Feb. 16, 1926.

1,573,790

J. V. RICE, JR

GASOLINE ROCK DRILL

Filed June 15, 1922

2 Sheets-Sheet 1

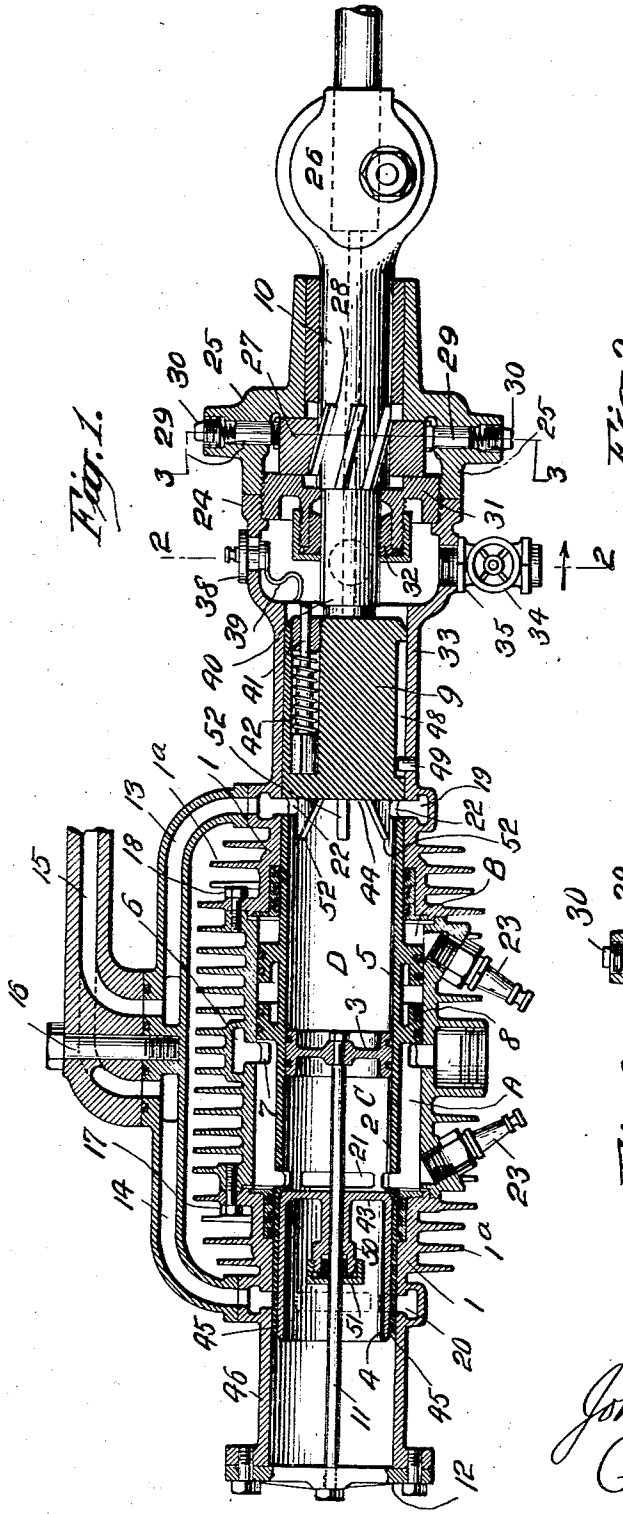


Fig. 1.

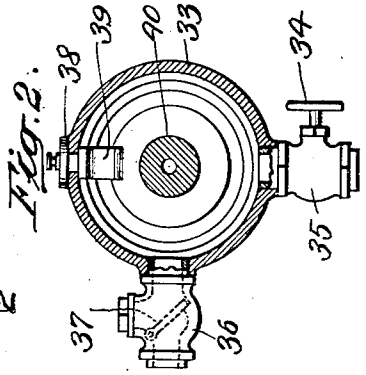


Fig. 2.

