Aug. 24, 1943. J. H. BROWN ET AL 2,327,619

ROCK DRILL

Filed Oct. 4, 1941 2 Sheets-Sheet 1

Fig. 1.

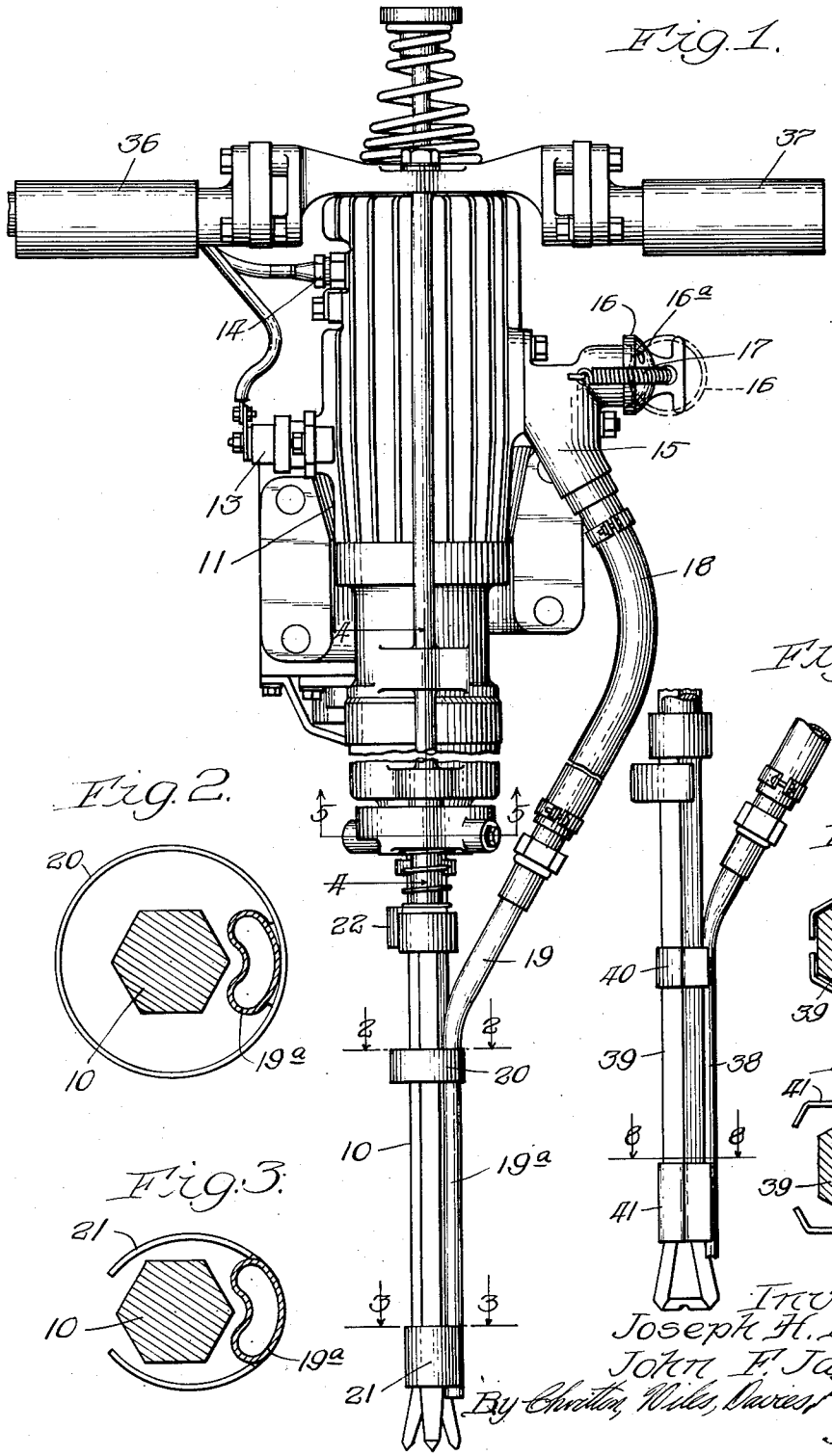


Fig. 2.

