Jan. 3, 1928. 1,654,833

J. V. RICE, JR

GASOLINE ROCK DRILL

Original Filed April 12, 1921 2 Sheets-Sheet 1

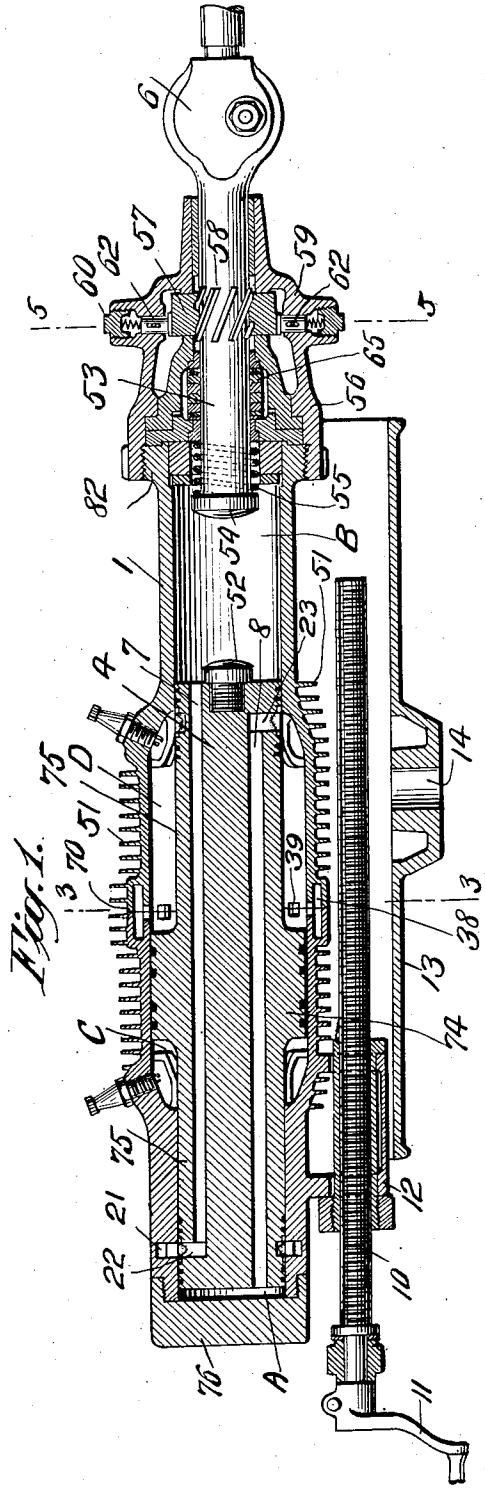


Fig. 1.

