Dec. 20, 1927. 1,653,373

J. V. RICE, JR

GASOLINE ROCK DRILL

Original Filed April 12, 1921 2 Sheets-Sheet 1

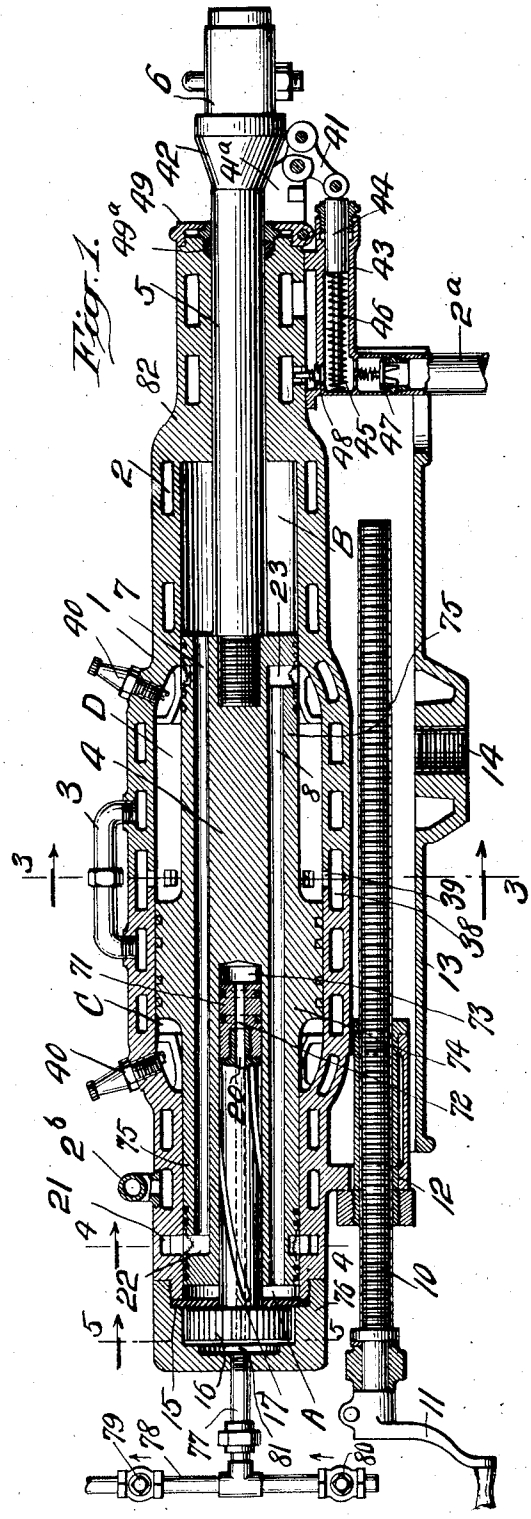


Fig. 1.