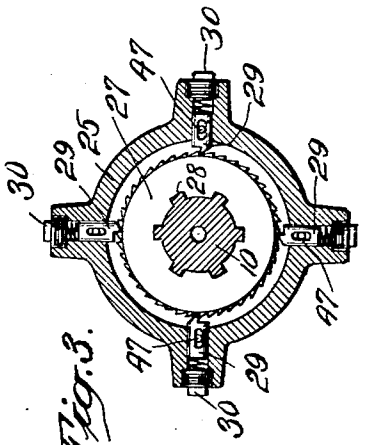


Fig. 3.

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2 Sheets-Sheet 2

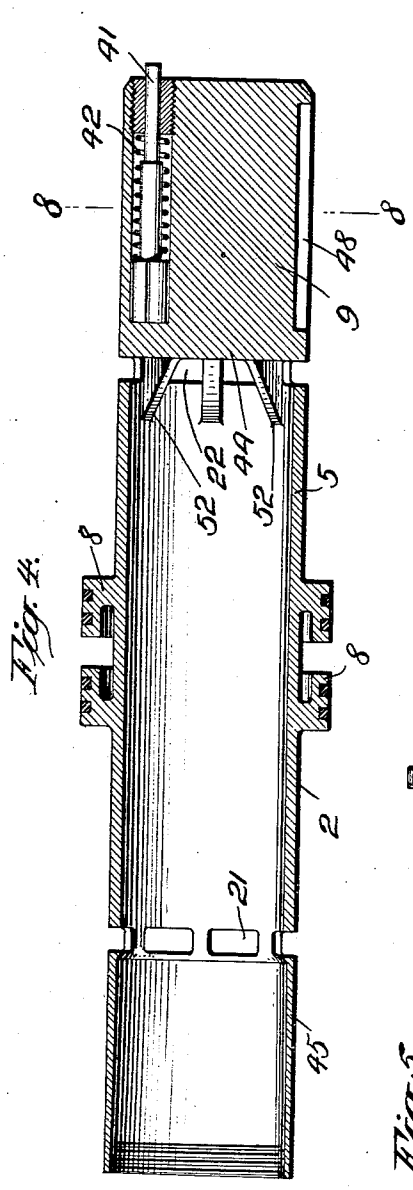


Fig. 4.

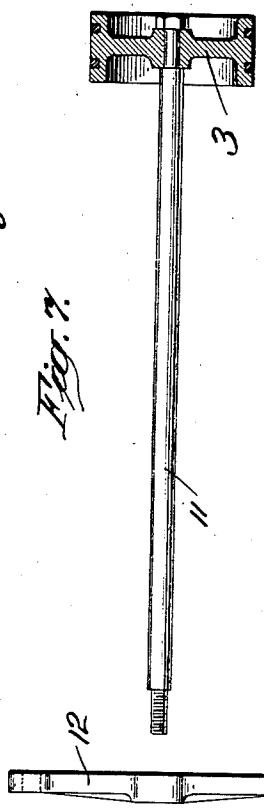


Fig. 7.

Fig. 6.

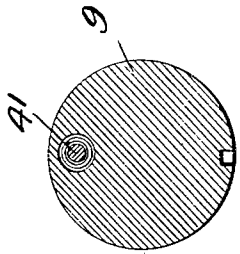


Fig. 8.

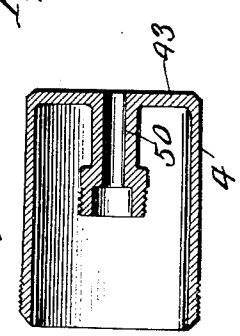


Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN V. RICE, JR., OF BORDENTOWN, NEW JERSEY, ASSIGNOR TO RICE PORTABLE ROCK DRILL CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

GASOLINE ROCK DRILL.

Application filed June 15, 1923. Serial No. 568,568.

To all whom it may concern:

Be it known that I, JOHN V. RICE, Jr., a citizen of the United States, and resident of Bordentown, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in Gasoline Rock Drills, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention refers to an improvement in the general class of hydrocarbon or gas-actuated rock drills, and especially to the particular subdivision of the general class commonly known as hammer or impact drills, and having as a special characteristic means for enabling the motor piston to deliver a succession of short, hard blows upon the end of the drill-carrying member, which latter corresponds to the piston-rod in other types of gasoline rock drills, it being therefore noted that primarily in the present case the piston and the drill-carrying member or rod are distinct and unconnected elements and that the operation involves the reciprocation of the piston freely within the cylinder in relation to the drill-carrying member, and the striking of a multiplicity of blows inside the cylinder.

