms from going below the head 43.

When the head is to be raised for any reason, the sleeve 68 is replaced by another sleeve of the same length but having shorter spring arms, with the result that when the grapple is lowered to rest on the bit head 13, the tops of the shorter spring arms automatically engage under the head 43 and upon upward movement of the cable 70, the head 43 engages under the head 41 drawing the stem 40 and rod 39 upwardly until the aforesaid shoulder on the upper end of the rod 39 engages the coupling 38. At this time the locking dogs 48 will have been released and may move inwardly to escape the shoulders 53, and upon further movement upward of the cable, the locking rollers 58 and 59 are raised from between the arms of the forks 18, permitting the lugs 19 thereof also to move inwardly free of the seats 20. At the same time, the walls 21 will have been released from their engagement with the blades permitting the said blades to swing inwardly and be drawn upwardly through the drill stem.

From the foregoing description and a study of the drawings, it will be seen that the improved collapsible bit is capable of withstanding very great torsional stresses incident to deep well boring. Further, the whole drill head can be removed without difficulty for repairs or for substitution of other tools. Moreover, the parts can be manufactured without prohibitive expense.

Obviously the present invention is not restricted to the particular embodiment thereof herein shown and described. Moreover, it is not indispensable that all the features of the invention be used conjointly, since they may be employed advantageously in various combinations and subcombinations.

What is claimed is:—

1. A drill apparatus comprising, in combination, a hollow drill stem; a bit head; a U-shaped fork having spring arms slidably mounted within the head; lugs on the fork; bit blades carried by the fork; a barrel secured to the drill stem and having seats for the blades; means associated with the lugs to aline the blades with the seats; and means integral with the bit head to expand and hold the blades in the seats.

2. A bit for rotary well boring, comprising, in combination, a hollow drill stem; a bit head having a slot extending therethrough intermediate the ends and an opening extending downwardly from said slot to the bottom of the head; said head also having side slots in its lower end; a U-shaped supporting fork having integral spring arms slidably mounted in the opening; lugs on the upper end of the arms and extending outwardly through the intermediate slot; bit blades pivoted to the fork and adapted to swing outwardly through the lower side slots; a barrel on the lower end of the drill stem and having seats for the blades; means cooperating with the lugs to aline the blades with the seats; and means to expand and hold the blades in the seats.

3. A bit for rotary well boring, comprising in combination, a hollow drill stem; a bit head having a slot extending therethrough intermediate the ends and an opening extending downwardly from said slot to the bottom of the head, said head also having lateral slots in its lower end; a supporting fork having spring arms slidably mounted in the opening; lugs on the upper end of the

arms and extending through the intermediate slot; bit blades depending from the fork and mounted to swing outwardly through the lower side slots; a barrel on the lower end of the drill stem and having seats for the blades; means co-operating with the lugs to aline the blades with the seats; said blades having cam surfaces adapted to be engaged by the bit head to expand and hold the blades in the seats.

4. A well drill comprising, in combination, a barrel; a head slidably mounted within the barrel; a pair of pivotally mounted bit blades associated with said head; means on said head to expand the bit blades when they are lowered in the barrel; shoulders formed on said bit blades and engageable by the lower portion of said head releasably to lock the bit blades in expanded position; said barrel having grooves presenting cam surfaces; and means on the head engageable with said cam surfaces to aline the blades with the seats.

5. A bit for rotary well boring, comprising, in combination, a hollow drill stem; a bit head having a slot extending therethrough intermediate the ends and opening extending downwardly from said slot to the bottom of the head; said head also having side slots in its lower end; a U-shaped supporting fork having spring arms slidably mounted in the opening; lugs on the upper end of the arms and extending outwardly through the intermediate slot; bit blades pivoted to the fork and adapted to swing outwardly through the lower side slots; a barrel on the lower end of the drill stem and having seats for the blades; means co-operating with the lugs to aline the blades with the seats; means integral with the head to expand and hold the blades in the seats; and means to lock the head in the barrel when the blades have been expanded.

6. A well drill comprising, in combination, a hollow drill stem; a bit head having a longitudinal slot extending therethrough intermediate its ends; collapsible blades associated with the head adapted to pass through the drill stem; means supporting the blades; said means being located within the head and having spring arms; lugs on the arms adapted to project from the slots; a barrel on the lower end of the drill stem having seats for the blades and seats for the lugs; cam surfaces formed in the barrel to be engaged by the lugs and aline the blades with their seats; and coacting means between the head and the blades to cause the blades to be expanded and held in their seats, when the lugs are seated.