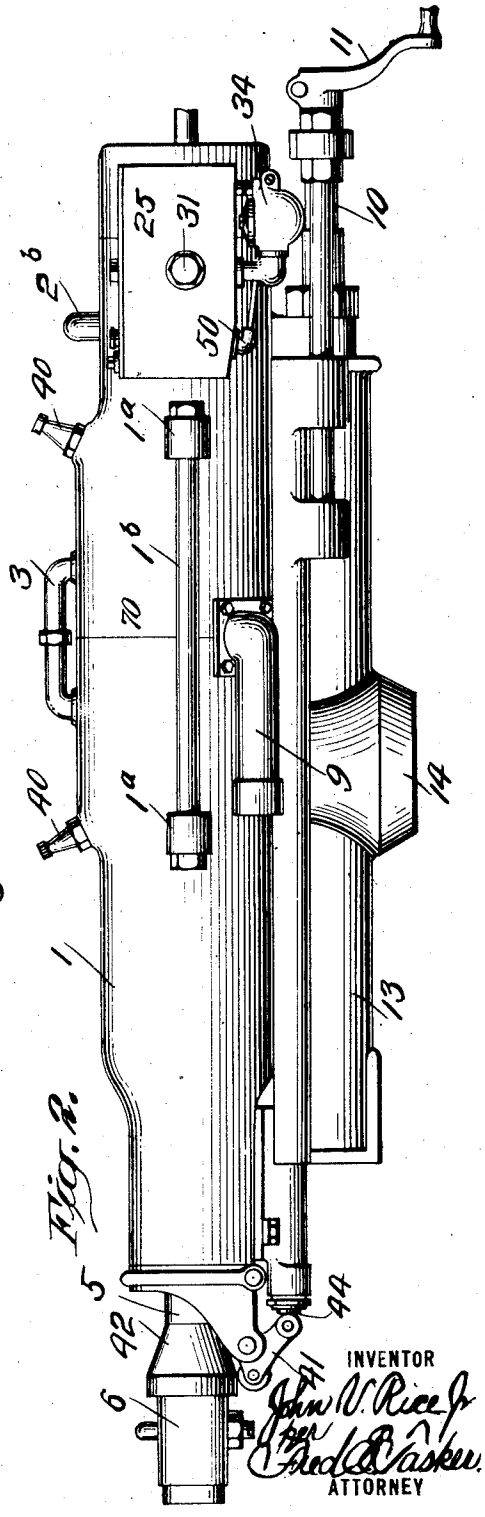


Fig. 2.

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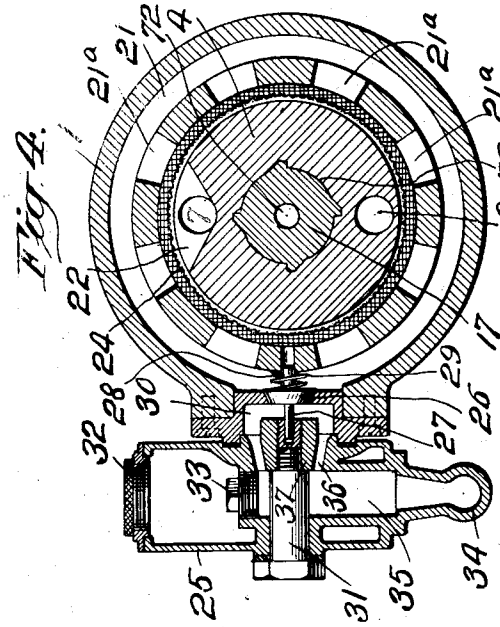


Fig. 4.

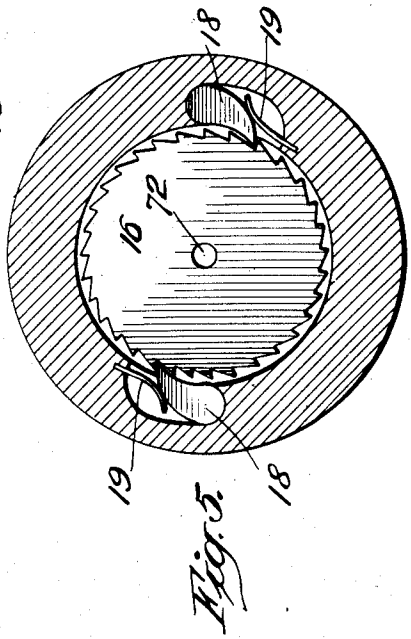


Fig. 5.