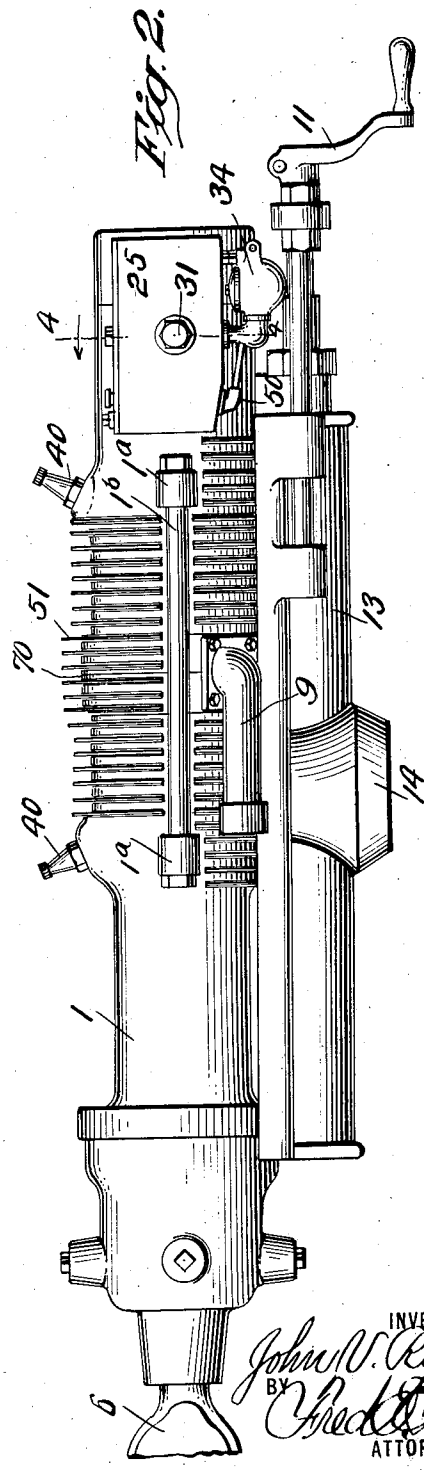


Fig. 2.

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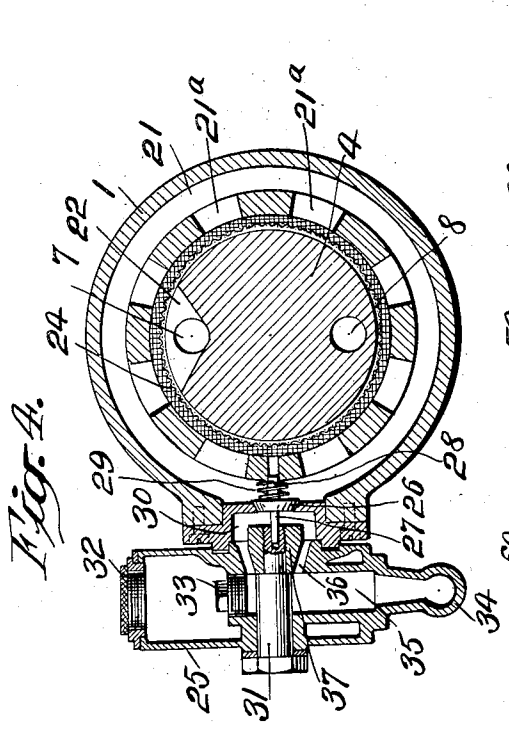


Fig. 4.

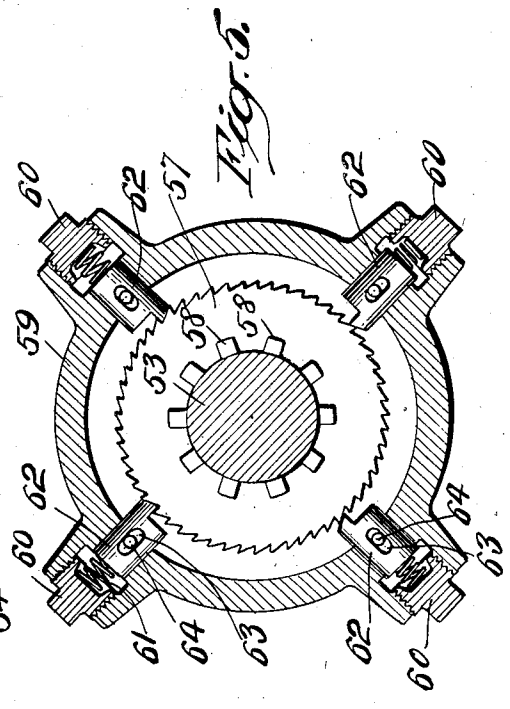


Fig. 5.

