J. DARLING.

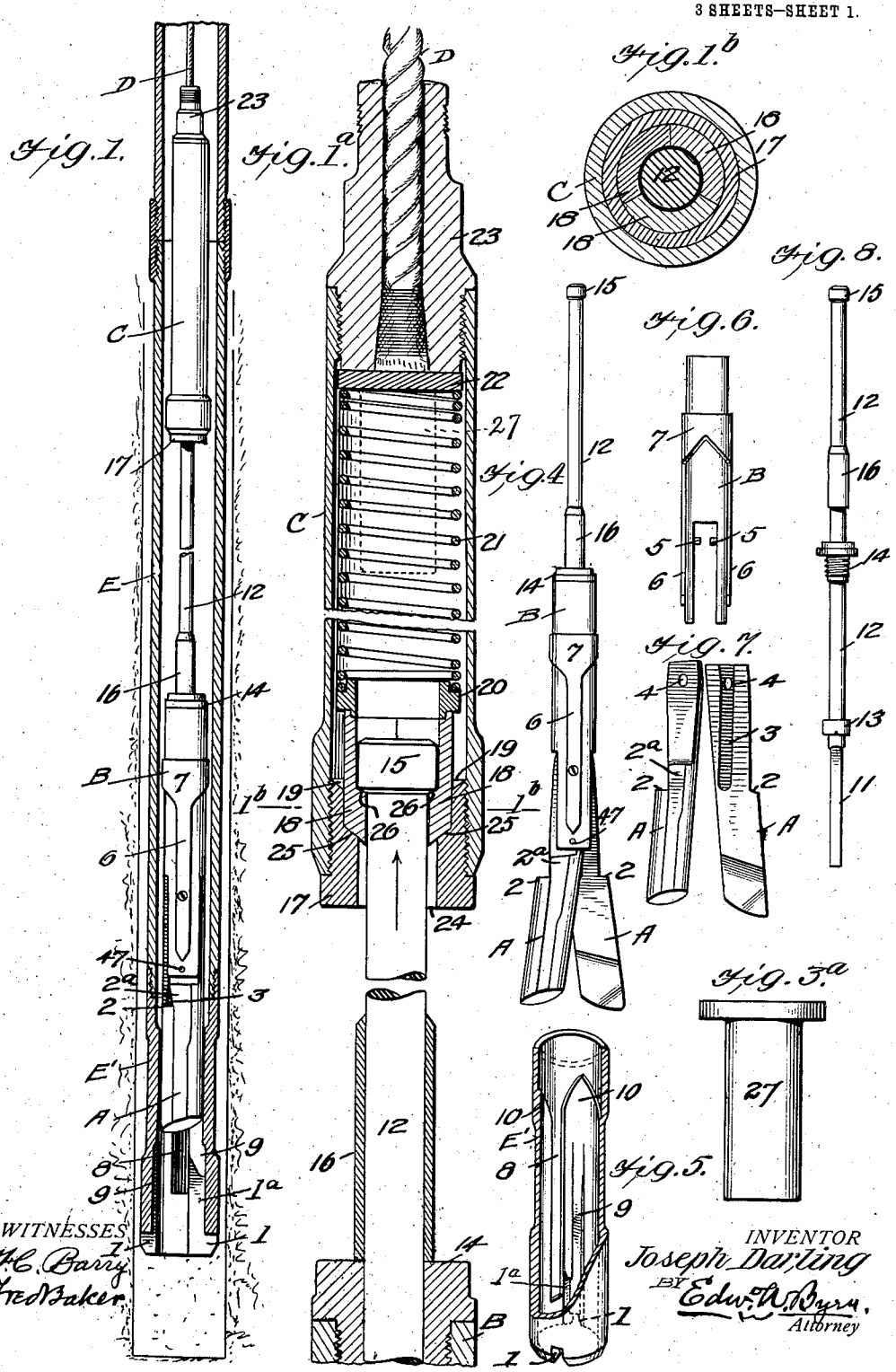
WELL DRILLING APPARATUS.

APPLICATION FILED MAY 17, 1911.

1,011,324.

Patented Dec. 12, 1911.

3 SHEETS—SHEET 1.



WITNESSES

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3 SHEETS—SHEET 2.

Fig. 2.

