No. 862,653.

PATENTED AUG. 6, 1907.

H. A. PEDRICK & C. A. SMITH.

ROCK DRILL.

APPLICATION FILED MAR. 10, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

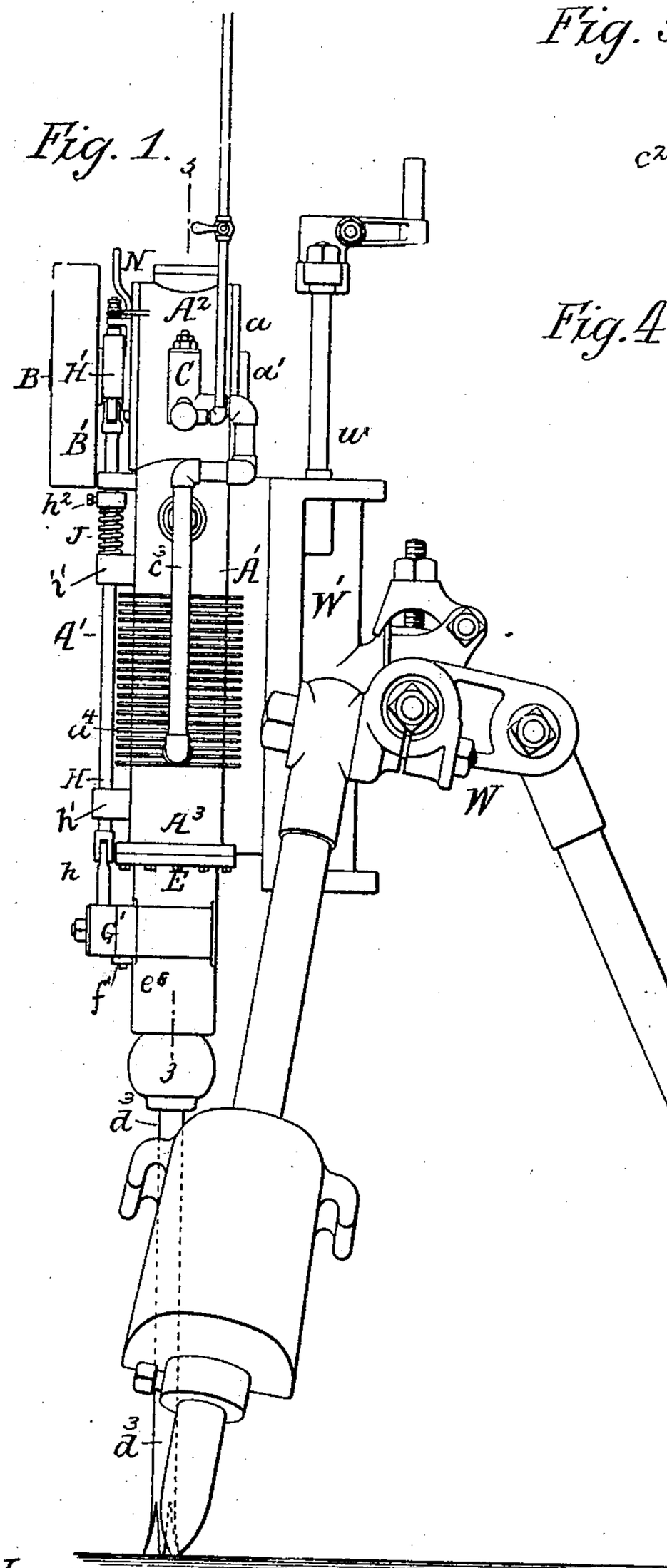


Fig. 5.