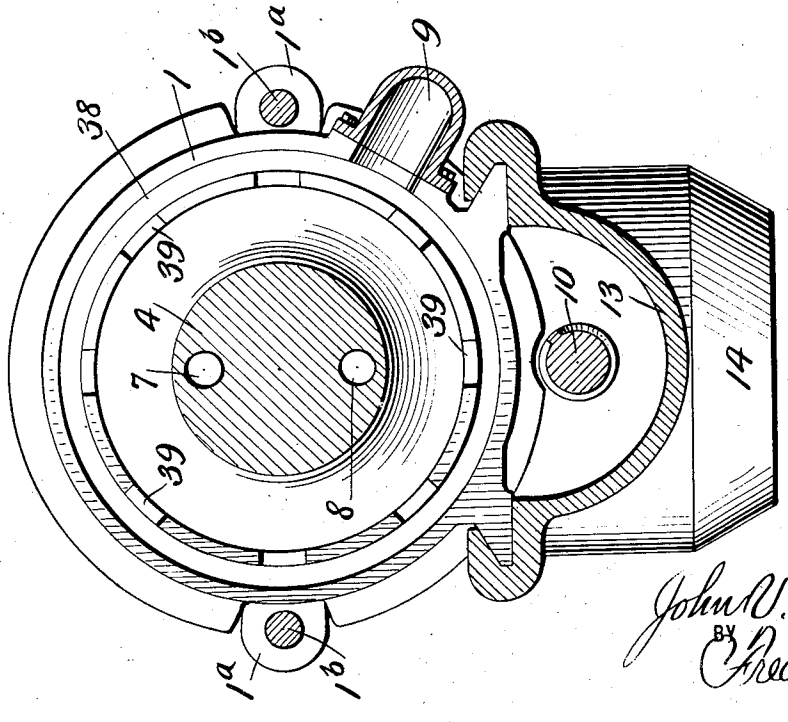


Fig. 3.

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UNITED STATES PATENT OFFICE.

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GASOLINE ROCK DRILL.

Application filed April 12, 1921, Serial No. 460,777. Renewed May 12, 1927.

This invention refers to an improvement in the general class of hydrocarbon or gas-actuated rock drills, and 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 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, whereby many unique and advantageous results are secured as compared with the other type where the piston rod or drill-carrying member is rigidly attached to the piston, all as will be hereinafter fully set forth, to the end that the best and most effective results in actual practice may be obtained, the hammer type of drill being particularly useful in certain locations and under certain conditions. The invention, therefore, having in view the end 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 side elevation of the same in a reverse position.

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

Figure 4 is a cross-section on the line 4, 4, of Figure 2.

Figure 5 is a cross-section on the line 5, 5, of Figure 1.

Similar characters of reference denote like parts throughout the different figures of the drawing.

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 heads 76 and 82. In connection with head 82 a drill-carrying rod which corresponds to the ordinary piston rod, as 53, is carried by suitable means, made up of a multiplicity of various parts which co-operate 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 51 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 two parts that are joined closely together at the centre, as at 70, and these two parts preferably have lugs 1^a, 1^a, thereon, through and to which the tie-rods 1^b are connected, so as to hold the two 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 bi-sectional character of the cylinder as at all essential.

Referring now to the cylinder head 82 and the appurtenant members, it will be noted that I have devised special means for carrying the drill-carrying rod 53 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 said piston rod 53 is provided at a point outside of the cylinder with a drill chuck 6, through and in which the drill, hammer, or other boring or cutting implement is attached and held in the ordinary way. The outer portion of the cylinder head 82 is preferably screw-threaded in order to allow a barrel member or cap 56 to be screwed thereon, said barrel member carrying within the same suitable packing rings and other parts for making a tight joint upon the rod 53. On the rod 53 is a series of inclined or spiral ribs 58, which engage corresponding grooves in the interior part of a ratchet wheel 57, which is loosely mounted upon the rod 53 inside of the barrel extension and its outer

section 59. The teeth of this wheel 57 are engaged by a series of flexible pawls that are mounted in the ring portion 59 of barrel 56 and the details of which are clearly indicated, not only in Figure 1, but more fully and on a larger scale in Figure 5. These pawls comprise pins 62 having teeth that engage the teeth of the ratchet wheel 57, and are located in radial slots in the ring portion 59 of the barrel extension 56. These pawls 62 are controlled as to their radial movement by means of pins 64 fast in the ring 59 and passing through slots 63 in the pawls 62. Further, these pawls 62 are urged inwardly so that their teeth may press against the teeth of the ratchet wheel 57 by means of springs 61, which are inserted between the ends of the pawls 62 and the screw caps 60 that are screwed into interiorly screw-threaded projections on the outside surface of the ring 59 and are therefore easily accessible from without and are adjustable as desired for regulating the tension of the springs 61 and therefore graduating the grip of the pawls in relation to the teeth of the ratchet wheel 57.