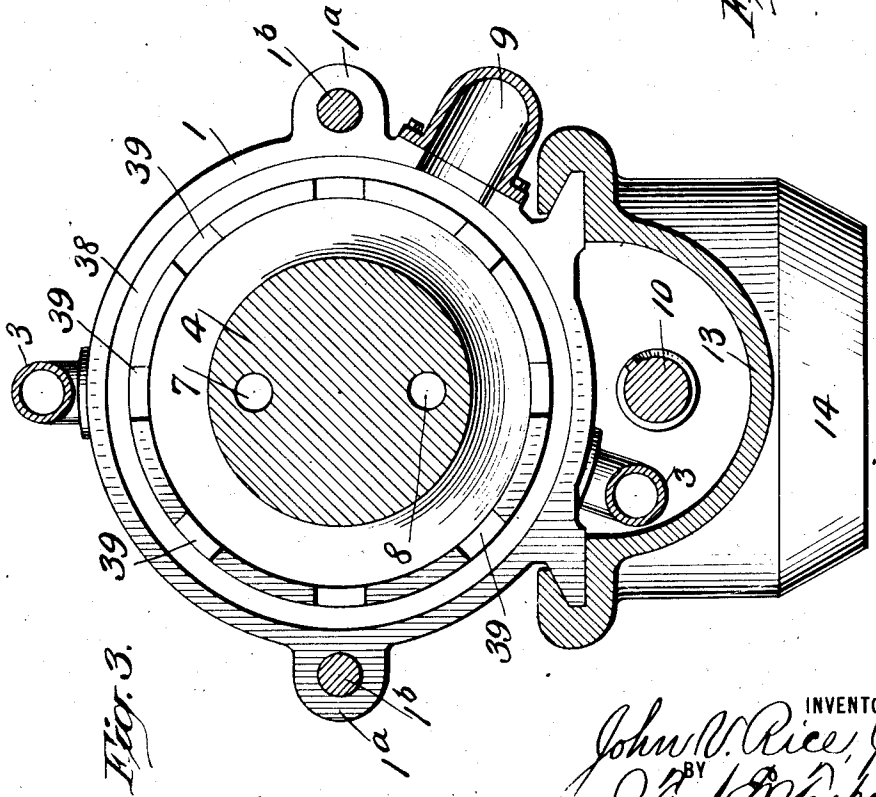


Fig. 3.

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1,653,373

UNITED STATES PATENT OFFICE.

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GASOLINE ROCK DRILL.

Application filed April 12, 1921, Serial No. 460,776. Renewed May 10, 1927.

My present invention relates to an improvement in hydrocarbon or gas-actuated rock drills, its object being to provide a simple and effective drilling appliance, which will develop a very high efficiency in operation, but will be economical in its use because of the novel and ingenious construction of the motor and other parts of the mechanism by means of which the reciprocations of the piston actuate the drilling or cutting instruments, the said motor parts being so disposed within the cylinder and so related to each other and to the drilling member or members, that exceedingly and unusually effective results may be obtained. The invention, therefore, in order to secure the many important advantages which I have in view, may be said to consist essentially in the construction, arrangement and combination of parts, substantially as will be hereinafter described and then more particularly pointed out in the claims.

In the accompanying drawings 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 1.

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 designates the main frame of the machine, the same being of a general outer cylindrical form and constituting the cylinder of the motor. It is interiorly of the differential type, as I shall explain, and has the opposite heads 76 and 82, through which head 82 the piston rod 5 reciprocates in actuating the drilling device, as I shall fully set forth. Said cylinder 1 has any suitable cooling appliance as, for example, a water jacket 2. 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 closely together in a single cylindrical unit, and when the construction is of this character, the separate parts of the water system in the two sections may be connected together by one or more short side pipes 3.

Within the cylinder 1 is the differential piston 4, to which is connected rigidly, by having the end thereof screwed into the end of the piston or otherwise attached, the piston rod 5, that reciprocates through the cylinder head 82 and carries on its outer end, outside the cylinder 1, a drill chuck 6 for holding the drill or other cutting implement. In order to effect a tight joint where the rod 5 passes through the cylinder head 82, I use a cover 49 that screws and clamps on said head and closes tightly against the packing gland or ring 49^a in the cylinder head 82. On the exterior part of the piston rod 5 is an inclined section 42 which, at each inward stroke of the rod, rides on the bell-crank tripping lever 41, pivoted to the projection 41^a on the cylinder, and this contact of section 42 with the tripper 41 causes one arm of the latter to strike against the end of the yielding plunger 44 carried in the housing 43 fast on the side of the cylinder 1, the plunger 44 having a pin 46 provided with an enveloping spring 45, which latter has the function of returning the plunger 44 each time after it is released by the tripper 41. The housing 43 is entered by the water-pipe 2^a, leading from some source of water supply and furnishing water to the jacket 2, there being a check-valve 47 interposed between the end of pipe 2^a and the interior of housing 43, and there being another check-valve 48 interposed between the interior of housing 43 and the water jacket 2.