In making the hammer type drill the primary subject of the present improvements I do not mean to exclude the other type where a piston-rod or drill-carrying member is rigidly attached to the piston, because the invention can be easily adapted to apply to that form of drill, all as will be clearly seen, to the end that the best and most effective results in actual practice may be obtained, both types of drill being particularly useful in certain alternate locations and under certain conditions.

The invention, therefore, having in view the ends I have suggested, and made up of as few mechanical parts as possible, may be said to consist essentially in the construction, arrangement and combination of the various parts, substantially as will be hereinafter more fully described and then definitely and carefully pointed out in the ensuing clauses of claim.

In the accompanying drawing illustrating my invention:

Figure 1 is a longitudinal section of my improved gasoline rock drill.

Figure 2 is a cross-section of the same on the line 2, 2, of Figure 1.

Figure 3 is a cross-section on the line 3, 3, of Figure 1.

Figure 4 is a detail longitudinal section of the piston.

Figure 5 is a detail sectional view of one of the heads of the piston, which is removable therefrom.

Figure 6 is an edge view of the cross-piece for carrying the stem that holds the partition in the piston.

Figure 7 is a side view of said stem, and shows the partition in section.

Figure 8 is a cross-section on the line 8, 8, of Figure 4.

1 denotes the main cylindrical frame of the machine, which constitutes the cylinder of the motor. It is of the differential type and has the opposite ends 46 and 33, said end 33 having an enlarged portion 24 to which a casing 25 is united. In connection with these parts a drill-carrying rod which corresponds to the ordinary piston rod, as 10, is carried by suitable means, made up of a multiplicity of various parts which cooperate in the production of certain results, which I shall presently describe at length. Cylinder 1 has any suitable cooling appliance, for it may use water or other liquid, a fan, or any other effective cooling agent, but I preferably build it with a multiplicity of radial fins or flanges 1^a which cover more or less of the outer surface, so as to avoid some of the objections incidental to water jackets and the like, said flanges being properly proportioned to provide the radiating surface necessary for the amount of heat generated in the operation When desired, though not necessarily, the cylinder 1 may be made in three or more parts that are joined closely together by means of bolts or other devices 17 and 18, so as to hold the parts together in a single cylindrical unit. But it will be evident that this construction may be widely departed from, and that I do not consider the tri-sectional or other character of the cylinder as at all essential.

Referring now to the cylinder members 33 and 25 and the appurtenant parts, it will be noted that I have devised special means for carrying the drill-carrying rod 10 and allowing it to easily reciprocate under the impact of the piston blows thereon, and also the rod has therewith a special construction of ratchet and pawl device, which will cause it to intermittently rotate in order to

accomplish the necessary rotary shifting of the drill at the end of each stroke. The rod 10 is provided at a point outside of the cylinder with a drill choke 26, through and in which the drill, hammer, or other boring or cutting implement is attached and held in the ordinary way. The outer portion 24 of the cylinder head 33 is preferably screw-threaded in order to allow a barrel member or cap 25 to be secured thereon, both parts 24 and 25 being screwed on an inner screw-threaded ring 31 which is packed at 32 around a section 40 of rod 10, on which part 40 the piston hammer 9 delivers its blows, said barrel member 25 carrying also within the same suitable other parts for making a tight joint upon the rod 10. On the rod 10 is a series of inclined or spiral ribs 28, which engage corresponding grooves in the interior part of a ratchet wheel 27, which is loosely mounted upon the rod 10 inside of the barrel extension 25. The teeth of this wheel 27 are engaged by a series of flexible pawls that are mounted in the part 25 and the details of which are clearly indicated, not only in Figure 1, but more fully and on a larger scale in Figure 3. These pawls comprise pins 29 having teeth that engage the teeth of the ratchet wheel 27, and are located in radial slots in the ring portion 25 of the barrel extension. These pawls 29 are controlled as to their radial movement by means of pins 47 fast in the ring 25 and passing through slots in the pawls 29. Further, these pawls 29 are urged inwardly so that their teeth may press against the teeth of the ratchet wheel 27 by means of springs which are inserted between the ends of the pawls 29 and the screw caps 30 that are screwed into interiorly screwthreaded projections on the outside surface of the ring 25 and are therefore easily accessible from without and are adjustable as desired for regulating the tension of the springs and therefore graduating the grip of the pawls in relation to the teeth of the ratchet wheel 27.