It will be evident that as the rod 53 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 over the pawls and allowing the pawls to engage, as shown in Figure 5. I utilize four pawls in the specific example of the invention here indicated in order that the rod 53 may be firmly held. A spring 55 is inserted between the head 54 of the rod 53 and some one of the rigid parts that constitute a portion of the bearing for the rod 53, which spring compresses as the rod 53 is driven outwardly and then extends and by its resiliency returns the rod inwardly or upwardly again each time after the outward movement is ended. It should be noted also that the head 54 on rod 53 is substantially larger than the piston rod 53 and is made of some very hard and tough material, so that the constant pounding and hammering thereon which takes place during the operation of the drill will not batter the same to pieces or injure it so as to require replacement any oftener than is absolutely necessary. The arrangement which I have described, consisting of a barrel-like extension 56 which screws on the head 82 of the cylinder, enables the parts to be quickly and easily disassembled in order to give quick access to the interior for the purpose of adjusting any part that may be out of order, supplying new parts, making repairs, etc. It is thus evident that the ratchet wheel 57 engaged by the pawls 62 is permitted to rotate in one direction, but effectually prevented from rotating in the other. The rod 53, therefore, and the drilling implement carried by the chuck 6 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 4, which is free to move in one direction or the other under the explosions of a gaseous mixture and which is entirely disconnected from any other element and is free and clear of the rod 53. The end thereof opposite to the head 54 of the rod 53 is provided with a head 52 having a screw shank which is screwed firmly into the centre of the piston. This head 52 during the reciprocations of the piston 4 strikes a succession of blows against the head 54 of the rod 53 and forces the rod and the drill implement carried thereby forwardly, as I have already explained, the return movement of the rod 53 resulting each time from the expanding action of the compressible spring 55.

The cylinder 1 is carried by some suitable frame, as 13, on which it, together with the connected parts, is adjustable by means of an elongated screw 10, having a handle 11, and working in a socket 12, on frame 13, so that in this way the drill may be fed forward and kept in close contact with its work as the boring of a hole, the cutting of rock or coal, or the like, is carried on. Frame 13 has a boss 14 thereon, by means of which the entire drilling machine is suitably supported on a tripod or otherwise.

As already stated, the bore of cylinder 1 has a smaller diameter at the end than in the middle portion, its differential character in this respect corresponding with the differential shape of the piston 4, which reciprocates within the cylinder 1. The middle and larger portion of cylinder 1 furnishes the two explosion chambers C and D, between and in which the widest part 74 of the piston operates, while in the left-hand end of the cylinder and between the end of the piston and the cylinder-head 76 is the pump chamber A for the reception of the mixture on the left-hand or up stroke, and in the right-hand end of the cylinder, below the piston, or between it and the lower cylinder head 82, is another pump chamber B for the reception of the charge on the right-hand or down stroke of the piston. The upper or left-hand head 76 of the cylinder is preferably made in the form of a removable screw cap, which is screwed upon or other-

wise applied to the end of the cylinder. Piston 4 has not only a middle section 74 but extensions 75 therefrom, said section 74 being of larger diameter than the extensions 75.