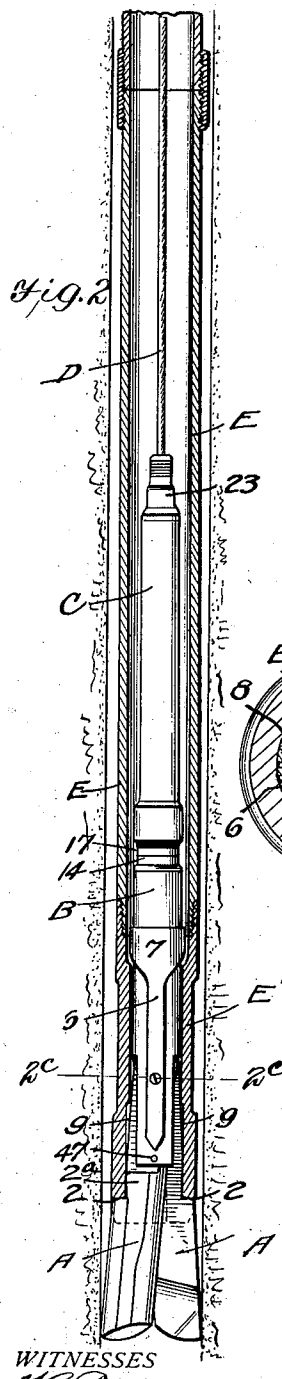


Fig. 2a.

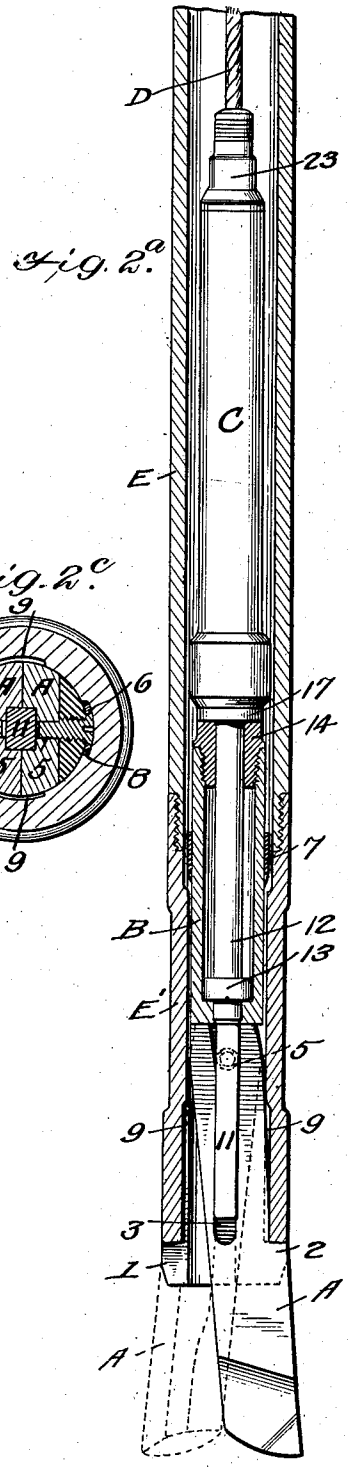
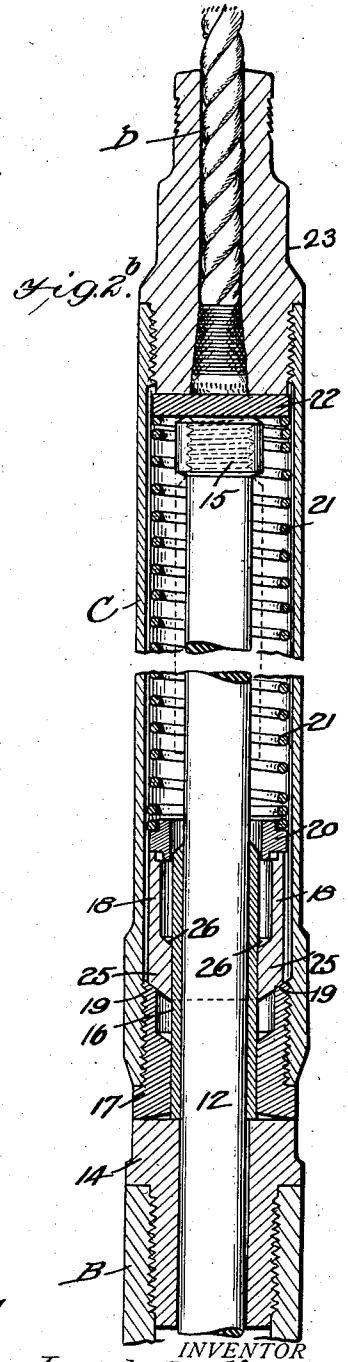


Fig. 2c.