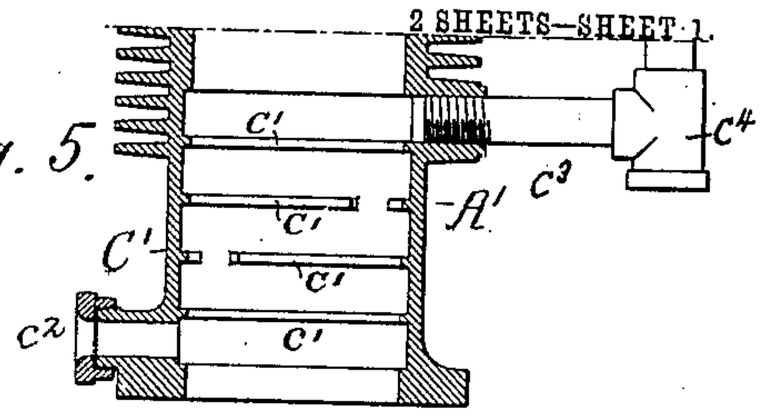
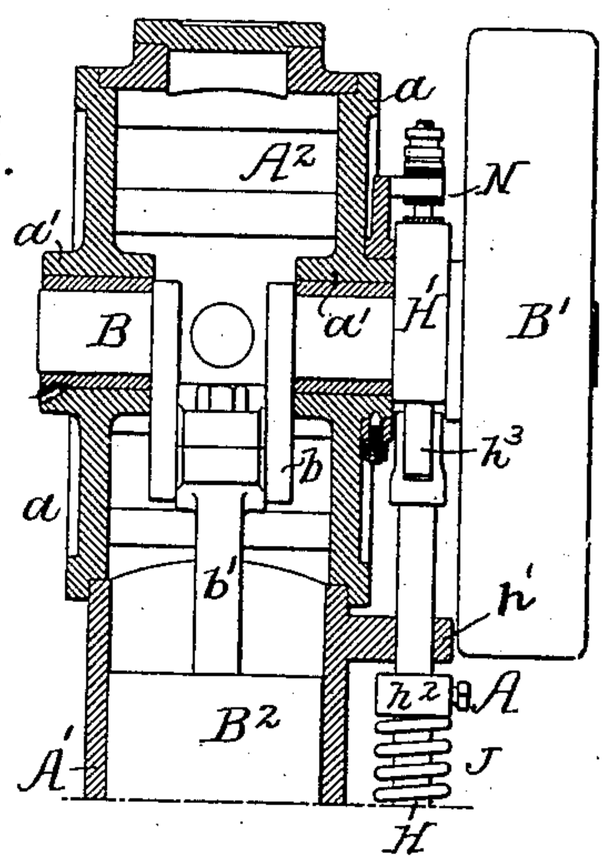


Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 2.

