Nov. 2, 1965 A. E. BARDWELL 3,215,212

PERCUSSION HAMMER DRILL

Filed Dec. 7, 1962

Fig. 1.

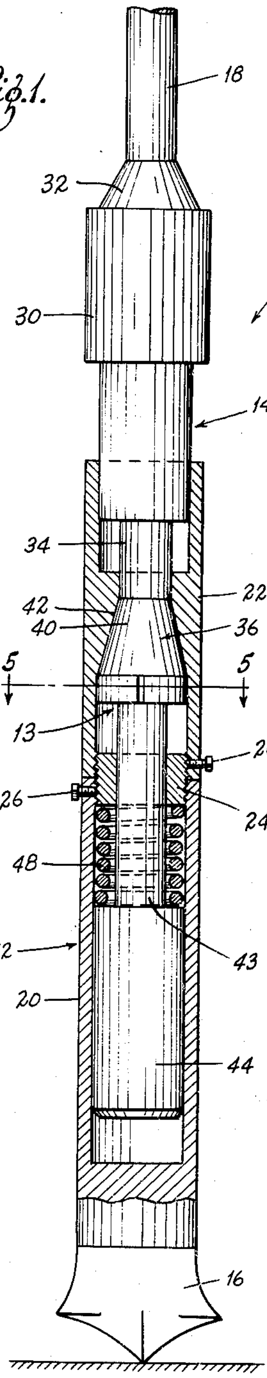


Fig. 2.

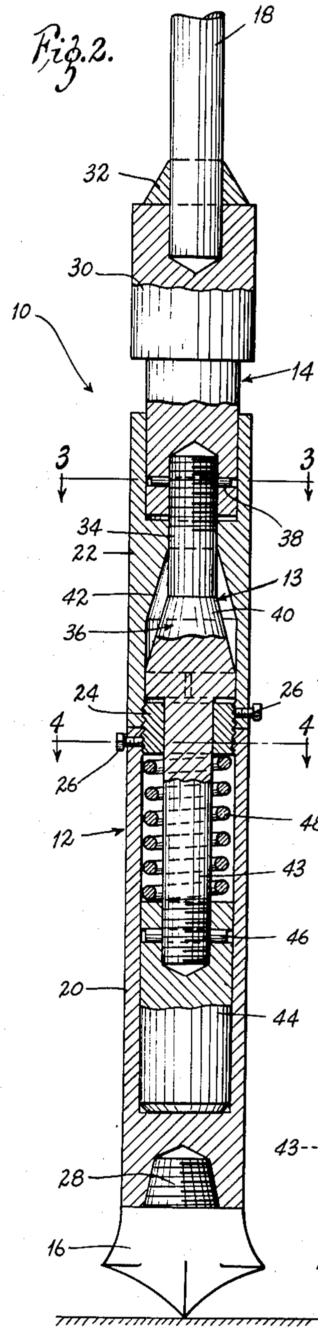


Fig. 3.

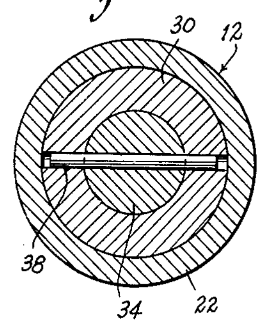


Fig. 4.

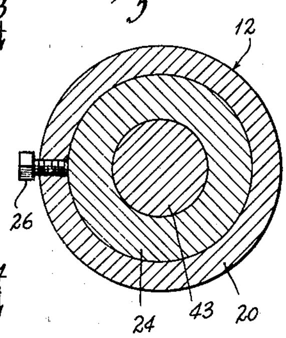
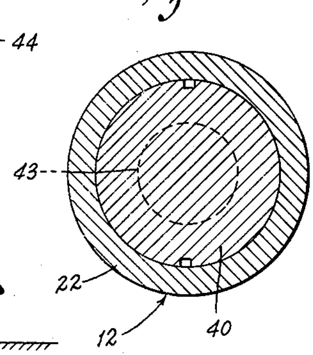


Fig. 5.