Fig. 2b.



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3 SHEETS—SHEET 3.

Fig. 3.

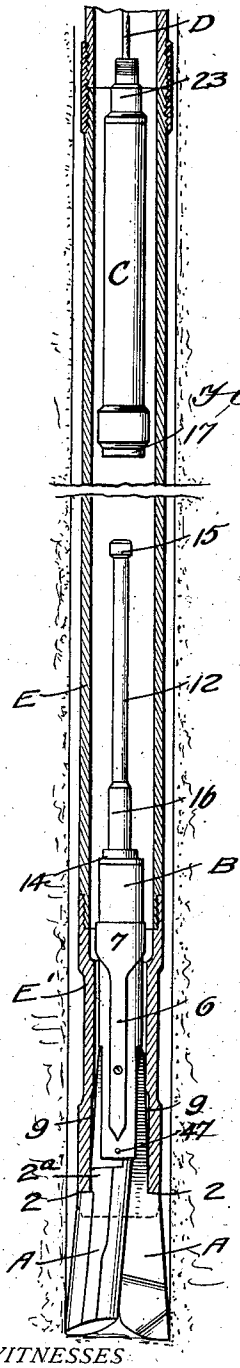


Fig. 10.

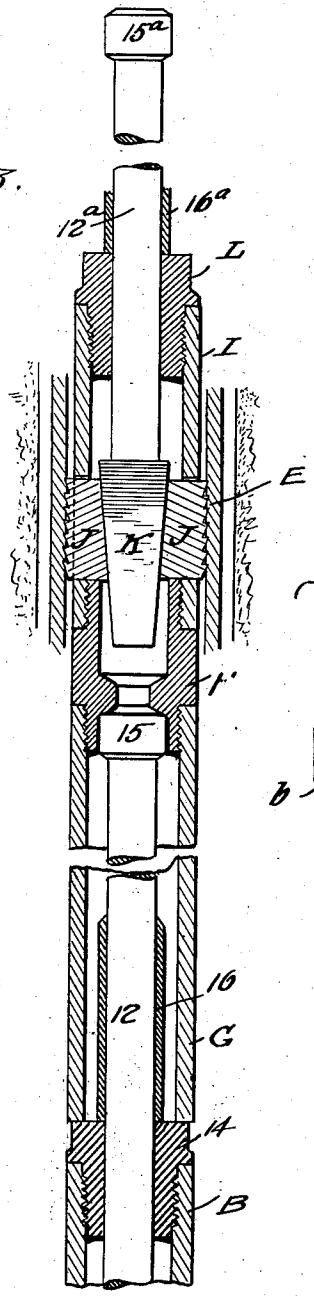


Fig. 9.

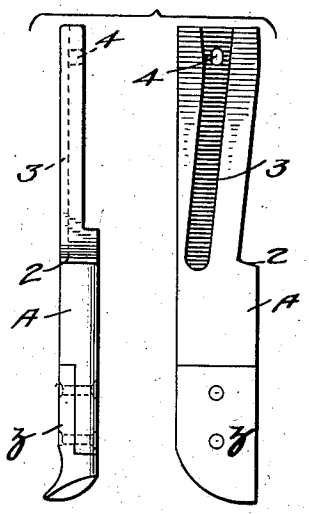
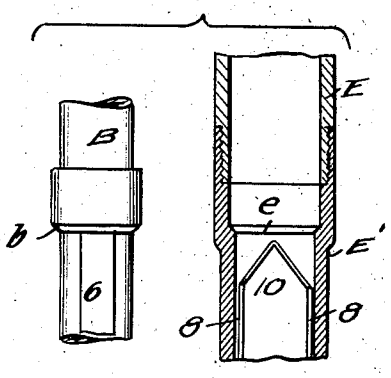


Fig. 11.



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WELL-DRILLING APPARATUS.