It will be evident that as the rod 10 reciprocates in one direction it will pursue a rectilineal movement without rotating, while at the next reciprocation it will not only pursue a rectilineal movement but will also rotate to a greater or less extent and will be held from rotating backwardly by the slipping of the teeth of the ratchet 27 over the pawls and allowing the pawls to engage, as shown in Figure 3. I utilize four pawls in the specific example of the invention here indicated in order that the rod 10 may be firmly held. It is thus evident that the ratchet wheel 27 engaged by the pawls 29 is permitted to rotate in one direction but effectually prevented from rotating in the other. The rod 10, therefore, and the drilling implement carried by the chuck 26 will move forward in a straight line on one reciprocation, without rotating, while at the next reciprocation, usually on the back stroke, it will not only pursue this straight line movement but rotate to a greater or less extent, in order to accomplish the necessary rotary shifting of the drill at the end of each stroke, in like manner and for the same purpose as is the customary operation with rock drills.

Within the cylinder 1 is a differential piston, which is free to move in one direction or the other under the expulsions of a gaseous mixture and which is entirely disconnected from any other element and is free and clear of the rod 10. The solid end 9 thereof opposite to the head 40 of the rod 10 acts as a hammer and strikes a succession of blows against the head 40 of the rod 10 and forces the rod and the drill implement carried thereby forwardly, as I have already explained, the return movement of the rod 10 resulting each time from the action of the rebound of the parts. The hammer 9 has a straight groove 48 cut therein, which is engaged by a pin 49 in the wall of the cylinder and this device keeps the piston from rotating and also causes its travel in each direction to be limited.

As already stated, the bore of cylinder 1 has a smaller diameter at the ends in sections 46 and 33 than in the middle portion, its differential character in this respect corresponding with the differential shape of the piston which reciprocates within the cylinder 1. The middle and larger portion of cylinder 1 furnishes the two explosion chambers A and B, between and in which the widest part 8 of the piston operates, while in the left-hand end of the piston and between the head 43 of the piston and a central partition 3 is the chamber C for the primary compression of the mixture on the left-hand or up stroke, and in the right-hand end of the piston, or between the central partition 3 and the lower piston head 44, is another chamber D for the primary compression of the charge on the right-hand or down stroke of the piston. The upper or left-hand head 43 of the piston is preferably made as a part of a movable screw sleeve 4 which is screwed into or otherwise applied to the open sleeved end 45 of the piston. Piston 4 has not only a middle section 8, but sections 2 and 5 at each side thereof, said section 8 being of larger outside diameter than the extensions 2 and 5, but internally the piston is of the same diameter throughout.

The piston is of the differential type, consisting of a hollow sleeve or cylinder of the same interior diameter throughout, but with an exterior middle portion 8 of larger diameter than the sections 2 and 5 that are between said middle portion 8 and the left-hand head 43 and right-hand head 44 respectively, said section 2 having an interior pri-