The plunger 44 has the function, therefore, of a pump plunger. When it moves to the right or outwardly under the action of the spring 45, the suction effect of such movement will draw open the valve 47 and by unseating it will allow the interior of the housing 43 to fill with water flowing thereinto from the pipe 2^a; and also at each inward reciprocation of the plunger 44 caused by the action of the trip lever thereon, on each inward stroke of the main piston 4, the water in housing 43 will be pumped through the valve 48, which is temporarily lifted from its seat for the purpose, into the water system 2. At another point in the said system 2, as, for example, near

the opposite head 76 of cylinder 1, the water system 2 has an outlet pipe 2^b. In this manner there is kept up a constant circulation of cold water through the water jacket and around the cylinder, the action of the drill piston operating the pump in unison with the reciprocations of said piston, so that the cooling effect may be as large and satisfactory as possible.

While I have thus explained in detail one form of mechanism for pumping the water around the cylinder, so as to enable it to serve as a cooling agent, it will be obvious that other means may be employed in lieu thereof if desired, and also that instead of a water jacket, or a liquid cooling agent, fins, or flanges, or a fan or blower, or other means for affording radiation and cooling may be substituted, it being only necessary that some effective cooling means should be utilized to counteract the intense heat generated in the operation of the motor.

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 progresses. Frame 13 has a boss 14 thereon with a central opening, by means of which boss the entire drilling machine is carried by a tripod or other means of support.

As already suggested, the bore of the cylinder 1 has a smaller diameter at the ends than it has in the middle portion, the differential character in this respect corresponding to 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 stationary wall or plate 15, is the pump chamber A for receiving 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 receiving 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 cap plate, that is screwed upon or otherwise applied to the end of the cylinder, and between this cap 76 and the end of the cylinder the aforesaid plate 15 is clamped securely in place thus affording a chamber 81 in the cap 76 to accommodate a ratchet wheel 16 and pawl devices for a purpose to be presently explained.

The piston 4, which is of the differential type as stated, has a middle or intermediate section 74 and extensions 75 therefrom, the said middle section 74 being of larger diameter than the extensions 75. The 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 21^a that extend partly through the wall of cylinder 1 (see Figure 4) and enter the circular port or passage 21 in said wall. Said ports 21^a at other times coincide with, or open into, the explosion chamber C. The other similar gas duct or passage 8 connects with the other pump chamber A in the left-hand end of cylinder 1, and runs to the right through the piston 4 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 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 into 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. It will be noted that the terms "above" and "below", "left hand" and "right hand", and the like, as used in this description, are not terms of limitation but merely of explanation of a particular example, for the drill cylinder and other parts will obviously ordinarily occupy a position where the drill device will be below, or at the right of the piston, and I do not wish therefore to be in any sense limited by the use of these terms.

The ports 21^a, 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 21^a, 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 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 adjust itself on the pin 31 and automatically remain at the proper level, no matter what may be the angle of support of the drill frame. The tank 25 may therefore be self-leveling or it may be adjusted by hand; and a suitable packing between it and casing 30 will keep the joint tight. 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, and 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 21^a, 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 21^a and the duct 22, or the chamber A, as the case may be; but obviously when the piston is moving in the opposite direction, and compression is taking place, 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 left-hand end or upper portion of the piston 4 is hollowed out for a certain distance to provide an inner tubular passage 73, which will receive the rifled rod 17 that passes through the fixed plate 15 and is firmly attached to or made integral with the ratchet wheel 16 situated in the air chamber or recess 81 in the interior of the cap plate 76. The ribs or spiral beads on the rod 17 engage obviously corresponding grooves or riflings in the interior of the tubular passage 73. The ratchet wheel 16 is engaged by the pawls 18, which are acted on by springs 19 (see Figure 5) for permitting the rotation of the ratchet wheel 16 in one direction and effectually preventing it from rotating in the other. By this arrangement, therefore, the piston and its rigidly attached piston rod and drilling implement will, during the one reciprocation, be permitted to 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, in consequence of the ratchet and pawl construction, 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 of rock drills.

