

Feb. 3, 1959

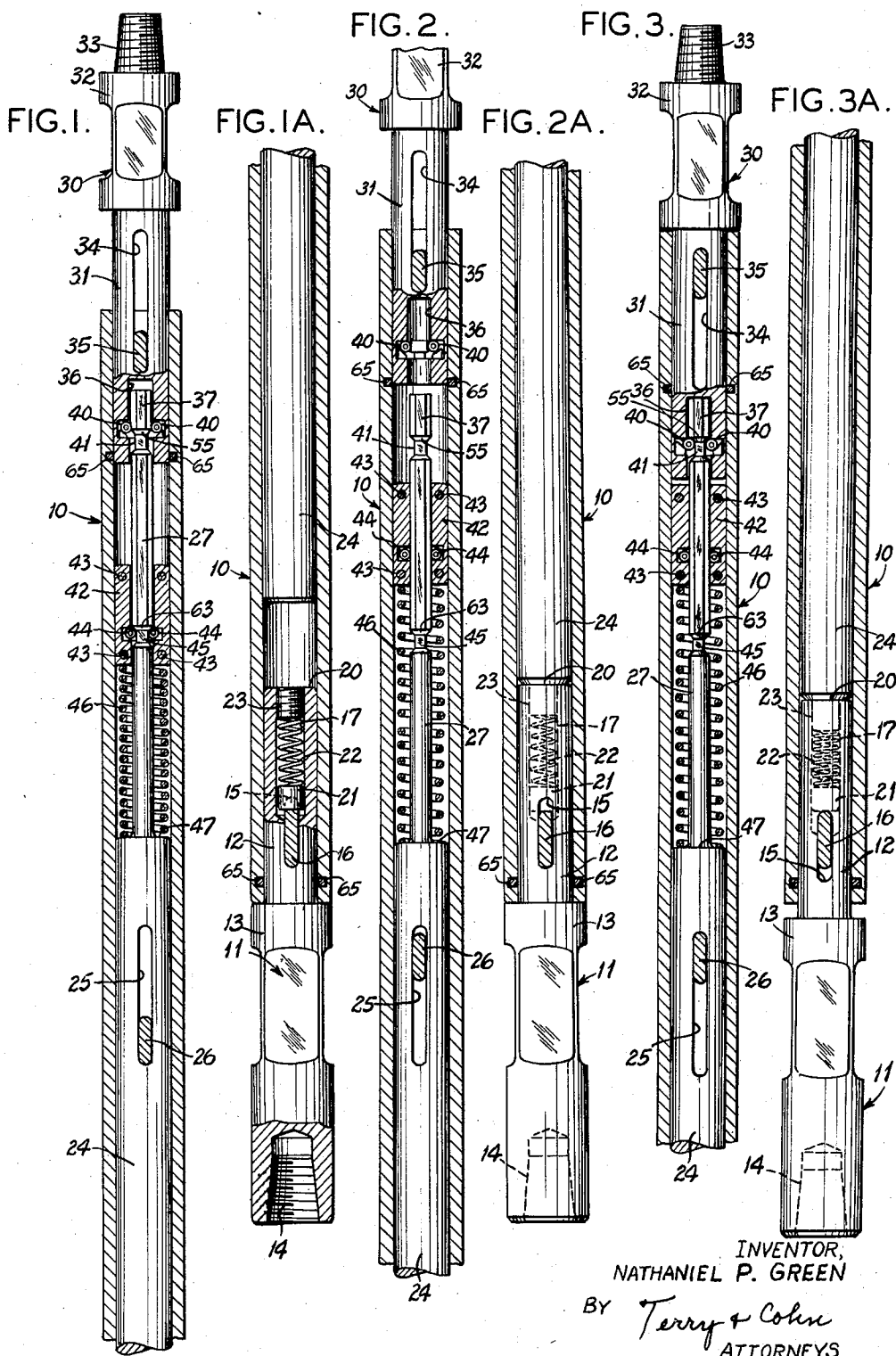
N. P. GREEN

2,872,158

DOUBLE BLOW DRILL

Filed July 5, 1955

2 Sheets-Sheet 1



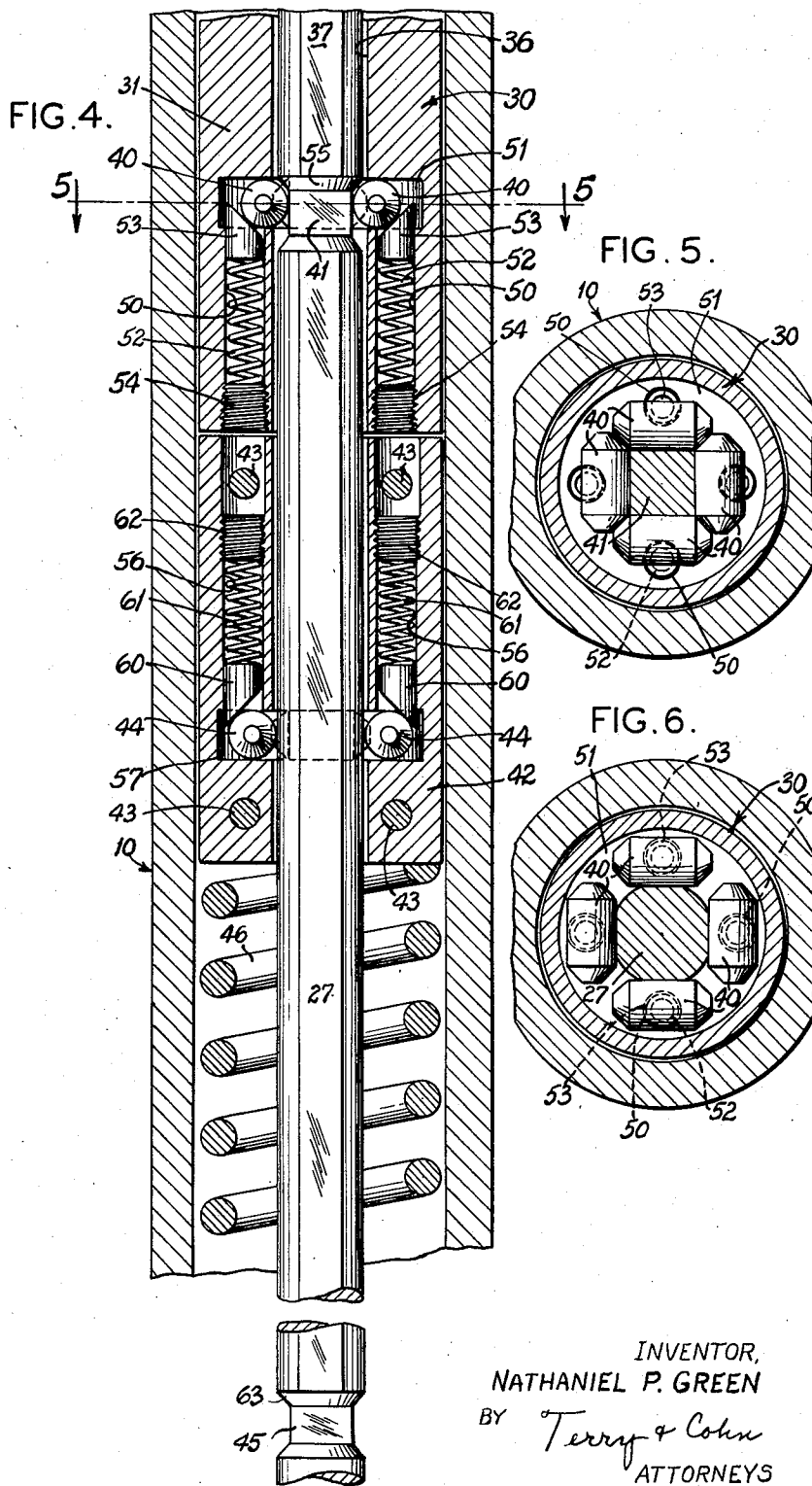
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DOUBLE BLOW DRILL

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Application July 5, 1955, Serial No. 519,833

17 Claims. (Cl. 255—6)

This invention relates to improvements in a drill, and more particularly to improvements in a double blow drill for use with earth drilling apparatus.

In earth boring operations, such as encountered in the sinking of deep wells, the use of churn drill rigs is well known. Such drill rigs include a cable or rope attached to the drill apparatus, the drill being provided with a cutting tool or bit at its lower end. This drill apparatus is then alternately hoisted and abruptly dropped through a given distance so that the repeated percussive strokes of the bit against the substance being drilled, such substance usually being rock, effect the cutting action. Because of the considerable weight of this type of drill, powered equipment is usually utilized to hoist the drill.

It is an important general object of the invention to provide an improved drill of this type in which the drilling efficiency is considerably increased. More specifically, the objective is to provide a device which will operate automatically to provide a hammer blow to the drill bit in addition to its initial gravity stroke, thereby increasing the efficiency of the drilling operation.

Another important object is realized by an improved percussive stroke drilling assembly, and by an improved, simpler and more efficient triggering mechanism adapted to realize the advantages and functional results noted above.

It is a highly important object of the invention to provide a drill in which a reciprocally mounted hammer is releasably restrained above the bit anvil, and adapted to be released automatically due to its inertia upon impact of the bit anvil upon the substance being drilled, whereby the hammer delivers a percussive blow to the bit anvil that is responsive to the hammer inertia.

Other advantages are realized by the provision of means adapted to lift automatically the hammer to its raised, restrained position above the bit anvil upon cable lift of the drill.

Another important object is achieved by the provision of a load spring in the drill assembly adapted to exert a force on the hammer that supplements the inertia of the hammer in delivering a percussive blow to the bit anvil immediately following the gravity stroke of the bit.