mary compression chamber C, and said section 5 having also an interior primary compression chamber D. The section 2 beyond head 43 has an open-ended sleeve-like extension 45 in which slides and screws the sleeve 4 carrying head 43 and bearing 50, there being preferably this arrangement of parts, and the section 5 of the piston below head 44 having a solid hammer extension 9 that slides in the end of cylinder 1, beyond chamber B, as already explained, and delivers its blows on the end 40 of rod 10. The inner compression chambers C and D are divided by a stationary partition or diaphragm 3, on which the hollow piston slides thus causing the said chambers C and D to respectively increase or decrease in size, and thus enabling the fuel contents of these chambers to undergo a primary compression against the diaphragm 3. This diaphragm is supported by a central rod 11 attached securely to the center of the diaphragm, and extending through a bearing 50 on piston head 43, which bearing 50 is provided with a packing gland 51 to make a tight joint, so that the piston may reciprocate on the rod 11 without leakage. And the outer end of rod 11 is carried by a cross-head or frame 12 that is securely bolted to the outer end 46 of cylinder 1. In this way the partition 3 maintains a stationary and rigid position with relation to the cylinder 1, and divides the hollow piston into two primary compression chambers. The chamber C, adjoining head 43, is provided with ports 21 that during the reciprocations of the piston register at one time with the circular supply port 20 and at another time with the explosion chamber A; while the chamber D adjoining head 44 is provided with a series of ports 22 that register at times with the circular supply port 19 and at other times with the explosion chamber B. The piston head 44 is preferably strengthened by ribs 52 lying between ports 22.

When the piston is at one limit of its stroke, the ports 21 will be open to the supply port 20 and a fuel charge will be introduced through ports 21, which will fill the chamber C, said chamber being now of its maximum size and capacity, since the head 43 is removed to its farthest point from the middle fixed partition 3. When the piston reciprocates and goes to the other limit of its stroke, the mixture will be compressed in chamber C until the end of the stroke is reached, when the ports 21 will open into the explosion chamber A, as shown in Figure 1, and as the primary compression in chamber C is now complete, the initially compressed fuel is transferred into the explosion chamber A for further compression and ignition.

Also it will be seen that when the piston is in the other end of the cylinder, as shown in Figure 1, the chamber D, which is now of maximum size, will have its ports 22 opening into the circular supply port 19, so that said chamber may be filled with a fresh charge of gas through ports 22, which will be compresed initially during the next upstroke of the piston, and when so compressed will be delivered by the ports 22 to the explosion chamber B as soon as said ports open into that chamber. The chambers A and B permit the charges of mixture therein to be compressed with a secondary or final compression and then ignited by suitable means, as by ordinary spark plugs, of which I indicate examples at 23.

The foregoing description of the construction and arrangement of the various parts is sufficiently ample to make it unnecessary to describe the operation in further detail. If we assume that the piston is at the right hand limit of its stroke, after being driven there by a firing of the charge in chamber A, the parts will be in the position shown in Figure 1, where exhaust from chamber A is taking place through ports 7 and 6, while chamber A is being filled by a new charge on top of the outgoing exhaust through ports 21 from chamber C. At the same time a previously introduced charge in chamber B is receiving its final compression therein preparatory to its explosion which is about to occur; and also at this moment the lateral ports 22 in chamber D have been brought into communication with the inlet port 19 and a charge is being introduced into chamber D. A spark plug 23 will now explode the compressed charge in chamber B, which will drive the piston up to the other end of its stroke. On its way up the mixture in chamber D is compressed until the ports 22 are brought into communication with chamber B when the said mixture will be delivered into said chamber B, while simultaneously with such delivery the chamber B will open into exhaust ports 7 and 6 and the new mixture will flow in on top of the exhaust and help to force it out; and while this is being done the charge that was introduced into chamber A is undergoing compression, in readiness for the next explosion in chamber A. Thus cycle follows cycle, after the manner of a two-cycle engine, and with resulting effects of the character I have set forth.

Many advantages accrue from the construction and arrangement of parts which I have set forth and their relative location as indicated, in respect to the saving of energy by the absorption of heat and the prevention of any loss in this way, for it will be noted that the cool stream of fresh mixture passes through the initial compression chamber to the explosion chamber each time, and not only is the undue heat of the explosion chamber absorbed and taken care of, but also the colder incoming mixture is more or less heated so that

it is in better condition for compression and introduction into the explosion chamber. It will also be kept in mind that although I have described and shown a leading and approved form of the invention which is particularly adapted for effective use with rock drill mechanism, yet I do not wish to be restricted thereto and I reserve the liberty of varying and modifying the details of the invention within wide limits and within the scope of the appended claims, and distinctly assert and insist upon my right to modify, rearrange or reconstruct the details of the invention along any suitable lines, in order to secure the best practical results, such changes to be made as may be found necessary to this end.