The inner end of the rod 17 is provided with an interior auxiliary piston 71 provided with packing rings to make it tight and located within the inner end of the tubular recess 73, said piston 71 being screwed or otherwise securely fastened to the end of the rod 17 and having a central passage 72 therein, which coincides with a central longitudinal passage 20 in the rod 17 and the rachet wheel 16, these passages 20 and 72 forming a line of communication between the air chamber 81 in the cap 76 and the inner end of the tubular passage 73, and are for the purpose of enabling air to pass from one point to the other.

Referring now to the left-hand end of Figure 1 it will be seen that the cap or head 76 is entered centrally by a pipe 77, to which is connected a right-angled pipe 78, having at one side of the connection a check-valve 80 and at the other side a check-valve 79, the same acting conversely but the details of which are not fully shown as this is not necessary. As the piston 4 reciprocates in one direction it will obviously cause the check-valve 80 to open and draw in air into

the chamber 81, the check-valve 79 at this time being closed, and the air within the chamber 81 will pass through the passages 20 and 72 into the tubular space 73. On the reverse movement of the piston the air that has thus entered the tubular space 73 will be driven back into the chamber 81, and then through pipe 77 and pipe 78, past the check-valve 79, which will now open, and into the storage tank provided at some suitable point to receive it, the valve 80 on this return movement being held closed to prevent the escape of air through it. In this way the piston acts as a pump to accumulate and store up air pressure which can be drawn upon as desired by any suitable means for starting and other purposes in the operation of the drilling mechanism. I find it convenient, however, to utilize the rifled rod, ratchet and co-operating parts for the sake of convenience in achieving this desirable result.

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 ports 23, which are 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 21^a 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 21^a and 22, so that said charge of the explosive mixture will flow by way of the tube 7 into the pumping 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 pumped through said chamber B until the circumferential duct 22 comes into communication with the explosion chamber C, when the said mixture thus being pumped in the 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 next 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 21^a into the left-hand end 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 initial pumping 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.

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 an air-pressure chamber in the head, a piston in the cylinder, means for transferring the charge through the piston, a rod rigidly attached to the piston and carrying a drilling device,

a ratchet device for imparting a partial rotation to the drilling device during certain reciprocations in one direction, a rifled rod secured to the ratchet device and entering a tubular passage in the piston, an auxiliary piston secured to the inner end of the rifled rod and located in said tubular passage, said auxiliary piston together with said rod and ratchet device being provided with an air passage, and a valve provided pipe system, communicating with the said air chamber in the head of the cylinder, into which air chamber the said air passage delivers air, whereby the auxiliary piston may pump air during the movements of the main piston and deliver said air to a storage.

2. In a gasoline rock drill, the combination of a cylinder and a piston working therein, the latter having a tubular recess, and a ratchet wheel, a rifled rod attached thereto and projecting in the tubular recess in the piston, an air chamber alongside of the ratchet wheel, an auxiliary piston secured to the inner end of the rifled rod and acting as a pumping piston in the tubular recess, there being a central air passage through the auxiliary piston and the rifled rod and ratchet wheel, a piping system entering the aforesaid air chamber and having oppositely acting check-valves, one of which admits air from the atmosphere on one reciprocation of the piston and the other of which allows air to pass to storage on the alternate reciprocation of the piston.

In testimony whereof I hereunto affix my signature.

JOHN V. RICE, Jr.