7. A well drill comprising, in combination, a barrel; a head slidably mounted within the barrel; a pair of pivotally mounted bit blades associated with said head; means on said head to expand the bit blades when they are lowered in the barrel; means associated with said bit blades and said head releasably to lock the bit blades in expanded position; said barrel having cam surfaces adapted to be engaged by the lugs to aline the blades with the seats; and means to lock the lugs in their seats.

8. A bit for rotary well boring, comprising, in combination, a hollow drill stem; a bit head having a slot extending therethrough intermediate the ends and an opening extending downwardly from said slot to the bottom of the head; said head also having side slots in its lower end; a supporting fork having spring arms slidably mounted in the opening; lugs on the upper end of the arms and extending through the intermediate slot; bit blades pivoted to the fork and adapted to swing outwardly through the lower side slots; a barrel on the lower end of the drill stem and having seats for the blades; means co-operating with the lugs to aline the blades with the seats; means to expand and hold the blades in the seats; and means to lock the head in the barrel when the blades are expanded.

9. A well drill comprising, in combination, a hollow drill stem, a bit head having a longitudinal slot extending therethrough; collapsible blades pivotally connected to the lower end of the head; a barrel having internal slotted seats at its lower end for the blades; means integral with the head to expand and hold the blades in the seats; shoulders formed in the barrel; and pivoted dogs near the upper end of the head adapted to engage the shoulders to lock the head to the barrel.

10. A well drill comprising, in combination, a hollow drill stem; a bit head having a longitudinal slot extending therethrough intermediate its ends; collapsible blades associated with the head adapted to pass through the drill stem; means supporting the blades; said means being located within the head and having spring arms; lugs on the arms adapted to project from the slots; a barrel on the lower end of the drill stem having seats for the blades and seats for the lugs; cam surfaces formed in the barrel to be engaged by the lugs and aline the blades with their seats; coacting means between the head and the blades to cause the blades to be expanded and held in their seats, when the lugs are seated; and releasable means to hold the dogs in engagement with the shoulders.

11. A well drill comprising, in combination, a hollow drill stem; a bit head having a longitudinal slot extending therethrough intermediate its ends; collapsible blades associated with the head adapted to pass through the drill stem; means supporting the blades; said means being located within the head and having spring arms; lugs on the arms adapted to project from the slots; a barrel on the lower end of the drill stem having seats for the blades and seats for the lugs; cam surfaces formed in the barrel to be en-

gaged by the lugs and aline the blades with their seats; coacting means between the head and the blades to cause the blades to be expanded and held in their seats, when the lugs are seated; a pair of dogs adapted to engage the shoulders; and a plunger adapted to force and hold the dogs in engagement with the shoulders to lock the head to the barrel.

12. A bit for rotary well boring, comprising, in combination, a hollow drill stem; a bit head having a slot extending therethrough intermediate the ends and an opening extending downwardly from said slot to the bottom of the head; said head also having side slots in its lower end; a supporting fork having spring arms slidably mounted in the opening; lugs on the upper end of the arms and extending through the intermediate slot; bit blades and pivoted to the fork and adapted to swing outwardly through the lower side slots; a barrel on the lower end of the drill stem and having seats for the blades; means co-operating with the lugs to aline the blades with the seats; means to expand and hold the blades in the seats; means to lock the head in the barrel when the blades have been expanded; means to lock the head in the barrel when the blades are expanded; a spring-pressed plunger adapted to pass between the dogs to project and hold the dogs in engagement with the shoulders; and means to withdraw the plunger from between the dogs to permit the head to be removed from the barrel.

13. A rotary well drill comprising, in combination, a hollow drill stem; a bit head slidably mounted in the stem; a U-shaped fork carried by and slidable within the head; a pair of depending, collapsible bit blades pivoted to the lower end of said fork; means on the head to expand the blades; lugs on the upper ends of the fork; cam surfaces in the stem adapted to be engaged by the lugs to locate the blades in position to be expanded, said surfaces terminating in seats for the lugs; and means on the head to lock the lugs in the seats when the blades are expanded.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature.

JESSE P. MILLER.