1,011,324. Specification of Letters Patent. Patented Dec. 12, 1911.

Application filed May 17, 1911. Serial No. 627,681.

To all whom it may concern:

Be it known that I, JOSEPH DARLING, a citizen of the United States, residing at Chicora, in the county of Butler and State of Pennsylvania, have invented certain new and useful Improvements in Well-Drilling Apparatus, of which the following is a specification.

In the drilling of deep wells, such as oil or Artesian wells, by the rotary boring process there have been employed at the bottom of the rotary drill tube, expansible drill bits of the type known as reamers in connection with a continuous flow of water down through the tube, which drill bits are capable of expansion beyond or withdrawal within the hollow drill tube. This rotary drill tube extends all the way from the bottom of the well to the surface of the ground where it passes centrally through a turning table provided with a set of gripping wheels acting like a chuck on the drill tube, which wheels serve to turn the tube and drill bits and at the same time allow the drill to feed downwardly. When the bits of such drill become dull it is necessary to take them out of the well to sharpen or replace them.

It has been proposed to insert the expansible drill bits through the hollow drill tube and to remove it therefrom without removing the long drill tube from the well. This removal of the drill bits without removing the long drill tube if properly accomplished in a practical way would be a great desideratum. This is the object of my invention, which consists in a novel construction and arrangement of a drill of this type in which the rope and a separable socket grip of special design are made to send the drilling bits down the well, expand and lock them, and then become entirely detached therefrom and be removed entirely from the well, and in which the same socket grip by its attached rope may be sent down into the well to unlock and remove the drill bits when the latter are required to be taken out and without disturbing or removing the rotary drill tube, which remains in the well with practically all of its sections connected.

Figure 1. is a longitudinal section of a well with the rotary drill tube in place and with the drill bits and their inserting and expanding devices shown in the act of passing down into the rotary drill tube. Fig. 1^a. is an enlarged longitudinal section of the separable socket grip in the position for lowering the drill bits and attached devices into the well. Fig. 1^b. is a cross section through line 1^b—1^b of Fig. 1^a. Fig. 2. is a longitudinal section of the rotary drill tube, drill bits, locking devices and inserting devices just after the drill bits have been expanded and locked in operative position for drilling. Fig. 2^a. is an enlarged longitudinal section of the parts shown in Fig. 2. Fig. 2^b. is a longitudinal section on a still larger scale of the socket grip adjusted to position for separation entirely from the drill bits and locking devices and ready to leave them and be entirely removed by the rope from the well. Fig. 2^c. is an enlarged cross section on line 2^c—2^c of Fig. 2. Fig. 3. is a view similar to Fig. 2. but with the socket grip and rope entirely detached from the drilling tools and rising out of the well. Fig. 3^a. is a side elevation showing a stop sleeve which is employed when it is desired to grab and remove the drilling devices. Fig. 4. is a view of the drill bits, the carrying head and adjusting devices removed from the rotary drill tube. Fig. 5. is a view partly broken away of the lower end of the rotary drill tube. Fig. 6. is a view of the bit-carrying head. Fig. 7. represents details of the bits. Fig. 8 is a detail of the bit-expanding key and attached driving stem. Fig. 9. is a detail of a detachable cutting edge for the bit. Fig. 10 is a locking device for holding the drill tools down and, Fig. 11. represents a detail of a modification.

In the drawing, Figs. 1, 2, 3, E E′ is the rotary drill tube, A A are the drill bits, B the expanding and locking devices, C the socket grip and D the rope attached to the socket grip and extending up to the top of the well by which the various operations at the bottom of the well are controlled.

In my invention the socket grip C and rope D lower the drilling devices A and B down the well, through the drill tube E E′ as in Fig. 1., and seats and locks the drill bits in the lower end of the drill tube, as in Fig. 2, and then said socket grip C separates itself from the drill bits and attached parts, as in Fig. 3, and rises with the rope D entirely out of the well. Then again, at the will of the operator, the socket grip C can be lowered into the well by the rope D, as in Fig. 3, and be made to engage the drilling tools and lift them out of the drill tube.

The means by which these functions are accomplished will be explained now, more in detail, in connection with the special construction of parts which render such functions possible.