Still another important object is realized by the provision of means for lifting the hammer to the raised position above the bit anvil, such means being automatically, operatively disengageable from the hammer after the hammer is locked in the raised position to permit the hammer to be subsequently released due to its inertia incident to drilling impact of said bit anvil.

A further object is to provide a tool of the character mentioned that is simple to operate, and that is positive and dependable in operation.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawing, in which:

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Fig. 1 is an elevational view, in partial vertical section, of a drill embodying the instant invention showing the relative position of its parts upon completion of its upward stroke;

5 Fig. 1A is a fragmentary elevational view, in partial vertical section, of the lower part of the drill of Fig. 1;

Fig. 2 is a view similar to that of Fig. 1, but showing the relative positions of the drill parts upon completion of its downward gravity stroke, yet before completion of the secondary blow by the hammer;

10 Fig. 2A is a fragmentary elevational view, in partial vertical section, of the lower anvil end of the drill shown in Fig. 2;

Fig. 3 is a fragmentary elevational view, in partial vertical section, showing the relative positions of the drill parts upon absolute completion of its downward stroke;

Fig. 3A is a fragmentary elevational view, in partial vertical section, of the lower anvil end of the drill shown in Fig. 3;

20 Fig. 4 is an enlarged, fragmentary view, in vertical section, showing the detailed structure of the lifting and locking means and their relation to the hammer;

Fig. 5 is a fragmentary view, partially in cross section, of the lifting means as seen along line 5—5 of Fig. 24, the lifting elements shown in effective lifting position, and

Fig. 6 is a fragmentary view, partially in cross section, of the lifting means similar to that shown in Fig. 5 but showing the lifting elements in released position relative to the hammer shank.

Referring now by characters of reference to the drawings, it is seen that the double blow drill includes an elongate tubular casing generally indicated at 10, which serves as a housing for the operable drill parts. In the lower end of casing 10 is a bit anvil referred to at 11 in Figs. 1A, 2A and 3A. The anvil 11 includes a shank portion 12 adapted to be received in casing 10, and an enlarged head portion 13 located below the lower end of casing 10. The lower head portion 13 of anvil 11 is provided with a tapped threaded socket 14 adapted to receive and retain a conventional type of drill bit or cutting tool (not shown). Such a drill bit may be screwed into threaded socket 14.

The reduced shank portion 12 of anvil 11 is provided with a transverse elongate slot 15 adapted to receive a cross bar 16 that internally bridges and is connected to casing 10. The relative movement of cross bar 16 and elongate slot 15 determines the range of permissive extension of the bit anvil in response to the secondary blow, as will be described in detail subsequently.

A recess 17 is formed in shank portion 12 of bit anvil 11, the recess 17 extending from the top 20 into communication with slot 15. Located within recess 17 is a movable plug 21 arranged to abut the upper end of cross bar 16, and a compression spring 22. A threaded closure plug 23 is threadedly received at the upper end of recess 17, and serves to hold spring 22 under compression so that spring 22 tends at all times to urge bit anvil 11 upwardly into the retracted position shown in Fig. 1A. In effect, the spring 22 is operatively placed between bit anvil 11 and casing 10 to provide the functional results noted above.

A hammer 24 is reciprocally mounted in casing 10 and located above bit anvil 11. The hammer 24 is provided with an elongate vertical slot 25 which is adapted to receive and retain a cross bar 26 bridging tubular casing 10 and connected thereto. The relative movement of cross bar 26 within slot 25 determines the range of relative movement between hammer 24 and casing 10, in other words, determines the raised and lowered positions of hammer 24. The hammer 24 includes a reduced hammer

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shank 27 that extends upwardly through the center of casing 10.

Reciprocally mounted in the upper end of casing 10 is a grip member referred to generally at 30, the grip member 30 including a reduced shank portion 31 received in the upper end of tubular casing 10, and an enlarged upper head portion 32 having a threaded pin 33. The pin 33 is adapted to attach to a conventional type of socket (not shown) on a cable which is adapted to alternately hoist and abruptly drop the drill apparatus through a given distance. An elongate vertical slot 34 is formed in the reduced shank 31 of grip member 30, the slot 34 being adapted to receive and retain a cross bar 35 connected to casing 10. The relative slidable movement of cross bar 35 in slot 34 determines the range of reciprocal movement of grip member 30 in casing 10.

The lower end of shank portion 31 of grip member 30 is provided with a recessed socket 36 adapted to receive the upper end 37 of hammer shank 27. Lifting elements 40 are carried by grip member 30, and arranged in recess 36 on the sides of hammer shank 27. The lifting elements 40 are of circular cross section as shown in Figs. 1 and 4, and are made of a short length of rod stock. These lifting elements 40 are urged into operative engagement with the shoulders 55 of groove 41 formed in the upper end 37 of hammer shank 27. The detailed structural arrangement of this lifting means is clearly shown in Fig. 4, and will be later described in detail along with its function.