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United States Patent Office 3,215,212
Patented Nov. 2, 1965

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3,215,212
PERCUSSION HAMMER DRILL

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Filed Dec. 7, 1962, Ser. No. 243,019
3 Claims. (Cl. 175—299)

The present invention relates generally to drills, and more particularly to a percussion hammer drill of novel construction adapted to be alternately hoisted and abruptly dropped through a specified distance in the drilling operation.

There has long been the need for a percussion hammer drill, that is, a gravity drop drill incorporating an internal striking hammer to effect multiple striking blows per cycle of operation, which will effectively perform the intended functions of such drill. Devices of this nature heretofore developed have failed in ultimate commercial application. It is manifest that drop or gravity type drills must be extremely rugged to stand the terrific pounding in the drilling operation. While the demand for an efficient multiple striking drop drill has been great, prior to the present invention no one has provided an activating device for such constructions which would stand the necessarily rough treatment inherent in use. It has been heretofore recognized and demonstrated that such drills are much more efficient than the standard gravity or drop drills, and much money, time and effort have been devoted to attempts to solve the stated problem, without success.

Therefore, an object of the present invention is to provide a multiple action, gravity percussion hammer drill which supplies said long-felt want and which is a solution to the problem long facing the drilling industry.

In brief, the present novel percussion hammer drill comprises a casing, integrated upper and lower hammers, the latter being within and the former partially within the casing in operative relation, male and female cones cooperatively arranged within the casing, a strong compression spring for effecting a second drilling blow immediately following the gravity drop blow, a detachable bit, and interconnecting elements. A cable is attached to the upper end of the upper hammer for raising the drill.

A broad object of the present invention is to provide a percussion hammer drill of the type set forth above which has greatly increased drilling speed and efficiency as compared with drop drills presently and heretofore employed.

Another object of the invention is to provide a novel percussion hammer drill of the multiple blow type capable of producing during each drilling cycle one or more percussive strokes each of which may exert a force greatly exceeding the force of the gravity or drop stroke of the drill.

Another object is to provide a percussion hammer drill of the multiple blow type incorporating novel spring or compressed air driven hammer structure releasable after delivery of the drill's initial gravity blow for imparting a series of subsequent blows which provide greatly increased cutting forces to the drill bit.

Another object is to provide a percussion hammer drill structure adaptable to presently employed drills of the type concerned.

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Another object is to provide a novel percussion hammer drill of the type described capable of delivering an initial blow for setting its drill bit followed by a series of blows producing a shattering action.

Another object is to provide a novel percussion hammer drill of the type described adaptable for use as a churn drill in which the inertial force created in the process of lifting the drill is utilized for storing potential energy in the form of a compressed spring or compressed air which is subsequently released as a result of the impact of the drill delivering the gravity stroke.

Another object is to provide a novel percussion hammer drill of the type described in which moving parts are reduced to a minimum, and dogs, latches, and the like, are eliminated.

Another object is to provide a novel percussion hammer drill of the type described which employs friction engagement of parts to maintain a hammer member in cocked relation.

Another object is to provide a novel percussion hammer drill of the type described which can be maintained at relatively low cost, which is of rugged construction and capable of long drilling service, and which requires no skill beyond that found in the drilling field for efficient long use thereof.

The foregoing and other objects and advantages are apparent from the following description taken with the accompanying drawings, in which:

FIGURE 1 is an elevational view of a percussion hammer drill of the multiple blow type constructed in accordance with the teachings of the present invention, the casing being shown in longitudinal cross section for illustration of internal elements, the several parts being in loaded or cocked state;

FIGURE 2 is a view similar to FIGURE 1, several elements as well as the casing being in longitudinal cross section, the parts being in unloaded or fired positions;

FIGURE 3 is an enlarged, transverse, cross-sectional view taken on substantially the line 3—3 of FIGURE 2;

FIGURE 4 is an enlarged, transverse, cross-sectional view taken on substantially the line 4—4 of FIGURE 2; and

FIGURE 5 is an enlarged, transverse, cross-sectional view taken on substantially the line 5—5 of FIGURE 1.