It will be understood that the drilling is done by rotating drill tube E E′, which is effected through the agency of a turning table at the top of the well through which the drill tube is rotated and fed down by a set of gripping wheels in the turning table. There is also a constant stream of water introduced down through the drill tube E E′ through a hose and a swiveling head at the top of the drill tube and this water passes down inside the drill tube and takes the mud and dirt from the drill bits and carries it in suspension up between the drill tube and the well walls where it flows off at the surface.

The lower end of the rotary drill tube is a short section E′ screwed on to the sections above and is provided at its lower end with two diametrical notches 1, 1, Figs. 1 and 5, into which the drill bits A, Fig. 7, when in operative position, are projected and locked with shoulders 2 of the bits bearing against the inner end of the notches, as seen in Fig. 2. The drill bits A, Fig. 7, have oblong holes 4 at their upper ends by which they are hung upon inwardly projecting fulcrum pins 5, 5, Fig. 6 of a hollow head B, the lower end of said head being slotted to receive the shanks of the drill bits A. The head B is formed on opposite sides with two longitudinal ribs 6, 6, which extend down along the outer sides of the forks and are wedge shaped at their lower ends as seen in Fig. 2. These ribs at their upper ends merge into a projecting shoulder 7 extending around the head and having a wedge shaped entering angle, as seen in Fig. 6. The interior surface of the lower end E′ of the drill tube is, see Figs. 1, 5 and 2^c, formed with two opposite longitudinal grooves 8 8, which are at right angles to, or a quarter turn from, the notches 1 at the lower end of the drill tube. In the same plane with these notches are grooves 9 9, of tapering depth adapted to receive the edges of the shanks of drill bits A A when expanded and at the top of these tapering grooves are triangular tongues 10 10, whose edges extend on each side into the grooves 8 8, so that when the head B enters the section E′ of the drill tube, the wedged shaped ends of ribs 6 6 ride on the tapered tongues 10 10 and rotate the head B so that its ribs 6 6 ride automatically into the grooves 8 8 and thus bring the drill bits A A into the plane of the locking notches 1, 1, and tapering grooves 9, 9, no matter in what axial position said head may enter the drill tube. When the drill bits are thus turned into the plane of the locking notches 1, the drill bits are expanded and locked in said notches as follows:

In the adjacent faces of the two drill bits A A, Figs. 7 and 2^a, are formed elongated grooves 3, square in cross section. They are not parallel to the longitudinal axis of the bit shank, but are set at an angle, so that when a long square key is projected one half into the groove of one bit, and one half into the other, the bits are made to diverge and are thrown into the expanded position where they are locked in the notches 1, 1, as seen in Figs. 2 and 2^a, but when such key is withdrawn, the bits move together inwardly over each other and the grooves 3, 3, are out of registration at the bottom. The key for expanding the bits is shown at 11, Figs. 8 and 2^a, being made on the lower end of an operating rod 12 which has a rigid collar 13 just above the key 11, and an enlarged terminal head 15 at the upper end, and a loose and perforated screw plug 14 adapted to enter the top of the head B and a freely sliding sleeve 16 just above the screw plug 14, the function of which will be explained hereafter. It is to be noted, however, at this point that the long and square key 11, Figs. 8 and 2^a, for expanding the bits by sliding in the grooves 3 and locking them expanded, possesses especial value in that it furnishes a long and strong bearing to resist the wear and shearing strain incident to the inward pressure involved in the boring action of the bits. The pivot holes 4, 4, at the tops of the drill bits are elongated to allow the bits to rise slightly in the boring action and by placing the extreme upper ends of the bit shanks against the solid head B, and the shoulders 2, 2, against the lower end of drill tube section E′, this relieves the pivot pins 5, 5, of the head of all wearing strain. So also when the rotary strain comes on the drill, the strain is not carried simply by the sides of the notches 1, but the flat sides 2^a of the bits extend up in the bowl of the section E′ and find an extended bearing thereagainst at the points 1^a, Figs. 1 and 5, which are made flat to fit the faces 2^a, said latter faces and bearings 1^a being below the pivots 4 of the drill bits and at a point near to and just above the notches 1 of the drill tube, so as to relieve the latter of the severe torsional strain. When the drill bits are being inserted they are temporarily locked together by wooden break-pins 47 which pass through the lower ends of the forks of the head and into an external hole in each drill bit.