Fig. 3.

Fig. 7.

Fig. 8.

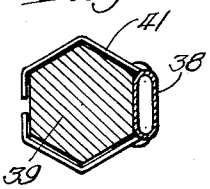
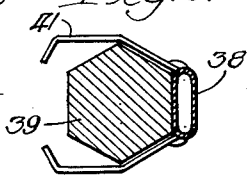


Fig. 9.



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Fig. 4.

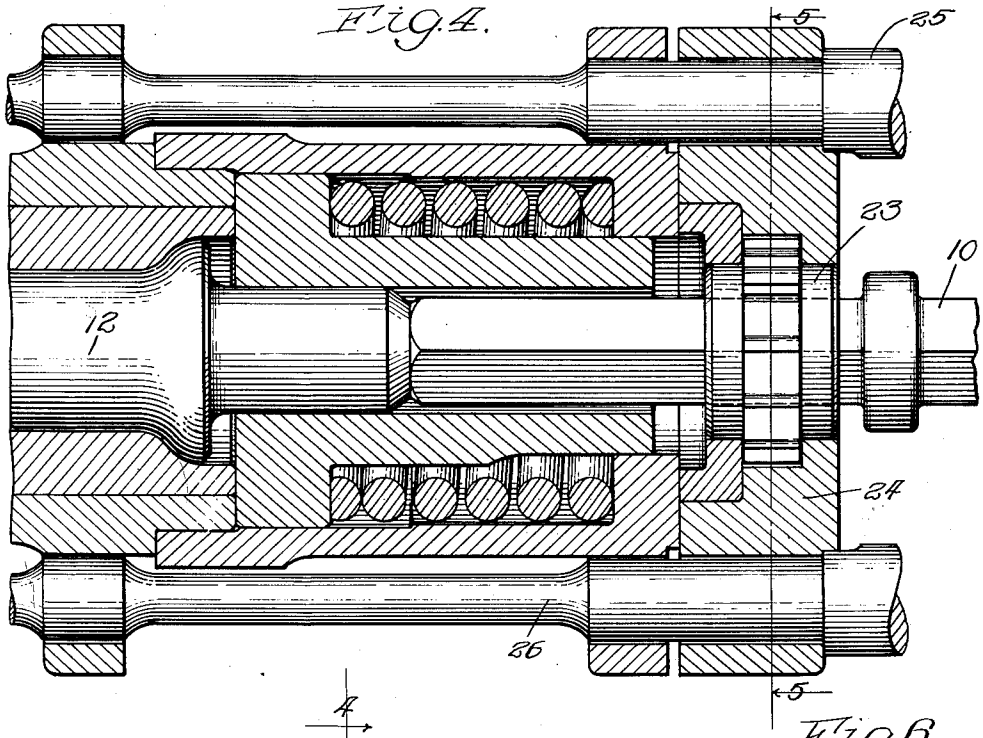


Fig. 5.