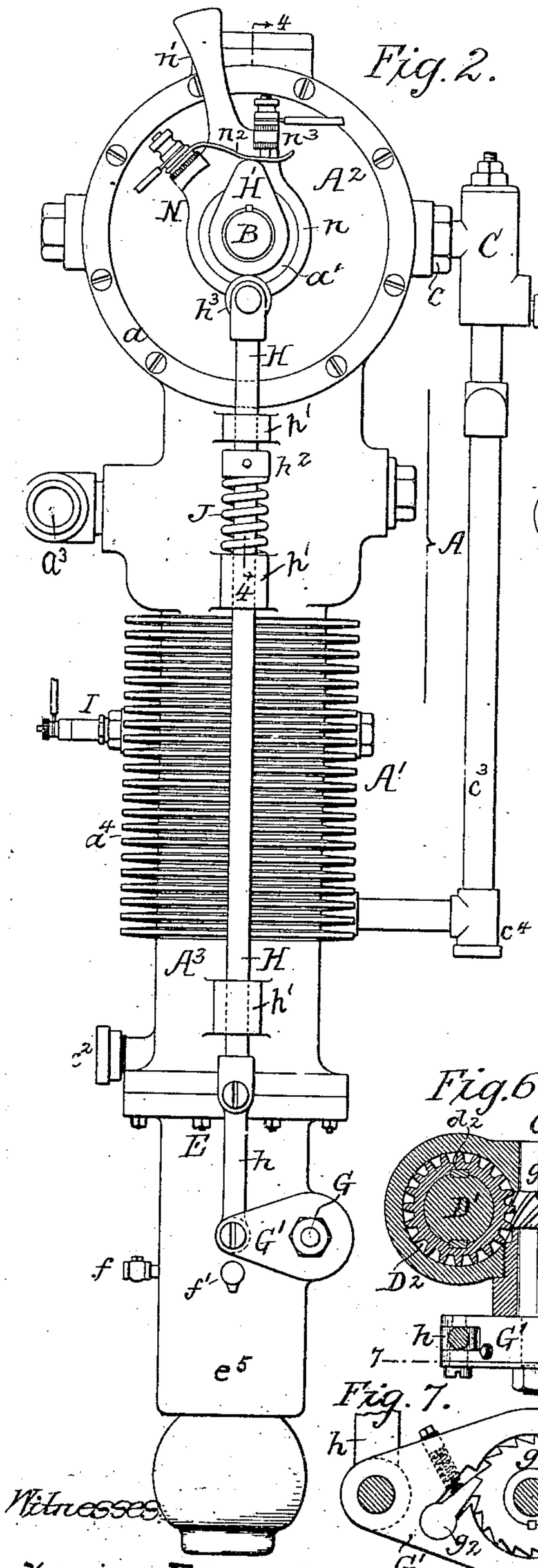

Fig. 3.

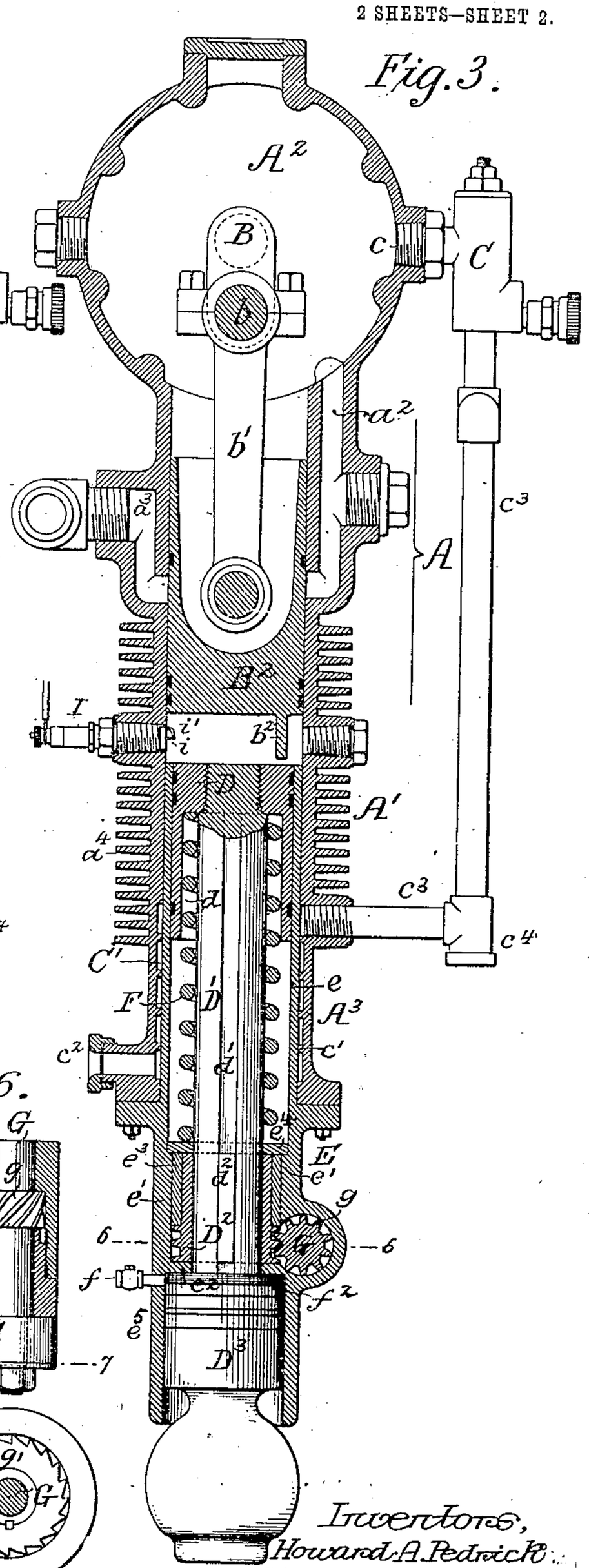

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

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ROCK-DRILL.