I am aware that break pins have been commonly used in the arts to relieve damaging strain on the working parts. I am also aware that it has been proposed to temporarily tie in the drill bits with twine and also to provide temporary metal locking devices for the lower ends of the bits.

In this connection my invention resides in the combination of the frangible break pins with the branches of the forks of the head and entering through the same a small external hole in each drill bit. The advantage of this construction is that it is not liable to be cut like a twine wrapping in lowering into the well and it involves no weakening of the drill bits, as when a metal locking clip is secured in notches in their lower ends.

Referring now to Figs. 1ª and 2ᵇ, which show the detail construction of the socket grip, it will be seen that the upper end of the operating rod 12 with its head 15 enters the socket grip C. Into the lower end of the socket grip is screwed a flanged sleeve 17 having a hole 24 as much larger than the rod 12 as is the slip sleeve 16. The interior of the sleeve 17 is turned out sufficiently larger than the head 15 to receive grip segments 18, which are three in number, more or less, as seen in Fig. 1ᵇ. These segments are thicker at their lower ends than at their upper ends by the difference between the diameter of rod 12 and its head 15. The lower ends of the segments are beveled at 25 and the upper ends are rabbeted and bear against a ring 20 which, in turn, bears against a spiral spring 21 which extends to the top of the socket C and bears against a disk 22, which in turn, is seated against a rope socket 23 screwed into the upper end of the socket grip C and connected to the operating rope D.

The devices just described furnish means for taking hold of and suspending the drill tools while inserting and removing the same, or letting go of the same after the drill tools are seated.

Fig. 1ª shows the position of the parts for suspending the drill bits, head and attached parts while lowering the same into or removing them from the rotary drill tube. As here shown the spring 21 has forced down the ring 20 and the grip segments 18, the tapering lower ends of said segments riding on the incline 25, have thrown them inwardly until their inner shoulders 26 lock under the head 15 and sustain the rod 12 with the drill head and drill bits while being lowered into the well. When the drill bits have passed to the bottom of the drill tube, the socket grip C is lowered suddenly and the rod 12 and head 15 now pass up into socket C. Sleeve 16 passes into the annular opening 24, forcing upwardly the grip segments 18, and said sleeve 16 being beveled on its upper edge it enters between and expands the segments, as in Fig. 2ᵇ, the sleeve 16 passing between the grip segments 18. These grip segments now by the action of spring 21 and bevel faces 19, grip the sleeve 16. Now as the socket C is raised by the rope, the sleeve 16 goes with it until it strikes the head 15, as shown in dotted lines in Fig. 2ᵇ, and as sleeve 16 is the same thickness as the shoulder of the head 15, the grip segments, by the impact, slide up over the head, being still expanded, and thus clear said head, allowing the socket C and rope D to be pulled out of the well and the rod 12 and attached drilling tools to remain locked in the drill tube, as in Fig. 3.

To unlock and take the drill bits out, the socket C is lowered into the well and telescopes over the beveled head 15 and rod 12, but the gripping segments are prevented from going low enough to grasp the releasing sleeve 16. For this purpose, see Fig. 1ª, the disk 22 is removed and a stop plug 27, Fig. 3ª, is put in its place as shown by dotted lines in Fig. 1ª, so that socket C cannot descend low enough to allow the grip segments 18 to grasp the releasing sleeve 16, but the grip segments close about the rod 12 directly and so get under the shoulder of head 15 to furnish a hold for withdrawing the rod 12 and the attached drilling tools from the well, as in Fig. 1. The grip segments do not pinch the rod 12, see Fig. 1ᵇ, for the reason that said segments arch against each other when in their inner position.

In the adjustment of the drilling bits and head into and out of the tube, it may be expected that the dirt and comminuted rock will make the parts work stiffly and possibly stick at times. This contingency is fully provided for in my invention by a drill-jar action in inserting and removing. Thus, referring to Figs. 1ª and 2ᵇ, in seating the bits, as in Fig. 1ª, on the downward movement of the socket grip C, when the bits are in position to be seated, the disk 22 strikes the head 15 of the driving rod 12, as in Fig. 2ᵇ, with a hammer blow to drive the parts to locking position. So also on the dislodging movement the grip segments 18 on the upward movement strike the shoulder of the head 15 with a hammer blow to release the drill bits, thus insuring a successful operation.