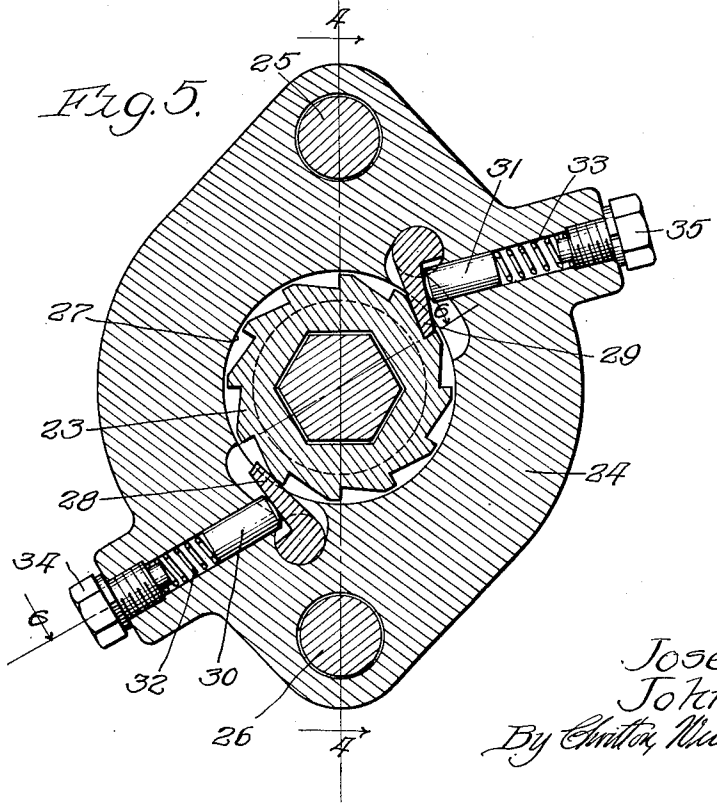
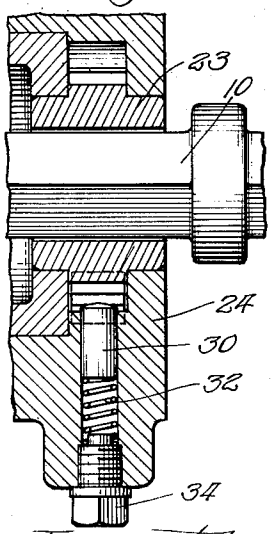


Fig. 6.



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UNITED STATES PATENT OFFICE

2,327,619

ROCK DRILL

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Application October 4, 1941, Serial No. 413,689

3 Claims. (Cl. 255—43)

This invention relates to a rock drill, and more particularly to an improved readily portable drilling arrangement provided with means for rotating the drill and for blowing the hole to clear debris therefrom.

One feature of this invention is that it provides, in a single compact unit, relatively light and readily portable apparatus for drilling holes in rock or the like, including not only a drill and an impact motor, but also means for rotating the drill and means for delivering gases to the bottom of the hole at substantial velocity to blow rock dust therefrom; another feature of this invention is that it makes use of the exhaust gases of an internal combustion motor for blowing the drill hole, conserving the kinetic energy in the gases for the desired function of removing debris from around the bottom of the drill; yet another feature of this invention is that it is adapted to be employed in association with conventional drills; still another feature of this invention is that the gas delivery tube may be attached to the drill or merely arranged in operative relation thereto; a further feature of this invention is the provision of particularly rugged yet simple and effective drill rotating means; other features and advantages of this invention will be apparent from the following specification and the drawings, in which:

Figure 1 is a side elevational view of apparatus embodying our invention; Figure 2 is a transverse sectional view along the line 2—2; Figure 3 is a sectional view along the line 3—3; Figure 4 is a fragmentary vertical sectional view along the line 4—4 of Figure 1; Figure 5 is a transverse sectional view of the ratchet mechanism, along the line 5—5 of Figure 1; Figure 6 is a fragmentary detail sectional view along the line 6—6 of Figure 4; Figure 7 is a partial elevational view of another modification of our invention; Figure 8 is a transverse sectional view along the line 8—8 of Figure 7, showing the gas delivery tube clamped in place on the drill; and Figure 9 is a view of the parts shown in Figure 8 before they are clamped in place.

We have found single cylinder free piston internal combustion hammers to be very light and readily portable, yet capable of sustained drilling in rock at rapid speed. If a hole is to be drilled only a few inches into rock little difficulty is encountered in the use of commercial hammers of the type mentioned above; but where a hole is to be drilled several feet into rock it is necessary to rotate the drill and to blow the hole to clear it of debris, and we have invented and are here disclosing and claiming drilling apparatus including means for accomplishing these things.