Referring to the drawings more particularly by reference numerals, **10** indicates generally a percussion hammer drill of the multiple blow type incorporating the concepts of the present invention. The drill **10** includes broadly a casing **12**, locking construction **13**, a reciprocative energizable hammer construction **14**, a drilling bit **16**, and a cable **18**.

The casing **12** comprises a lower section **20**, an upper sleeve-shaped section **22**, and a threaded internal collar or ring **24** which threadedly receives the upper end of the lower section **20** and the lower end of the upper section **22**, as is shown in the drawings. Setscrews **26** maintain the sections **20** and **22** in contiguous relation. The bit **16** is connected to the lower end of the lower section **20** by a conventional threaded reduced extension **28** for ready removal when dull or damaged.

The hammer construction **14** includes an upper hammer **30** to the upper end of which is secured the lower end of the cable **18**, as by welding **32**. The lower end of the upper hammer **30** extends into the upper end of the upper casing section 22 and threadedly receives the threaded reduced upper extension 34 of a male cone member 36 of the locking construction 13, a pin 38 being provided to prevent unthreading in the drilling operation. The cone member 36 includes a cone portion 40 which, in cocked position of the hammer construction 14, frictionally engages a female cone 42, the other part of the locking construction 13, formed within and as part of the casing upper section 22, as is clear from the drawings. The cone member 36 also includes a lower reduced segment 43, the free end of which threadedly engages the upper end of a lower hammer 44, a pin 46 being provided to prevent accidental removal. A cone slope of 1 to 6 has been found to be highly effective.

Surrounding the lower segment 43 is a heavy compression spring 48, the lower end of which engages the upper end of the lower hammer 44 and the upper end of which engages the bottom of the collar 24.

It will be understood that the cable 18 passes over a pulley, or the like, located at the top of a suitable derrick and is wound on a winch, or is otherwise stored for use. By means of suitable powered machinery, the cable is raised and dropped in the drilling operation. It is the upward acceleration of the drill 10 which creates the inertial force utilized in compressing the spring 48 and lodging the male cone 36 in the female cone 42.

In operation, the drill 10 is lowered to the bottom of a bore in the unloaded state as illustrated in FIGURE 2. The drill 10 is then raised vertically by means of the cable 18 and the powered machine to which it is attached and the hammer construction 14 begins to move upwardly relative to the casing 12 and the bit 16. The acceleration of this motion must be sufficiently great so that the inertial force generated in taking the casing 12 and bit 16 from a state of rest to a state of motion at the velocity of the rising cable 18 is sufficient to compress the spring 48 and lodge the male cone member 36 in the female cone 42. This being established, after the spring 48 is compressed and the male cone member 36 located as indicated in FIGURE 1, the drill 10 continues to rise for a predetermined distance. When the top point of the upward movement is reached, the drill 10 is allowed to drop abruptly by gravity. During this return towards the bottom of the bore, the drill 10 remains in loaded state, as illustrated in FIGURE 1, the spring 48 being held in the compressed state by the forces of friction and elasticity inherently present in the region of contact between the male cone member 36 and the female cone 42. When the bit 16 strikes the bottom of the bore and delivers the conventional gravity blow, the impact so created breaks the bond between the cones 36 and 42 and the energy of the compressed spring 48 acts against the top of the lower hammer 44. The rapidly accelerated lower hammer 44 strikes the bottom of the lower casing section 20 and therethrough delivers its initial blow to the bit 16. Since in general not all of the momentum of the hammer construction 14 will be transferred to the bottom of the casing section 20 and therethrough to the bit 16 initially, the hammer construction 14 will rebound. The energy contained in this rebounding action, which is not lost to friction, will be captured by the spring 48 and, in turn, used to impose additional impacts on the bottom of the lower casing section 20 and therethrough on the bit 16. Obviously, the number of impacts which will be effected by the energy of rebound is determined by the time lapse between the impact of the initial hammer blow and the hoisting of the drill 10. With the beginning of the hoisting action, the basic cycle is complete, and continuing drilling is effected by the repetition of this basic cycle of operation.