After the drill bits have been lowered into position and locked ready for drilling, it may be desirable to lock the drill bits A, head B and driving rod 12 down against any upward reactionary movement from drilling which might have a tendency to loosen the parts. To do this I have provided the devices shown in Fig. 10. These devices sit on top of the head 15 of the driving rod 12 and on screw cap 14 and consist of a sleeve G, coupling H, sleeve I, screw cap L, driving rod 12ª with head 15ª on its upper end and tapering mandrel K on its lower end, and tapering clutch segments J playing in openings in sleeve I and whose teeth are adapted to be projected out to clutching contact with the drill tube when rod 12ª is driven down so as to resist any upward movement of

sleeve G, and thus hold down the rod 12 of the drill bit connections. The rod 12^a is provided with a sliding sleeve 16^a and with it and the rod 12^a and head 15^a, the socket grip C of Figs. 1^a and 2^b coöperate, to place the parts shown in Fig. 10 over the rod 12 and head 15 of the seated drill bits, or remove them therefrom by precisely the same mode of action by which the tools themselves are inserted or removed as hereinbefore described with reference to Figs. 1^a and 2^b, it being understood, however, that one operation is required to seat the drill bits, and then, after the socket grip has been drawn out of the well another operation is required to insert the locking devices shown in Fig. 10.

When the drill bits are worn they require to be taken out and sharpened. In doing so the form and proportions of the same are liable to be slightly distorted, and this may make them fail to work smoothly in the automatic inserting and removing operations. To avoid this contingency I form the drill bits with detachable cutting edges *z*, as seen in Fig. 9, so that the drill bits do not have to be forged anew and are therefore not distorted and the cutting edges may be made of the finest steel and may be quickly and easily replaced.

In Fig. 11, I show a form of drill head B and lower casing section E′ which is best adapted to drills of larger size. Instead of relying upon the triangular shoulder 7, Fig. 6, seating on the triangular tongue 10, Fig. 5, I employ, in Fig. 11, a straight transverse shoulder *b* on the drill head B which rests on a straight shoulder *e* of the casing, it being understood that the ribs 6 6 coact with the tongues 10 and grooves 8 of the casing in the same way as hereinbefore described. The straight shoulder *b* is of larger diameter than the axial turning ribs.

In constructing my socket grip as it appears in Figs. 1^a and 2^b, the flanged sleeve 17 is shown separate from the socket casing C and is screwed into the latter. I do not confine myself to making it separable, as it may in some cases, and frequently will, be made in one piece therewith. In seating the drill bits in the drill tube, when first inserting the same and also in taking out the same, the drill tube E E′ is slightly lifted to give clearance at the bottom to the drill bits, so as not to obstruct their action in seating and unseating the same.

It will be understood that as my invention is designed to employ a stream of water admitted to the drill bits, the parts herein described have sufficient space between them and the drill tube to allow the water to flow down, and also such channels or passageways past the closer fitting parts as to give continuous passage to the water, but I make no claim to this feature.

I claim.

1. A well drilling apparatus, comprising a rotary drill tube, expansible bits adapted to be lowered within the same and be expanded to working position at the bottom thereof, locking devices for the bits and a separable socket grip provided with means which adapt it to be sent down into the rotary drill tube to introduce, seat and lock the drill bits and to be disengaged therefrom and be lifted out of the well and leave the rotary drill tube and its bits in working position.

2. A well drilling apparatus, comprising a rotary drill tube, expansible bits adapted to be lowered within the same and be expanded to working position at the bottom thereof, locking devices for the bits and a separable socket grip provided with means which adapt it to be sent down into the rotary drill tube to adjust the parts of the bits, the said socket grip and its attached parts being adapted to enter the drill tube with the drill bits and leave the tube without the drill bits and also to enter the drill tube without the bits and leave it with the bits.

3. A well drilling apparatus, comprising a rotary drill tube, expansible bits adapted to be lowered within the same and be expanded to working position at the bottom thereof, locking devices for the bits and a socket grip adapted to be sent down into the rotary drill tube to introduce, seat and lock the drill bits and to be disengaged therefrom and be lifted out of the well and leave the rotary drill tube and its bits in working position said socket grip being constructed as a drill jar to insure lodgment and dislodgment of the drill bits.