In the particular embodiment of our invention illustrated herewith in Figures 1 to 6, the drilling apparatus comprises as its principal parts a drill steel 10 and an internal combustion motor for delivering periodic impacts to the drill. This motor comprises a main body portion or cylinder 11 coaxial with the drill, the cylinder having freely reciprocal therein a piston adapted to be driven downwardly by the explosion of a charge of gasoline and air thereabove to deliver an impact through the anvil 12 to the drill, there being a spring adapted to return the piston to the top of the cylinder, whereupon the cycle is repeated. That is, the motor is of the two-cycle internal combustion type, provided with an ignition system including timing means 13 and a spark plug 14, and having appropriate fuel supply and carburetion means in connection therewith. We have not particularly disclosed the details of this motor, since such hammers are commercially available and are shown in the prior art, as for example Charles Patent 2,180,034, which issued November 14, 1939, and Mould Patent 1,997,072.

Referring now more particularly to Figures 1, 2 and 3, it will be seen that the cylinder has fastened thereto over the motor exhaust opening an exhaust deflector 15. This deflector is provided with an opening which may be termed the free exit opening, here shown as closed by a cap 16 removably held in place by a spring 17. When the hammer is being started the cap would be slipped off to one side to uncover this free exit opening, as shown in dotted lines, so that there would be no undesired back pressure in the exhaust passageway. After the hammer is running properly, however, and in position to drill, the cap 16 would be replaced in the position shown and the exhaust gas would have to escape through the lower opening in the deflector plate 15. We have found that it is preferable to provide the cap 16 with one or two small openings about a quarter of an inch in diameter (as the opening identified as 16*a*), so that there is always some small free exit opening for the exhaust gases.

It will be understood, however, that when the cap 16 is in place the major part of the exhaust gases pass down through the lower opening in the deflector plate 15, this opening delivering the ex-

haust gas to a flexible insulated tube 18. This tube may be of plaited metal tape or the like, covered with asbestos, and in a commercial embodiment of our invention has an internal diameter of three-fourths inch. The flexible tube 18 in turn delivers the exhaust gases to a rigid tube 19, this tube having an expanded portion adapted to be coupled to the lower end of the flexible tube, and a flattened and reduced portion, here identified as 19a. The lower end of this reduced portion delivers the exhaust gas to the working end of the drill 10.

As may be better seen in Figures 2 and 3, the reduced portion 19a is so shaped as to permit the drill steel 10 to rotate, yet it is maintained in the desired relation to the steel by the fastening bands 20 and 21. The drill is maintained in the hammer by the yoke or holding means 22, and when this is released the drill may be slipped out through the bands holding the exhaust delivery tube in position when the parts are in operative relation. The drill should preferably be of solid bar stock, or should have its central hole plugged to prevent dust and debris from working back up through it. The lower band 21 should be small enough to keep the band and exhaust tube within the confines of the hole being drilled, without undue wedging or too tight a fit. That is, the drill hole is always larger than the shank of the drill by reason of the expansion of the drill at its working end, and it is only necessary that the exhaust tube and its clamps lie within the circumference of the drill hole as defined by the working end of the drill.

As may be better seen in Figures 4, 5 and 6, the polygonal drill 10 passes through a polygonal opening in a ratchet wheel 23 mounted in the lower end of the hammer in an additional member 24 provided for that purpose and held in place by the tie rods 25 and 26 which hold the hammer parts together. The ratchet wheel must be a strong and substantial member, and be provided with teeth of substantial size and strength, as the teeth 27. These teeth are adapted to have two pawls 28 and 29 cooperate with them, these pawls also being large and rugged. Hammers of the type here disclosed deliver 1,500 or 1,600 impacts per second to the tool, each impact being of considerable power, so that there is a great deal of vibration and much strain and fatigue caused thereby. It is desirable to have a relatively short throw on the ratchet, but the use of small closely spaced relatively fragile teeth would result in frequent breakage of the parts. Instead, the two pawls are arranged to act alternately, as may be best seen in Figure 5, so that the advantages of strength and size of teeth and pawls are retained, yet the ratchet will catch upon a movement of half a tooth spacing. The pawls are, of course, spring pressed toward the ratchet wheel, this being accomplished by engagement with them of pressure plungers 30 and 31 urged inwardly by springs 32 and 33 held in place by cap studs 34 and 35. The result is a very rugged ratchet arrangement providing for uni-directional rotation of the drill.