Disposed below grip member 30 in casing 10 is a sleeve 42 fixed to casing 10 by pins 43. The hammer shank 27 extends centrally through sleeve 42. Carried by sleeve 42 are a plurality of lock elements 44 arranged on the sides of hammer shank 27. These lock elements 44 are of similar shape and character to the lifting elements 40 previously described, the lock elements being of a circular cross section as shown in Fig. 1, and being constructed of a short length of rod stock. These locking elements 44 are adapted to be urged by spring means, later described, into a groove 45 formed in hammer shank 27, the annular groove 45 being spaced from and located below groove 41. The locking elements 44 and groove 45 cooperate to retain hammer 24 in the raised position shown in Fig. 1.

Disposed about hammer shank 27 is a load spring 46 having one end abutting sleeve 42, and having the opposite lower end abutting upper shoulder 47 on hammer 24. The load spring 46 is adapted to be compressed between sleeve 42 and hammer 24 so as to tend to urge hammer 24 downwardly into engagement with bit anvil 11.

Referring now to Fig. 4 for a more detailed description of the lifting and locking means for hammer 24, and referring first to the lifting means carried by grip member 30, it will be noted that a plurality of bores 50 are formed in the lower end of grip shank 31, the bores 50 extending vertically upwardly into communication with a short dogleg passage 51 that opens into recess socket 36. It will appear that lifting elements 40 are located in passages 51, and are adapted to move into and out of recess socket 36. Disposed in each of bores 50 is a compression spring 52 and a cam 53. A closure plug 54 is utilized to retain spring 52 and cam 53 in bores 50. The compression springs 52 tend to urge cams 53 into engagement with lifting elements 40, and hence tend to urge lifting elements 40 inwardly into socket 36 and into engagement with hammer shank 27.

At the completion of the downward stroke of the entire drill assembly, as shown in Figs. 3 and 3A, the lifting elements 40 are urged inwardly into annular groove 41, and hence urged into operative engagement with camming shoulders 55 as shown in Fig. 4. Lifting elements 40 and camming shoulders 55 coact to enable hammer 24 to be lifted to its raised, locked position (Fig. 1) during the first part of the cable lift of the drill.

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A somewhat similar type of triggering mechanism is provided for the locking means more clearly shown in Fig. 4. For example, a plurality of vertical bores 56 are formed in sleeve 42, the bores 56 communicating with a short dog-leg passage 57 in which locking elements 44 are located. A cam element 60 and a coacting compression spring 61 are located in each of bores 56, and are retained therein by a threaded closure plug 62. The compression springs 61 urge cams 60 against locking elements 44, and hence tend to urge locking elements 44 outwardly of passages 57 and against hammer shank 27. When the hammer 24 is lifted to the raised, locked position shown in Fig. 1, the springs 61 urge locking elements 44 inwardly into annular groove 45, the locking elements 44 engaging camming shoulders 63 to retain hammer 24 in the raised position during the last part of the cable lift of the drill, and during its gravity descent until gravity impact of the drill upon the substance being drilled.

When the drill assembly is raised and then dropped by gravity to effect a blow of the drill bit upon the bottom of the hole being drilled, there results a gravity blow, and in addition, a second percussive blow which follows the gravity blow a short moment thereafter. This second percussive blow is actuated by the relatively abrupt deceleration of the casing 10 with respect to hammer 24, which at the moment of impact of the drill bit on the bottom of the hole, overrides the retentive force exerted by locking elements 44 cammed outwardly into groove 45 under the influence of compression spring 61. The overriding is caused by the inertia of hammer 24 tending to continue its downward motion, augmented with the compressive force exerted on hammer 24 by load spring 46. The compressive strength of springs 61 is selected to be that which will exert enough pressure on locking elements 44 through the effect of cams 60 to prevent downward motion of the hammer 24 at the force levels created by the disengaging effect of the weight of hammer 24 added to the force stored in load spring 46, such force levels acting through the abutment of cam shoulders 63 at the upper end of groove 45, and tending to displace the lock elements 44 and cams 60 in opposition to the compressive force of springs 61.

With the drill assembled as illustrated in Fig. 1, it is attached to the cable of the churn drilling apparatus by means of threaded pin 33. Under the lifting action of the drilling apparatus, the entire assembly is raised through a given distance from which point it is abruptly dropped to deliver the drill bit with a gravity blow.