Piston 4 is preferably cast in a solid piece, except for the ports, passages and chambers therein, which I will now explain, though it is evident that it may be made of as many or as few parts as are desirable, these being combined in any suitable manner. Within the piston 4 are two longitudinal parallel gas ducts 7 and 8. The duct 7 extends from the chamber B, below the piston, through the latter, to the left, until it reaches and terminates in a circumferential duct or port 22, which coincides at times with openings or ports 21ª that extend partly through the wall of cylinder 1 (see Figure 4) and enters the circular port or passage 21 in said wall. Said ports 21ª at other times coincide with, or open into the explosion chamber C. The other similar gas duct or passage 8 connects with the primary chamber A, in the left-hand end of cylinder 1, and runs to the right through the piston until it reaches and terminates in the circumferential duct or port 23, which coincides at times with the explosion chamber D. At a point about midway of the length of the cylinder 1 I locate a series of exhaust ports 39, that lead into the circular exhaust passage 38, which discharges through lateral exhaust pipe 9 (see Figure 3). The exhaust ports 39 have large capacity and perform their function with both explosion chambers C and D. In this way are provided two fuel-handling systems, one comprising chamber B, duct 7, port 22 and explosion chamber C; and the other a distinct and non-communicating system comprising chamber A, duct 8, port 23, and explosion chamber D; it being further noted that the piston is double-acting, that an explosion occurs at the end of each stroke and drives it in one direction or the other, and that although the mixture is (in this example) all taken in both systems from one and the same end of the cylinder on the same stroke, yet compression occurs at each stroke, as well as ignition and exhaust.

The ports 21ª, as also the ports 22 and 23 in both ends of the piston, are preferably provided with wire gauze protectors 24 of any suitable construction, designed to occupy the port openings and having the function of protecting or screening the incoming charge and preventing it from firing prematurely or causing a back explosion, or preventing bad effects from the use of poor or slow-burning mixtures.

The cylinder receives the explosive mixture for either end thereof by mechanism which delivers it through a check-valve into the circular port 21, from which it flows through the ports 21ª, passing at certain times into the port 22 and duct 7, and at other times into the chamber A and duct 8. The detailed construction of the mechanism for delivering the fuel mixture is indicated in section in Figure 4 and partly in side view in Figure 2. I utilize a small tank 25 for the gasoline or other hydrocarbon element, which tank is mounted loosely on the side of the cylinder by means of a central pivot pin 31, screwed into the central member 37, forming part of the valve casing 30, which is securely attached to the side of the cylinder in order that the tank 25 may automatically adjust itself or be adjusted by hand on the pin 31 and easily be made to remain at the proper level, no matter what may be the angle of support of the drill frame. Tank 25 is provided with a screw cap 32 for an opening through which the gasoline contents are introduced thereinto, and said contents pass down through a pipe 50 into the carburetter 34 (see Figure 2) from which the mixture of air and gas passes upwardly into the chamber 35 located within the tank 25, and to which access may be had when desired through the interior screw cap 33, while the combustible mixture thus prepared flows out through the passage 36 around the bearing 37 and past the check-valve 26, which is supported in relation to its seat by means of a pin 27 on one side and a pin 28 on the other side, which latter pin 28 is enveloped by means of a closing spring 29, said pin 28 working in a perforation in the wall of the cylinder between two of the ports 21ª, and said pin 27 working in a suitable opening opposite to the stationary pin 31, all the parts being thus arranged so that when valve 26 is removed from its seat in consequence of the action of the piston 4 in moving forward and creating a vacuum, the explosive mixture will immediately pass through the valve 26 and enter the circular port 21, the ports 21ª and the duct 22, or the chamber A, as the case may be; but obviously when the piston is moving in the opposite direction the effect will be to tightly close the check-valve 26 upon its seat and prevent any loss of the fuel contents which have previously been introduced. Obviously many of the details of the fuel tank and the means for supporting the same, as well as the carburetting means, and the relation and operation of the different parts, may be widely diversified and changed without exceeding the scope of the invention, but it is quite in the interest of efficiency and the best service that the gasoline tank should be supported upon the drill frame and be enabled to supply the mixture automatically at all times as may be required during the operation of the drill.