The supply of gas or fuel mixture for operating the drill may be delivered to the cylinder in any suitable or desirable manner. An example of means for this purpose is shown in the drawing where the passage 15 is found running from a lateral member secured to cylinder 1 by a bolt 16. Said passage 15 preferably divides into two branches, one of which, as passage 14, leads to one end of the cylinder to the circular supply port 20 and the other of which, as passage 13, leads to the other end of the cylinder and the circular supply port 19.

In the wall of the casing 24 there enters an air-pipe 36, see Figure 2, having a check valve 37. The suction of the piston as it reciprocates will on each upstroke draw in air past the valve 37, which will close down on the return stroke so that the air will be held and a certain amount of pressure created in the casing 24. The degree of this pressure can be regulated by the hand valve 34 carried by casing 35 fastened in the wall of casing 24 at any point and said valve 34 being opened more or less to the atmosphere so that these valves 34 and 37 will control the amount of air that will be allowed to remain within the casing 24 and permit it to increase in pressure as much as may be desired. The air pressure thus introduced will on each down-stroke of the piston be forced into the central passage in the rod 10 and caused to flow therethrough into the bottom of the hole where the drill is operating and cutting the rock and blow the dust at the cutting end of the tool away from the same and upwardly in the hole that is being drilled, whereby this objectionable dust and refuse material will be expelled from the hole and gotten rid of, for otherwise it might clog the operation of the drill. I thus furnish an easy and convenient device for enabling the drill to function in a cleanly fashion and without obstruction on account of clippings, drillings and other refuse.

It will be noted that the electrode 39 carried in the wall of the casing 24 by means of a plug or pin 38 is used as a device against which the resilent pin 41 comes into contact and acts as another electrode, may be supported and arranged in any desired way and connections with batteries and other parts of the ignition apparatus may be made in such a manner that the spark plug or plugs 23 in the adjoining explosion chamber will be active at the proper time. And on each down-stroke of the piston a spring pin 41 will come into contact with an electrode 39 after the end of the hammer 9 strikes the end of the piston rod 10, so that the explosion in the adjacent explosion chamber will take place at the proper moment to cause the correct timing of the rebound of the piston after striking the rod 10.

Many changes in the construction and combination of the various parts may be made without exceeding the scope of my invention as set forth in the claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a gasoline rock drill, the combination of a cylinder, a piston therein having twin interior chambers, a free member reciprocating through one end of the cylinder and provided with means for carrying a drilling or cutting tool, and means arranged in connection with said free member to impart a partial rotation thereto at each reciprocation in one direction, while permitting it to pursue a rectilineal movement only during the reciprocations in the other direction, said rotating means consisting essentially of a ratchet wheel mounted on a free rod and connected therewith by a tongue and groove connection, and a series of one or more pawls engaging the teeth of said ratchet to prevent reverse movement.

2. In a gasoline rock drill, the combination of a cylinder, a piston therein having twin interior chambers, a free member reciprocating through one end of the cylinder and provided with means for carrying a drilling or cutting tool, and means arranged in connection with said free member to impart a partial rotation thereto at each reciprocation in one direction while permitting it to pursue a rectilineal movement only during the reciprocations in the other direction, said means consisting essentially of a ratchet wheel mounted loosely on a rod and connected therewith by means of a tongued and grooved connection, and a series of one or more pawls arranged around the ratchet wheel and engaging the teeth thereof, said pawls being provided with adjusting caps and interposed springs.

3. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a double-acting piston therein, having interior primary compression chambers, a freely moving member reciprocating through one end of the cylinder in line with

the piston, its inner end being adapted to be struck by the hammer head of the piston and its outer end provided with a chuck for carrying a drill or cutting tool, all arranged so that the reciprocations of the piston will deliver a succession of blows upon the freely-moving drill-carrying member and thereby actuate the drill.

4. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a double-acting piston having an enlarged hammer head, a freely moving member reciprocating through one end of the cylinder in line with the piston, its inner end having an anvil adapted to be struck by the hammer head of the piston and its outer end provided with a chuck for carrying a drill or cutting tool, all arranged so that the reciprocations of the piston will deliver a succession of blows upon the freely-moving drill-carrying member and thereby actuate the drill, and means consisting of a ratchet and pawl device mounted in connection with the freely-reciprocating member for the purpose of partially rotating the same during each reciprocation in one direction while permitting the same rod to pursue a rectilineal movement only during each reciprocation in the other direction.

5. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a differential piston operating in connection with said chambers and having inner primary compression chambers ported to permit the flow of the mixture from the compression chambers to the explosion chambers, a stationary partition between the chambers in the piston, a freely reciprocating rod mounted in the end of the cylinder opposite the piston and adapted to carry a tool, the inner end of said rod being struck by the piston during its reciprocations, and means for partially rotating said rod during certain reciprocations.

6. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a differential piston having inner compression chambers and its middle enlarged portion operating in the explosion chambers, means for transferring the fuel mixture through the piston to the explosion chambers, a freely reciprocating rod working through one end of the cylinder and having its inner end exposed to the hammering action of the piston thereon.

7. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a differential piston having inner compression chambers and its middle enlarged portion operating in the explosion chambers, which latter chambers surround the piston, the said piston being provided with two separate non-communicating lines of ports for transferring the fuel mixture alternately from the compression chambers to the explosion chambers, a relatively stationary partition in the piston, and a freely reciprocating rod working through one end of the cylinder and carrying on its outer end a drill or cutting implement while its inner end is exposed to the impact of blows delivered thereon by the piston.

8. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a differential piston having inner compression chambers and its middle enlarged section operating in the explosion chambers, said piston having ports to permit the charge to be transferred from the compression chambers to the explosion chambers, a relatively stationary partition in the piston, a freely reciprocating rod working through one head of the cylinder in line with the piston and carrying on its outer end a drill or implement while its inner end is exposed to blows from the piston, an inlet means for admitting the explosive mixture to the cylinder and acting automatically to prevent outflow of the fuel during compression.

9. In a gasoline rock drill, the combination of a cylinder having explosion chambers, a differential piston having inner compression chambers and its middle enlarged portion operating in the explosion chambers, said piston having ports to permit the charges to be transferred from the compression chambers to the explosion chambers, a stationary partition in the piston between the inner chambers, a rod carrying said partition, a cross member on the cylinder for supporting said rod, a freely reciprocating rod working through one head of the cylinder in line with the piston and carrying on its outer end a drill or implement while its inner end is exposed to blows from the piston, and inlet means for admitting fuel to both compression chambers, said inlet means having automatically operated closing means to prevent outflow of the mixture during compression in the chamber.

10. In a gasoline rock drill, the combination of a cylinder having dual explosion chambers, a differential piston containing inner primary compression chambers and having its middle portion of larger section operating in the explosion chambers, means for transferring the charge through the piston from the compression chambers to the explosion chambers, inlet means for introducing two charges of the mixture one for each compression chamber, and an independent end-wise movable rod which is reciprocated by the impact of the piston against the same, together with a diaphragm in the piston between the inner chambers, said diaphragm being held stationary on the cylinder, and allowing the piston to slide thereon.

11. In a gasoline rock drill, the combination of a cylinder having dual explosion chambers, a differential piston containing inner primary compression chambers and having its middle portion of larger section operating in the explosion chambers, means for transferring the charge through the piston from the compression chambers to the explosion chambers, inlet means for introducing two charges of the mixture one for each compression chamber, and an independent endwise-movable rod which is reciprocated by the impact of the piston against the same, together with a diaphragm in the piston between the inner chambers, said diaphragm being held stationary on the cylinder, and allowing the piston to slide thereon, a spring contact in the cylinder wall, and a resilient contact pin carried by the piston.

12. In a rock drill, ignition means in combination with a cylinder and piston and an explosion chamber, said ignition means consisting of a spring electrode supported in the wall of the cylinder and a spring pin carried by the piston and arranged to strike the electrode after the piston delivers its hammer blow upon the drilling implement.

In testimony whereof I hereunto affix my signature.

JOHN V. RICE, JR.