On the upward stroke shortly after the cable of the churn drill rig has started upward, the lifting elements 40 are engaged in the annular groove 41 of hammer shank 27, the lifting elements 40 being held in place by springs 52 through the action of cams 53. As the cable is raised, it pulls and lifts grip member 30 in which lifting elements 40 are supported. The lifting of grip member 30 consequently raises lifting elements 40, which in turn coact with cam shoulders 55 to lift hammer 24. As hammer 24 is raised, the load spring 46 is compressed until the lower end of slot 25 abuts the under surface of cross bar 26, which determines the raised position of hammer 24. At this moment in the upward travel of the cable, the locking elements 44 are urged into groove 45 under the compressive force exerted by springs 61 acting through cams 60. The locking elements 44 engage cam shoulders 63 and serve to hold hammer 24 in the raised position.

As the cable continues upwardly, it will be noted that hammer 24 has stopped its movement with respect to casing 10, and the weight of the casing 10 is transferred to lifting elements 40 acting in groove 41. Because of the particular compressive strength of springs 52 as noted above, the lifting elements 40 are permitted to move laterally upwardly under the camming effect of the upper cam shoulders 55 of groove 41, and are permit-

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ted to ride up on hammer shank 27 until the bottom end of slot 34 contacts the under surface of cross bar 35. From this point to the extreme upward travel of the cable; the casing 10 rises with the cable, and hammer 24 remains in a locked position with the loading spring 46 compressed. Fig. 1 shows the drill assembly and the relative position of its parts upon completion of upward stroke.

During the downward travel of the cable end, the component parts of the drill maintain the same relative positions last described and shown in Fig. 1 until the instant the drill bit strikes the bottom of the hole being drilled. This event decelerates casing 10 and anvil 11, but the inertia of hammer 24 augmented by the force exerted by load spring 46 causes the locking elements 44 to move outwardly laterally under the camming action of the upper cam shoulders 63 of groove 45, thus releasing hammer 24 to descend with force under the influence of its inertia and the energy stored in load spring 46 to strike bit anvil 11 with a secondary percussive blow.

At this point, it should be noted that load spring 46 may be eliminated if desired. In this event, compression spring 61 should be of such strength so as to permit the locking elements 44 to support and retain the weight of hammer 24, and yet permit operative release of locking elements 44 from cam shoulders 63 under influence of the hammer inertia at the instant the bit anvil 11 strikes the bottom of the hole. Under either circumstance, the hammer 24 will strike a percussive blow on bit anvil 11 which is responsive to the hammer inertia.

The bit anvil 11, as a result of the percussive blow by hammer 24, is displaced axially downwardly with respect to casing 10, as is shown by the relative position of bit anvil 11 in Fig. 2A and in Fig. 3A. Such axial displacement is limited by the movement of cross bar 16 in slot 15. As the cable continues its descent, the gripping member 30 descends from the position of Fig. 2 to the lowered position of Fig. 3 in which the lifting elements 40 interfit the groove 41 of hammer shank 27. Figs. 3 and 3A illustrate the relative positions of the drill parts in the completely lowered position.

When the cable starts up it carries with it the grip member 30 and hammer 24 through the operative abutment of lift elements 40 with cam shoulders 55. As hammer 24 is raised, it disengages the bit anvil 11, thus permitting compression spring 22 to urge anvil 11 upwardly until the bottom surface of bar 16 seats in the bottom of slot 15. The component parts of the drill are then relocated to the position shown by Figs. 1 and 1A in the manner that has already been described, at which point the entire cycle is repeated.

Obviously, the depth of grooves 41 and 45, the shape of the sloped cam shoulders 55 and 63, the shape of cams 53 and 60, and the strength of springs 52 and 61 must be chosen properly to effect lockup up to predetermined vertical forces exerted on hammer shank 27, and to permit release at higher vertical forces. The value of these forces will be determined by the relative weight of the hammer 24 and the casing 10, together with the weight of any appendages attached to casing 10, and by the force exerted by the load spring 46.

The O rings 65 located at the top and bottom of casing 10 serve as seals to keep out dirt and moisture.

Although the invention has been described by making detailed reference to a single preferred embodiment, such detail is to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, and adapted to move into impact engagement with said bit anvil, and means within said casing releasably restraining said hammer, said hammer being provided with a shoulder means, the restraining

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means including locking elements and resilient means urging said locking elements into engagement with said shoulder means to restrain said hammer in a raised position, the shoulder means and locking elements having coacting cam surfaces interengaging, said resilient means being yieldable to permit operative disengagement of said locking elements from said shoulder means due to the inertia of said hammer on said elements upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil.

2. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, and adapted to move into impact engagement with said bit anvil, a grip member mounted in said casing and adapted to be attached to a drop cable, the grip member including lift means for lifting said hammer to a raised position during cable lift of said drill, a lock shoulder on said hammer, and resilient lock means within said casing urged against said shoulder for releasably restraining said hammer in said raised position, the shoulder and lock means having coacting cam surfaces interengaging, said resilient lock means having a retentive force sufficient to restrain said hammer in the raised position yet of a value to permit release of said hammer under influence of hammer inertia on said lock means upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil.

3. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, and adapted to move into impact engagement with said bit anvil, a grip member mounted in said casing and adapted to be attached to a drop cable, lift elements carried by said grip member, the hammer and lift elements having coacting cam surfaces interengaging for lifting said hammer to a raised position, during cable lift of said drill, and resilient lock means within said casing releasably restraining said hammer in the raised position, yieldable means engaging said lift elements to permit said lift elements to be operatively disengaged from said hammer subsequent to said hammer being moved to the raised position upon further lifting of said drill so that said hammer is supported by said resilient lock means, coacting cam surfaces on said hammer and said lock means interengaging, said lock means having a retentive force sufficient to restrain said hammer in the raised position and yet of a value to permit release of said hammer under influence of hammer inertia on said lock means upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil.

4. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above said anvil, and adapted to move into impact engagement with said bit anvil, lock means within said casing releasably restraining said hammer, said lock means including locking elements, shoulder means on said hammer, and resilient force means tending to urge said locking elements against the shoulder means to restrain said hammer in a raised position relative to said anvil, the shoulder means and locking elements having coacting cam surfaces interengaging, said force means having a retentive force of a value to permit operative disengagement of the locking elements from said shoulder means due to the inertia of said hammer exerted on said locking elements upon drilling impact of said bit anvil, whereby said released hammer delivers a blow to said bit anvil.

5. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing and adapted to move into impact engagement with said bit anvil, a grip member reciprocally mounted in said casing and adapted for connection to a drop cable, lift elements carried by said grip member, a shoulder means on said hammer, spring means on said grip member tending to urge said lift elements against

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said shoulder means to permit said grip member to lift said hammer to a raised position with respect to said anvil during cable lift of said drill, said spring means being yieldable to permit operative disengagement of said lift elements from said shoulder means upon subsequent cable lift of said grip member, a lock shoulder on said hammer, and resilient lock means within said casing urged against said lock shoulder for releasably restraining said hammer in the raised position, the lock shoulder and lock means having coacting cam surfaces interengaging, said resilient lock means being yieldable to release said hammer due to its inertia exerted on said lock means upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil.

6. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing and adapted to move into impact engagement with said bit anvil, a grip member reciprocally mounted in said casing and adapted for attachment to a drop cable, lift elements carried by said grip member, a shoulder means on said hammer, spring means tending to urge said lift elements against said shoulder means so as to permit said grip member to lift said hammer to a raised position during cable lift of said drill, said spring means being adapted to permit operative disengagement of said lift members from said shoulder means upon subsequent cable lift of said grip member, and lock means within said casing for releasably restraining said hammer, said lock means including locking elements, shoulder means on said hammer, and spring means tending to urge said locking elements against the last said shoulder means to restrain said hammer in the raised position, said spring means permitting operative disengagement of the locking elements from said shoulder means due to the inertia of said hammer upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil that is substantially responsive to the inertia of said hammer.

7. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, locking means in said casing for releasably restraining said hammer in a raised position relative to said anvil, a grip member mounted in said casing for attachably receiving a drop cable, a lift shoulder on said hammer, lifting means carried by said grip member, resilient means tending to urge said lifting means into engagement with said lift shoulder for lifting said hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, the lift shoulder and the lifting means having coacting cam surfaces interengaging, said lifting means being yieldable to disengage operatively from said hammer shoulder upon subsequent lifting of said grip member as the weight of said casing is transferred to said lifting means, and means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift means from said hammer shoulder during cable lift of the grip member, whereby to realize cable lift of the entire drill.

8. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above said anvil, the anvil being in the path of said hammer, locking means in said casing releasably restraining said hammer in a raised position relative to said anvil, a grip member reciprocally mounted in said casing for attachably receiving a drop cable, a lift shoulder means on said hammer, lifting means carried by said grip member, resilient means tending to urge the lifting means into engagement with said lift shoulder means for lifting said hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill,

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said lift shoulder means and said lifting means having coacting cam surfaces interengaging, said lifting means being yieldable to disengage operatively from said hammer shoulder means upon subsequent lifting of said grip member as the weight of said casing is transferred to said lifting means, and means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift means from said hammer during cable lift of the grip member, whereby to realize cable lift of the entire drill, the locking means including a lock portion fixed to the casing, and a portion of said hammer, a lock shoulder on one of said portions, locking elements carried by the other said portion, resilient means tending to urge the locking elements into engagement with the lock shoulder, the lock shoulder and locking elements having coacting cam surfaces interengaging, said locking elements being yieldable to release said hammer upon drilling impact of said bit anvil due to the inertia of said hammer exerted on said locking elements, whereby said hammer delivers a percussive blow to said bit anvil responsive to the hammer inertia.