The foregoing description of the construction and arrangement of the various parts

is quite sufficient to explain the operation without the need of much additional discussion along this line. Suppose we assume that the piston is at the upper or left-hand limit of its stroke, after being driven there by the firing of the charge in the explosion chamber D, the parts will be in the position shown in Figure 1, where exhaust from the chamber D is taking place through ports 39, while the chamber D is being filled by a new charge on top of the outgoing exhaust, through the port 23, which is supplied by the duct 8 leading from chamber A. At the same time the previously introduced charge in chamber C is receiving its compression therein preparatory to its explosion, which is about to occur; and also at this moment the lateral cylinder ports 21ª are in communication with the circumferential piston duct 22 and a charge is being introduced through the valve 26 and the circular port 21 into and through the ports 21ª and 22, so that said charge of the explosive mixture will flow by way of the tube 7 into the chamber B. It may be noted that the explosion chambers C and D are supplied with spark plugs 40 of any customary pattern, or any other suitable ignition means. It will be seen that at the moment the spark plugs in the chamber C explode the compressed charge in said chamber, the piston 4 will be driven to the lower or right-hand limit of its stroke and into a position opposite to that which it occupied in Figure 1. On its way from the position shown in Figure 1 into this other position at the other end of the cylinder, the mixture in the chamber B which has just been introduced thereinto, as explained, is compressed until the circumferential duct 22 comes into communication with the explosion chamber C, when the said mixture thus being compressed in the compression chamber B will be delivered through the longitudinal duct 7 into the explosion chamber C, while simultaneously with such delivery of the new charge into the explosion chamber C, said chamber C will open into the exhaust ports 39 and the exhaust will flow out through said ports, while the new mixture is flowing in on top of the exhaust and helping to force it out; and while this is being done the charge that was introduced into explosion chamber D is undergoing compression, while at the same time a new charge is being sucked in through the uncovered ports 21ª into the left-hand and primary pump chamber A and the piston duct 8. Thus cycle follows cycle, after the manner of the two-cycle engine, and with resulting effects of the character which I have set forth, the operation being at once simple, complete and efficient and a great deal of power being generated, so that the free piston 4, in its very rapid movement, causes a succession of blows to be struck by the drill or pounding implement, upon the rock, coal or other substance which is being operated upon.

Many advantages accrue from the construction and arrangement of parts which I have set forth and their relative location as indicated, in respect of 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 pump 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 introduction into the explosion chamber.

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 having pump chambers in each end and explosion chambers intermediate the pump chambers, a differential piston operating in connection with said chambers and provided with ducts to permit the mixture to pass from one pump chamber to one explosion chamber and to separately pass from the other pump chamber to the other explosion chamber and provided also with a hammer head for imparting blows to the drill-holding rod, together with an exhaust system common to both explosion chambers, and a reciprocating rod working through one end of the cylinder and adapted to hold a drilling or cutting tool and adapted on its inner end to receive the blows of the hammer head of the piston during its reciprocation.

2. In a gasoline rock drill, the combination of a cylinder having pump chambers in each end and explosion chambers intermediate the pump chambers, a differential piston having its ends operating in the pump 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 ducts and ports for transferring the fuel mixture alternately from the pump chambers to the explosion chambers and said piston being also provided with a hammer head, and a freely-reciprocating rod carrying on its outer end a drill while its inner end is exposed to the impact of blows delivered thereon by the hammer head of the piston.

3. In a gasoline rock drill, the combination of a cylinder having a pump chamber in each end and explosion chambers of larger diameter intermediate the pump chambers, a differential piston having its ends of smaller section operating in the pump chambers and its middle enlarged section operating in the explosion chambers, said piston having ducts

to permit the discharge to be transferred from the pump chambers and said piston being also provided with a hammer head to the explosion chambers, a drill or implement with its inner end exposed to blows from the hammer head of the piston, and inlet means at one end only of the cylinder for admitting at each stroke of the piston in one direction the fuel which is delivered to both compression chambers, said inlet means having automatically operating closing means to prevent outflow of the mixture during compression in the chamber.

In testimony whereof I hereunto affix my signature.

JOHN V. RICE, JR.