No. 862,653. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed March 10, 1906. Serial No. 305,319.

To all whom it may concern:

Be it known that we, HOWARD A. PEDRICK and CHARLES A. SMITH, citizens of the United States, residing at Philadelphia, Pennsylvania, have invented certain Improvements in Rock-Drills, of which the following is a specification.

The object of our invention is to construct a rock drill, actuated by the explosion of a gaseous compound, which will withstand the severe racking strains to which a rock drill is subjected. This object we attain by so designing the rock drill that there will be no direct connection between the drill plunger and the other mechanism of the drill, there being always a body of compressible fluid back of the plunger to resist the back lash, thus preventing the destructive jarring or racking of the parts.

In this type of rock drill gasolene gas is preferably used as the motive fluid, although other explosive mixtures can be used without departing from our invention.

Heretofore in rock drills driven by an explosive mixture the great difficulty has been to construct a drill which will withstand the heavy shocks to which the mechanism of the drill is subjected, as it will be understood that the constant hammering of the drill against a rock which is not resilient causes a reaction on the frame which, if the drill is not properly constructed soon shatters it and renders the drill inoperative.

Prior to our invention there has been no drill operated by an explosive mixture which is able to stand the back lash or racking strain.

In the accompanying drawings:—Figure 1, is a side view of our improved rock drill; Fig. 2, is a face view with the fly wheel removed; Fig. 3, is a sectional elevation on the line 3—3, Fig. 1; Fig. 4, is a sectional elevation on the line 4—4, Fig. 2; Fig. 5, is a sectional view of the lower portion of the cylinder; Fig. 6, is a sectional plan view on the line 6—6, Fig. 3, and Fig. 7, is a sectional view on the line 7—7, Fig. 6.

At the outset it will be understood that our improved drill is mounted in any suitable manner on the usual tripod. In the present instance we have shown a tripod W, in Fig. 1, carrying a slide W′ on which the casing of the drill is mounted, *w* is the usual feed screw for feeding the drill to the work. The drill is connected to a gasolene tank preferably by a flexible coupling and any suitable igniter may be used for creating a spark to cause the explosion. These features form no part of our invention.

A is the casing of our improved rock drill. In the upper portion of this casing is a mixing chamber A^2 and the lower portion of the casing incloses the cylinder A′.

a, *a* are cap plates mounted on each side of the casing A and forming the side walls of the mixing chamber A^2; in these side plates are the bearings *a*′ for the crank shaft B. On one end of this crank shaft we preferably mount a fly wheel B′.

B^2 is a compression piston mounted in the portion A^2 of the cylinder A′, and this piston is connected to the crank *b* of the shaft B by a connecting rod *b*′.

c is an inlet for the explosive mixture, communicating with a carbureter C.

In the lower portion of the casing is a plunger D connected to the drill spindle, and the explosive mixture is ignited at a point between the head of the plunger and the head of the piston.

a^2 is a passage leading from the mixing chamber A^2 to the interior of the cylinder A′ and a^3 is an exhaust passage leading from the interior of the cylinder A′ on a line in the present instance with the inlet passage.

Projecting from the head of the piston B^2 is a deflector b^2 which deflects the incoming gases when the piston uncovers the inlet port, so as to prevent the gases escaping at once through the exhaust passage.

In the present construction we preferably secure an extension E to the end of the casing A by bolts or other suitable fastenings and the cylindrical portion *e* of this extension E is mounted within the lower portion A^3 of the cylinder A′, forming a lining for said cylinder.

The plunger D has a deep flange *d* in the present instance and reciprocates in the lining portion *e* of the cylinder.

Connected to the plunger D is a spindle D′, which passes through an abutment *e*′ on the extension E and through the hub of a right angle gear wheel D^2. This spindle has a longitudinal key-way *d*′ and mounted in this key-way and a key-way in the hub of the right angle gear wheel D^2 is a key d^2, so that the spindle can slide freely in the hub of the gear wheel but must turn with it. The wheel D^2 rests on a flange e^2 and surrounding the hub is a sleeve e^3.