4. A well drilling apparatus, comprising a rotary drill tube and expansible and removable bits, a controlling rod having a shoulder, a releasing sleeve sliding on said rod and equal to the thickness of said shoulder on the rod and a socket arranged to telescope over the rod and having grips adapted to engage said sleeve, and ride up over the shoulder of the rod to be detached therefrom and to engage the rod above the sleeve and lock under the shoulder of the rod to pull the latter out.

5. A well drilling apparatus, comprising a rotary drill tube and expansible and removable bits, a controlling rod having a shoulder, a releasing sleeve sliding on said rod and equal to the thickness of said shoulder on the rod and a socket arranged to telescope over the rod and having grips adapted to engage said sleeve and ride up over the shoulder of the rod to be detached therefrom and to engage the rod above the sleeve and lock under the shoulder of the rod to pull the latter out and a stop device to limit the downward projection of the

socket over the rod to prevent the grips from reaching the releasing sleeve.

6. The combination with a drill tube and detachable drill tools therein having a headed operating rod; of a socket grip comprising a cylindrical tube having seats for grip segments in its lower end, grip segments arranged therein, a ring above the segments, a spiral spring above the ring and a releasing sleeve sliding on the operating rod and arranged to be seized by the grips and pass the grip segments over the head of the rod.

7. The combination with a drill tube and detachable drill tools therein having a headed operating rod; of a socket grip comprising a cylindrical tube having seats for grip segments in its lower end, grip segments arranged therein, a ring above the segments, a spiral spring above the ring and a releasing sleeve sliding on the operating rod and arranged to be seized by the grips and pass the grip segments over the head of the rod and a stop device to limit the downward extension of the socket over the operating rods.

8. The combination with the drill tools for a deep well having an attached operating rod with a shoulder; of a sliding releasing sleeve on the said rod and a socket grip arranged to grip either the sleeve or the rod.

9. A well drilling apparatus, comprising a rotary drill tube, two expansible bits arranged within the same and having on their inner faces longitudinal grooves set at an angle, a longitudinal key for entering the same and expanding the bits and a driving rod connected to and operating said key.

10. A well drilling apparatus, comprising a rotary drill tube having on its lower sections internal grooves and locking notches and also turning shoulders, a carrying head for expansible drill bits having wedge shaped guide ribs and pivoted and expansible drill bits with inclined longitudinal grooves on their adjacent faces and a longitudinal expanding key adapted to enter the said grooves to expand the bits.

11. A well drilling apparatus, comprising a rotary drill tube, two expansible bits arranged within the same and having on their inner faces longitudinal grooves set at an angle, a longitudinal key for entering the same and expanding the bits and a driving rod connected to and operating said key and a carrying head for the bits and rod having an opening in the bottom through which the key projects and a shoulder on the rod within the carrying head.

12. A well drilling apparatus, comprising a rotary drill tube having its lower section provided with notches in its end, a carrying head having pivoted drill bits and means for expanding them, said drill bits having shoulders that fit the end notches of the drill tube and also flat bearings below the pivots of the drill bits and above the notches of the drill tube, adapted to engage torsionally the interior wall of the drill tube at points above the notches to relieve breaking strain on the latter.

13. A well drilling apparatus, comprising a drill tube, pivoted and expansible drill bits within said tube, a carrying head having its lower end forked to receive the bits and frangible break pins extending through the branches of the fork into the bits for locking the bits to the head in closed position when being inserted in the tube.

14. A well drilling apparatus, comprising a rotary drill tube, expansible bits and a carrying head for the same, said carrying head and drill tube being provided with axially turning devices and said carrying head and drill tube being provided each with a straight transverse shoulder of greater diameter than the turning devices.

15. A well drilling apparatus, comprising a rotary drill tube, expansible bits with carrying head and upwardly projecting rod and terminal shoulder, a releasing sleeve sliding on said rod, a socket grip adapted either to suspend said rod by its shoulder or grip its sleeve, to connect and disconnect with the drill bits, and a device for locking down said rod and drill bits comprising a clutch adapted to engage with the inner walls of the drill tube and having a shoulder rod and releasing sleeve of similar proportions to that of the drill tool to permit its application and removal by the same socket grip which adjusts the drill tools.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH DARLING.

Witnesses:

ELIZABETH BERESFORD,

A. J. BERESFORD.