It is clear that the strength of the spring 48, which can be used as the activating device in the drill 10, is a function of the capacity of the powered machine employed for raising the drill 10. Usually, it is desirable that the force required to compress the spring 48 and lodge the male cone member 36 substantially exceed the gravity force resulting from the weight of the casing 12 and bit 16. In this case, the drill 10 may be hoisted slowly in the unloaded state without effecting a transition to the loaded state. Also, from maximum strength of impact, it is generally desirable that the strength of the spring 48 be maximized within the capacity limits of the powered machine to effect the indicated operation. It should be understood that although the force of gravity acting on the casing 12 and the bit 16 is instrumental in the operation of loading the drill 10, this operation is not essentially dependent on this force. That is, the operation as prescribed for loading the drill 10 would be equally successful were the motion horizontal rather than vertical.

In general, the success of the operation of releasing the male cone member 36 from its lodged position in the female cone 42 depends on two principal factors. First, the substance being drilled must be sufficiently hard to result in a sharp deceleration of the drill 10 when the bit 16 strikes the bottom of the bore at the instant of impact for the gravity stroke. Second, the mass of the hammer construction 14 must be such that the product of this mass and deceleration occurring at the instant of impact for the gravity stroke is, in fact, a change in momentum or force sufficient to break the bond between the male cone member 36 and the female cone 42.

It is clear from the fact that the cable 18 is attached directly to the hammer construction 14 that the cable 18 should be allowed sufficient slack to permit the hammer construction 14 to move freely from its position in the loaded state to impact with the bottom of the casing section 20 upon release of the spring 48. Since the travel required for such movement is only a few inches, the required amount of slack in the cable 18 is not inconsistent with good drilling practices.

It is apparent that there has been provided a percussion hammer drill of the multiple impact type which fulfills the objects and advantages sought therefor.

It is to be understood that the foregoing description and the accompanying drawing have been given by way of illustration and example. It is also to be understood that changes in form of the elements, rearrangement of parts or steps, and substitution of equivalent elements or steps, which will be obvious to those skilled in the art, are contemplated as within the scope of the present invention which is limited only by the claims which follow.

What is claimed is:

1. In combination, a percussion hammer drill comprising a casing, a bit at one end thereof, a hammer construction disposed in said casing for reciprocative movement, means for releasably maintaining said hammer construction in one position of movement, comprising surfaces on the casing and the hammer construction and held against relative movement solely by friction, and means for energizing said hammer construction to strike a drilling blow to said bit upon release of said first-mentioned means.

2. In combination, a percussion hammer drill comprising a casing, a bit at one end thereof, a hammer construction disposed in said casing for reciprocative movement, means for releasably maintaining said hammer construction in one position of movement, comprising cone surfaces on the casing and the hammer construction and held against relative movement solely by friction, and means for energizing said hammer construction to strike a drilling blow to said bit upon release of said first-mentioned means.

3. In combination, a percussion hammer drill comprising a casing, a bit at one end thereof, a hammer construction disposed in said casing for reciprocative movement, means for releasably maintaining said hammer construction in one position of movement, comprising cone surfaces on the casing and the hammer construction and held against relative movement solely by friction, and means for energizing said hammer construction to strike a drilling blow to said bit upon release of said first-mentioned means comprising a heavy compression spring.

References Cited by the Examiner

UNITED STATES PATENTS

1,794,991	3/31	Stephan	175—302
2,059,540	11/36	Stephan	175—302
2,241,477	5/41	Rasmussen	175—302
2,265,431	12/41	Kerr	175—297
2,365,858	12/44	Binkley	175—57
2,524,707	10/50	Koeln	175—299
2,835,474	5/58	O'Connor et al	175—299
2,872,158	2/59	Green	175—299
3,028,921	4/62	Le Bus	175—57

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