Mounted between the plunger D and the abutment *e*′ is a heavy coiled spring F which is compressed when the plunger is driven forward by the explosion of the gases in the cylinder, a washer e^4 is preferably mounted between the spring and the abutment to increase the bearing of the spring.

The portion e^5 of the extension E forms a dash pot and in this dash pot is mounted the head D^3 on the end of the spindle D′ of the plunger D. This head is so proportioned that it will come against the underside of the flange e^2 when the plunger D is at the inner end of its stroke, as shown in Fig. 3, of the drawing. The position of this head determines the position of the plunger in the cylinder and the head may be made adjustable if desired. By adjusting this head the compression could be regulated to a certain extent. The dash pot has a valved inlet *f* and an outlet *f*′ in which is a valve of any suitable construction for regulating the exhaust. Preferably carried by the head is a ring of yielding

material f^2 to cushion the head should the entrapped air in the dash pot not be sufficient to resist the back lash.

We preferably form an air chamber C′ around the cylinder A′, this air chamber is mounted in the lower portion of the cylinder, in the present instance between the lining e and the casing, the casing being hollowed out to form the chamber as shown in Fig. 5. One or more annular or vertical ribs e' may be formed and these ribs may be discontinued at certain points, the openings being preferably staggered in respect to each other so that the air will have a circuitous passage through the chamber. The inlet opening c^2 to this air chamber is preferably provided with a screen or other means to prevent impurities entering the air chamber, and the opposite end of the chamber is connected by a pipe c^3 to the carbureter C. The pipe c^3 leading from this air chamber to the carbureter may have a valve c^4 so arranged that a certain amount of air may be taken in from the atmosphere without passing through the said chamber. By heating the air before entering the vaporizer we provide absolutely dry air and of a temperature to make the most efficient mixture.

Detachably secured to the head D^3 of the spindle D is the drill rod d^3.

I is the igniter plug screwed into a threaded opening in the cylinder A′ and this igniter has contact points i, i in the present instance, and these points are in electric circuit with a suitable contact regulator N so as to create a spark at the proper time. We have shown two openings for the insertion of a sparker, either one of which may be used, the other being closed by a plug. We preferably mount the commutator or contact regulator N for regulating the time of the spark on one of the bearings a' of the plates a, as shown in Figs. 2 and 4, and in this instance the contact regulator consists of a ring n mounted on the bearing a' having a handle n' by which it can be turned and set at any point desired, and this ring carries a spring contact n^2. The spring is actuated in the present instance by the cam H′ which actuates the turning mechanism for the drill, although a separate cam may be used if desired.

In the path of the spring is a screw contact point n^3 both the spring n^2 and point n^3 are insulated from the ring and are in the battery and igniter circuit or may be indirectly connected to the igniter through an intensifier. This screw contact can be adjusted towards and from the spring to regulate the tension of the spring and the regulator can be adjusted to regulate the time of the spark.

In order to turn the drill rod at each stroke of the spindle so that the drill point will not strike the same place consecutively we mount a shaft G in suitable bearings in the extension E and on this shaft is a right angle gear wheel g which meshes with the right angle gear wheel D^2. On the outer end of this shaft is a ratchet wheel g' with which a spring actuated pawl g^2 engages, this pawl is pivoted to an arm G′ connected by a link h to a rod H mounted in bearings h' on the casing A.

Secured to the rod H is a collar h^2 and between this collar and one of the bearings is a spring J. On the end of the rod H is a friction roller h^3 which rests against the cam H′ on the crank shaft B, so that on each revolution of the crank shaft the rod H will be reciprocated, causing the pawl to turn the ratchet wheel intermittently and the gearing imparting a like movement to the spindle D′ and the drill rod. Other mechanism for turning the drill rod may be used without departing from the main features of the invention.