9. In a double blow drill, a casing, a bit anvil mounted in said casing, a hammer mounted in said casing above said anvil, the anvil being in the path of said hammer, locking means in said casing for releasably restraining said hammer in a raised position relative to said anvil, a grip member reciprocally mounted in said casing for attachably receiving a drop cable, lifting elements carried by said grip member, shoulder means on said hammer, spring means carried by said grip member tending to urge said lifting elements against said shoulder means, said shoulder means and said lifting elements having coacting cam surfaces interengaging, said spring means being of sufficient strength to permit the lifting elements to lift the hammer, and of such a strength to permit the lifting elements to disengage operatively from said shoulder means as the weight of the casing is transmitted to the lifting elements incident to raising the hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, and means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift elements from said shoulder means during cable lift of the grip member, whereby to realize cable lift of the entire drill assembly.

10. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above the anvil, the anvil being in the path of said hammer, locking means in said casing, said locking means including locking elements, lock shoulder means on said hammer, and spring means tending to urge said locking elements into releasable engagement with said lock shoulder means for restraining said hammer in a raised position relative to said anvil, a grip member mounted in said casing for attachably receiving a drop cable, a lift shoulder means on said hammer, lifting means carried by said grip member resilient means tending to urge said lifting means into engagement with said lift shoulder means for lifting said hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, the lift shoulder means and the lifting means having coacting cam surfaces interengaging, said lifting means being yieldable to disengage operatively from said hammer upon subsequent lifting of said grip member as the weight of said casing is transmitted to said lifting means, and means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift means from said hammer during cable lift of the grip member, whereby to realize cable lift of the entire drill, the lock shoulder means and locking elements having coacting cam surfaces interengaging, said spring means being of

sufficient strength to permit the locking elements to release said hammer due to the inertia of said hammer upon drilling impact of said bit anvil, whereby said hammer delivers a blow to said bit anvil responsive to said hammer inertia.

11. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer member reciprocally mounted in said casing above said anvil, and adapted to move into impact engagement with said bit anvil, a lock member fixed to the casing, a shoulder on one of said members, locking means carried by the other said member, resilient means tending to urge the locking means into engagement with the shoulder to hold the hammer member in a raised position above said anvil, the shoulder and locking means having coacting cam surfaces interengaging, spring means located in said casing above said bit anvil to exert a force on said hammer, said spring means being compressed when the hammer member is restrained in raised position, and being adapted to expand to exert a drilling force that augments the inertia of the hammer member when said hammer member is released, said locking means being yieldable to release said hammer member due to the inertia of said hammer member on the locking means upon drilling impact of said bit anvil, whereby said hammer member delivers a blow to said bit anvil responsive to hammer inertia and to loading of said spring means.

12. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above said anvil, the anvil being in the path of said hammer, locking means in said casing including locking elements, shoulder means on said hammer, and spring means tending to urge said locking elements against said shoulder means to restrain said hammer in a raised position above said bit anvil, the shoulder means and locking elements having coacting cam surfaces interengaging, said spring means being of sufficient strength to permit operative disengagement of the locking elements from said shoulder means due to the inertia of said hammer upon drilling impact of bit anvil, a load spring located in said casing above said bit anvil to exert a downward force on said hammer, said load spring being compressed when the hammer is restrained in raised position, and being adapted to expand to exert a drilling force that augments the inertia of said hammer when the hammer is released, whereby said hammer delivers a blow to said bit anvil responsive to hammer inertia and spring loading.

13. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above said anvil, the anvil being in the path of said hammer, locking means in said casing for releasably restraining said hammer in a raised position relative to said anvil, a grip member mounted on said casing for attachably receiving a drop cable, a lift shoulder on said hammer, lifting means carried by said grip member resilient means tending to urge said lifting means into engagement with said shoulder for lifting said hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, the lift shoulder and lifting means having coacting cam surfaces interengaging, said lifting means being yieldable to disengage operatively from said hammer lift shoulder upon subsequent lifting of said grip member as the weight of the casing is transferred to said lifting means, means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift means from said hammer during cable lift of the grip member, whereby to realize cable lift of the entire drill, a lock shoulder on said hammer, resilient means tending to urge said locking means into engagement with said lock shoulder, the lock shoulder and locking means having coacting cam surfaces interengaging, said locking means being yield-

able to release said hammer upon drilling impact of said bit anvil due to the inertia of said hammer exerted on said locking means, a load spring located in said casing above said bit anvil to exert a downward force on said hammer, said load spring being compressed when the spring is restrained in raised position, and being adapted to expand to exert a drilling force that augments the inertia of said hammer when the hammer is released, whereby said hammer delivers a blow to said bit anvil responsive to hammer inertia and to loading of said load spring.

14. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, locking means in said casing including locking elements, shoulder means on said hammer, and spring means tending to urge locking elements into engagement with said shoulder means for releasably restraining said hammer in a raised position relative to said anvil, a grip member mounted in said casing for attachably receiving a drop cable, lifting means carried by said grip member including lifting elements, shoulder means on said hammer, and spring means carried by said grip member tending to urge said lifting elements against said shoulder means, for lifting said hammer to the raised position, means on said casing engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, said spring means being adapted to permit operative disengagement of said lift elements from said shoulder means upon subsequent cable lift of said grip member, means on said casing engaging said grip member to prevent relative movement of said casing and grip member after disengagement of said lift means from said hammer during cable lift of the grip member, whereby to realize cable lift of the entire drill assembly, the spring means acting on said locking elements being of sufficient strength to permit operative disengagement of said locking elements from the coacting shoulder means due to the inertia of said hammer upon drilling impact of said bit anvil, a load spring in said casing above said bit anvil, said load spring being compressed when the hammer is restrained in raised position, and being adapted to expand to exert a drilling force that augments the inertia of said hammer when the hammer is released, whereby said hammer delivers a blow to said anvil responsive to hammer inertia and to the loading of said load spring.

15. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing above said anvil, the anvil being in the path of said hammer, locking means in said casing for releasably restraining said hammer in a raised position relative to said anvil, a grip member reciprocally mounted in said casing for attachably receiving a drop cable, a shoulder on said hammer, lifting means carried by said grip member, resilient means tending to urge said lifting means into engagement with said shoulder for lifting said hammer to the raised position, said hammer being provided with an elongate slot, a cross bar on said casing and received in said slot, said bar coacting in said slot to determine the raised position of said hammer, and to prevent further relative movement of said hammer and said casing during cable lift of said drill, said grip member being provided with an elongate slot, a second cross bar on said casing received in the last said slot, said second cross bar and its coacting slot being of a size to permit said grip member to move upwardly relative to said casing after said hammer is locked in said raised position, the shoulder and lifting means having coacting cam surfaces interengaging, said lifting means being yieldable to disengage operatively from said hammer shoulder as said grip member is lifted after said hammer is moved to said raised position as the weight of said casing is transferred to said lifting means, said second cross bar and its coacting slot preventing relative movement of said casing and grip member after disengage-

ment of said lift means from said hammer, whereby to realize cable lift of the entire drill, a lock shoulder on said hammer, resilient means tending to urge said locking means into engagement with said lock shoulder, the lock shoulder and locking means having coacting cam surfaces interengaging, said locking means being yieldable to release said hammer due to the inertia of the hammer exerted on said locking means upon drilling impact of said bit anvil, a load spring located in said casing above said bit anvil to exert a downward force on said hammer, said load spring being compressed when the hammer is restrained in raised position, and being adapted to expand to exert a drilling force that augments the inertia of the hammer when said hammer is released, whereby said hammer delivers a blow to said bit anvil.

16. In a double blow drill, a casing, a bit anvil reciprocally mounted in said casing, a hammer reciprocally mounted in said casing, locking means in said casing including locking elements, shoulder means on said hammer, and spring elements tending to urge said locking elements against said shoulder means for releasably retaining said hammer in a raised position relative to said anvil, a grip member reciprocally mounted in said casing for attachably receiving a drop cable, lifting elements carried by said grip member, shoulder means on said hammer, and spring means tending to urge said lifting elements against the last said shoulder means for lifting said hammer to the raised position, the hammer being provided with an elongate slot, a cross bar on said casing received in said slot, said cross bar engaging said hammer in the raised position to prevent further relative movement of said hammer and casing during cable lift of said drill, said grip member being provided with an elongate slot, a second cross bar on said casing received in the last said slot, said second cross bar and its coacting slot permitting relative upward movement of said grip member relative to said casing after said hammer is locked in the raised position, the spring means acting on said grip elements being of such strength to permit operative disengagement of said grip element from said shoulder means during cable lift of said grip member

after said hammer is located in the raised position, said second cross bar engaging said grip member after disengagement of said lift elements from said hammer to realize cable lift of the entire drill, the spring means acting on said locking elements being of a strength to permit operative disengagement of said locking elements from the coacting shoulder means due to the inertia of said hammer upon drilling impact of said bit anvil, a load spring in said casing above bit anvil, said load spring being compressed when the hammer is restrained in raised position and being adapted to expand to exert a drilling force that augments the inertia of the hammer when the hammer is released, whereby said hammer delivers a blow to said bit anvil that is responsive to the inertia of said hammer and to the loading of said load spring.

17. In a double blow drill, a casing, a bit anvil carried by said casing, a hammer member reciprocally mounted in said casing above said anvil, the anvil being in the path of said hammer member, means within said casing for releasably restraining said hammer member above said anvil, said restraining means including a grip member fixed relative to the casing, a shoulder on one of said members, a locking element carried by the other said member, and resilient means tending to urge the locking element into engagement with the shoulder for holding the hammer member in a raised position relative to the anvil, the shoulder and locking element being provided with coacting cam surfaces interengaging, the locking element being operatively disengageable from the shoulder under loading of said resilient means because of the inertia of the hammer member exerted between said cam surfaces upon drilling impact of said bit anvil, whereby said hammer member delivers a blow to said bit anvil.

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