By utilizing the spring J to turn the drill rod instead of a positive means we prevent the breaking of the parts should the drill be prevented from turning, as the spring will simply be compressed not having the strength to operate the mechanism to turn the bit until the bit is released.

In order to cool the cylinder we preferably form a series of radiating ribs a^4 on that portion of the cylinder A′ where the explosion takes place. In place of the ribs a water jacket may be used as an equivalent.

The operation of our improved rock drill is as follows:—The explosive mixture enters the mixing chamber A^2 through the feed pipe c and is thoroughly mixed by the reciprocation of the piston B^2 and when the piston is at the upper portion of its stroke the explosive mixture passes through the admission port a^2 into the cylinder A′ between the head of the piston and the head of the plunger F. The deflector b^2 projecting from the piston deflecting the gases as they pass into the cylinder, the mixture completely filling the space. On the forward stroke of the piston the gases are compressed as the spring F is of sufficient strength to hold the plunger D in the fixed position while the piston is compressing the gases, and when the crank b is on a dead center, as shown in Fig. 2, of the drawing, with the piston at the end of its forward stroke, the gases are ignited, causing the explosion which will overcome the pressure of the spring F and force the plunger D forward, compressing the spring and driving the drill with a positive pressure against the stone or other material to be cut. On the return stroke of the piston the spent gases are exhausted through the passage a^3 at the same time a fresh charge of the explosive mixture enters through the inlet passage a^2. The plunger, as soon as the blow is struck, is quickly returned by the spring F and is ready to resist the action of the piston in compressing the next charge. As the crank shaft B is turned the cam H′ forces down the rod H, causing the pawl to slip past one or more teeth of the ratchet wheel g', the spring J lifts the rod, the pawl then engages the teeth of the ratchet wheel g' turning the shaft G, and as this shaft is geared to the spindle D′ said spindle will be turned, causing the drill rod to strike blows at different points on each reciprocation.

It will be understood that while we have described the explosion taking place when the crank is on a dead center, as shown in Fig. 2, the commutator may be so set as to create the spark either before or after the crank reaches the dead center according to the blow and speed desired. We have also found by experience that by operating the contact regulator we are able to regulate the stroke of the plunger and its drill rod and in practice we start the engine by exploding on the dead center and as it attains its required speed we adjust the commutator so that the spark will be made before the crank reaches the dead center. This gives the most power and the proper speed. Thus it will be seen that we compress the gases by the use of a piston, the pressure being resisted by the plunger backed by a spring which is strong enough to resist the pressure and yet is not strong enough to resist the explosive

force of the mixture, and that there is no direct connection between the drill rod and the casing or compression mechanism of the drill, so that there is no tendency to rack the parts by the back lash of the plunger when the drill strikes the blow.

The arrangement of the parts of this drill is such that the forward feed of the drill does not affect in any way the operation of the compression mechanism of the drill, as the compression mechanism is in no wise connected to or controlled by the feed. If the operator should feed too fast he simply shortens the stroke of the plunger if the drill cannot cut to the full depth at a single stroke, so that all that is done is to shorten the stroke of the plunger until the drill has cut a depth equal to the amount of feed. If the feed is increased so that there will be practically no reciprocation of the plunger and its drill rod then the drill is in effect similar to the hammer blow drill where the drill is held in contact with the work and the blow is struck by a plunger on the opposite end of the drill rod, but if there is reciprocation this reciprocation may be varied according to the amount of feed and then it becomes a variable reciprocating drill.

We preferably arrange the mechanism so that the plunger will be in direct line with the piston and the mixing chamber will be formed in the upper end of the casing and inclosing the crank shaft, thus making a very compact rock drill and as the pressure is all in direct line it can be made much lighter than if the parts were otherwise constructed.

While the mechanism is driven at such a speed that the blows are struck in rapid succession, nevertheless the action is such that the spring supported plunger will resist the action of the piston in compressing the gases while the piston also having a certain movement will resist the force of the explosion, but as the explosion takes place as the piston is returning and as there is always space between the head of the plunger and the head of the piston the severe racking strains are reduced to a considerable extent.

It will be understood that the blow of the drill against the rock or other material is the force of the explosion less the amount taken up in compressing the spring.

The details of the mechanism may be modified without departing from the essential features of the invention.

We claim:

1. The combination in a rock drill actuated by the explosion of a gaseous mixture, of a cylinder, an automatically actuated piston and a plunger mounted in the cylinder, a spindle connected to the plunger, a spring concentrically surrounding said spindle and operatively independent of the piston, said spring being capable of resisting the action of said piston as it compresses the explosive mixture but insufficient to overcome the force of the explosion of said mixture, and means for cushioning the return stroke of the plunger, substantially as described.

2. The combination in a rock drill, of a cylinder having an inlet for an explosive mixture and an outlet for spent gases, a piston and a plunger in said cylinder, a drill rod arranged to be actuated by said plunger, automatic means for reciprocating the piston, and an igniting device, a spindle connected to the plunger, a spring concentrically surrounding the spindle within the cylinder and operatively independent of the piston for causing the plunger to resist the pressure when the explosive mixture is being compressed, said spring being insufficient to resist the force of the explosion of said mixture, substantially as described.

3. The combination in a rock drill, of a cylinder having an inlet for explosive mixture and an outlet for spent gases, a piston in said cylinder, automatic means for reciprocating the piston to admit the gases and to compress the same, a plunger in the cylinder, a drill rod connected to the plunger, a spring surrounding the drill rod within the cylinder and acting against the plunger, said spring being of sufficient strength to resist the compression of the gases by the piston, but insufficient to resist the force of the explosion, and a device for cushioning the stroke of the plunger caused by said spring, substantially as described.

4. The combination in a gas engine, of a cylinder having an inlet for the explosive mixture and an outlet for spent gases, a piston in one end of the cylinder, automatic means for actuating the piston including a crank shaft connected thereto, a plunger on the other portion of the cylinder in line with the piston, a spindle connected to the plunger and carrying the drill rod, a spring mounted within the cylinder between an abutment on the casing and the back of the plunger, said spring being of a sufficient strength to resist the action of the piston in compressing the gases in the cylinder between the piston and the plunger, but not of sufficient strength to overcome the force of the explosion of the mixture, with a dash pot for cushioning the return stroke of the plunger caused by the spring, substantially as described.

5. The combination in a gas engine, of a casing, a mixing chamber formed in the upper portion of the casing, a crank shaft mounted in said mixing chamber, a cylinder, a piston mounted in the cylinder and connected to said crank shaft, said cylinder having an inlet port leading from the mixing chamber and an exhaust port, a plunger also in the cylinder and connected to the drill, a spring mounted between an abutment of the casing and the plunger, means for igniting an explosive charge between the piston and the plunger, with an extension to the casing for supporting said abutment, said extension having a portion within the cylinder constructed to form a lining therefor, substantially as described.

6. The combination in a rock drill, of a casing inclosing a cylinder and a mixing chamber, a crank shaft mounted in the mixing chamber, a piston mounted in the cylinder and connected to the crank shaft, a passage leading from the mixing chamber to the cylinder, an outlet from the cylinder for spent gases, an extension of the casing, a portion of said extension being mounted in the cylinder and forming a lining for the same, a plunger mounted in the lined portion of the cylinder, a spindle extending from the plunger through an abutment on the extension and carrying the drill rod, a spring mounted between the abutment and the plunger, with means for igniting the explosive mixture at a point between the head of the piston and the head of the plunger, substantially as described.

7. The combination in a rock drill, of a casing, a mixing chamber, a crank shaft in the mixing chamber, a fly wheel on the crank shaft, a cylinder, a piston mounted in the cylinder and connected to the crank of the crank shaft, a passage leading from the mixing chamber to the cylinder and an outlet passage leading from the cylinder, a plunger, an extension to the casing having a portion forming a lining for the cylinder and provided with an abutment a stem on the plunger passing through the abutment and arranged to actuate the drill rod, a spring mounted between the abutment and the plunger, means for igniting the explosive mixture between the piston and the plunger, and means for turning the spindle, substantially as described.

8. The combination in a rock drill, of a casing, a mixing chamber, a crank shaft in the mixing chamber, a fly wheel on the crank shaft, a cylinder, a piston mounted in the cylinder and connected to the crank of the crank shaft, a passage leading from the mixing chamber to the cylinder and an outlet passage leading from the cylinder, a plunger, a stem on the plunger passing through an abutment and arranged to actuate the drill rod, a spring mounted between the abutment and the plunger, means for igniting the explosive mixture between the piston and the plunger, means for turning the spindle, a gear wheel through the hub of which the spindle extends, the said spindle being

keyed to the hub so that it will slide therein, a second gear wheel meshing with the first gear wheel, ratchet mechanism for intermittently turning the said gearing, a rod connected to the ratchet mechanism, and a driven cam for reciprocating the rod, substantially as described.

9. The combination in a rock drill actuated by the explosion of a gaseous charge, of a cylinder, a piston mounted in said cylinder, a crank shaft connected to the piston, a fly wheel on the crank shaft, a structure forming an extension of the cylinder and provided with a portion forming a lining for a part thereof, a plunger mounted in the cylinder so as to operate within said lining, means for holding the plunger so that it will resist the compression of gases by the piston, while leaving said plunger free to move under the force of an explosion, a drill carried by the plunger, said cylinder having inlet and outlet ports leading to the space between the piston and the plunger, an igniter, and a cushioning device for the plunger, substantially as described.

10. The combination in a rock drill actuated by an explosive mixture, of a cylinder, a piston and a plunger therein, there being an air chamber surrounding that portion of the cylinder containing the plunger, and the structure having an inlet and an outlet for said air chamber, with a carbureter with which said air chamber communicates, substantially as described.

11. The combination in a rock drill operated by an explosive mixture, of a cylinder, a piston and plunger mounted in the cylinder, an air chamber surrounding that portion of the cylinder containing the plunger, one end of the air chamber being open to the atmosphere and the other end thereof being connected to the carbureter of the drill, means for operating the piston, and a device tending to maintain the plunger in a predetermined position, substantially as described.

12. The combination in a rock drill operated by an explosive mixture, of a casing having a cylinder formed therein, a piston in one end of the cylinder, a plunger in the opposite end of the cylinder, an extension secured to the end of the casing and having a portion mounted within the lower portion of the cylinder and forming a lining therefor, an air chamber formed between the lining and the casing, broken projections separating the air chamber into a number of communicating compartments, an inlet communicating with one portion of the air chamber and an outlet connected to the other portion of the air chamber, said outlet extending to the vaporizer, substantially as described.

13. The combination in a rock drill of a frame having a cylinder, a plunger, a spindle for the plunger, an abutment on the frame through which said spindle extends, a gear wheel mounted in the abutment and splined to the spindle, a spring on the spindle interposed between the plunger and said gear wheel, a drill rod attached to the end of the spindle, a second gear wheel meshing with said first gear wheel and having a supporting shaft extending at right angles to the spindle, a ratchet wheel on said shaft, a pawl therefor, a reciprocating rod connected to the ratchet, and means for intermittently actuating said rod, substantially as described.

14. The combination in a rock drill, of a casing containing a cylinder, an extension of said casing having an abutment and a dash pot formed therein, a plunger mounted in the cylinder, a spindle attached to the plunger and passing through the abutment and through the dash pot, a head on said spindle mounted in the dash pot, means for connecting a drill bit to the end of the spindle, a spring mounted around the spindle between the plunger and the abutment, a piston in the cylinder, ports leading to the space between the piston and the plunger, and means for exploding a gaseous mixture in said space, substantially as described.

15. The combination in a rock drill, of a cylinder, a plunger therein, a dash pot in line with the cylinder, a spindle attached to the plunger and extending through the dash pot, a head on the spindle mounted in the dash pot, a spring mounted between an abutment and the plunger, with a yielding material mounted between the head and the inner end of the dash pot, substantially as described.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

HOWARD A. PEDRICK.
CHARLES A. SMITH.

Witnesses:
WILL. A. BARR,
JOS. H. KLEIN.