Now referring more particularly to Figure 1, it will be seen that the hammer is provided, in conventional manner, with oppositely extending handles 36 and 37. These handles provide means for guiding and supporting the drilling apparatus during its operation, and rotation of the drill in the hole is effected by oscillation of the whole hammer by these handles. That is, as a workman is drilling he oscillates the hammer body and drill about their vertical axis through a small and convenient arc, as 30° or 40°, rotation of the body in one direction carrying the drill with it and rotation in the other direction permitting the ratchet to slip. This enables the drill to be continuously rotated in the hole during drilling by a single operator, resulting in the ability of the apparatus to drill to substantial depths without sticking or wedging of the drill. It will be understood, of course, that rock dust and chips created by the drilling are forced up out of the hole around the drill shank by the exhaust gases delivered to the bottom of the hole through the tubes 18 and 19, so that the hole does not choke up with this debris.

Referring more particularly to Figures 7, 8 and 9, it will be seen that the exhaust delivery tube 38 can be clamped tightly to the drill 39 by the bands 40 and 41 where it is not desired to rotate the drill with respect to the body of the hammer during drilling. That is, one modification of our invention contemplates the elimination of the ratchet mechanism and the keeping of the drill free through back and forth oscillation of it with the hammer body; and in this case we find it preferable to clamp the exhaust delivery tube closely to the drill as shown in these last figures. In this form the reduced portion of the delivery tube can be made flat and adapted to lie along one of the flat sides of a hexagonal drill, this reduced portion having internal dimensions of about one-eighth inch by five-eighths inch in a commercial embodiment of our invention. When it is desired to change drills the clamp is opened up as shown in Figure 9, so that the drill may be readily inserted or removed; and then it is forced or hammered down into place as shown in Figure 8 before drilling is started. One of the advantages of this modification of our invention is the fact that all of the parts are very close to the drill shank, so that little excess hole diameter is necessary to provide for them.

In either case, however, it is highly important that a portion of the exhaust delivery tube be flexible, to absorb shock and movement between the drill and the cylinder of the hammer; it is important that at least the initial portion of the tube be heat insulated; and that the delivery end of the tube be considerably reduced in internal cross-sectional area with respect to the point where the exhaust gases enter it. The exhaust gases are exceedingly hot, generally in excess of one thousand degrees F., when they enter the upper end of the flexible tube 18, and the heat insulation of this tube is necessary to prevent an unduly rapid loss of volume by rapid chilling of the gases. As the exhaust gases approach the drill steel, and particularly the working end, however, it is impossible to keep them at high temperatures, and accordingly a reduction in temperature and volume must be compensated for by reducing the cross-sectional area of the tube if sufficient velocity and kinetic energy are to be maintained for doing a good job of blowing the hole. We have found that, with the flexible tube well heat insulated as shown, best results are obtained by having the reduced portion of the delivery tube extending to the working end of the drill with an internal cross-sectional area not more than one-third that of the flexible insulated tube, and preferably about one-fifth or one-sixth.

While we have shown and described certain embodiments of our invention, it is to be understood that it is capable of many modifications.

Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

We claim:

1. Drilling apparatus of the character described, including: a drill; an internal combustion motor for delivering periodic impacts to the drill, said motor having an exhaust fitting; a delivery tube extending alongside the drill to the working end thereof to clear debris therefrom; and a connector tube with easy curves connecting the exhaust fitting and delivery tube.

2. Drilling apparatus of the character described, including: a drill; an internal combustion motor for delivering periodic impacts to the drill, said motor having an exhaust fitting with a downwardly extending opening; a delivery tube extending alongside the drill to the working end thereof to clear debris therefrom; and a connector tube with easy curves connecting the exhaust fitting and delivery tube, the internal cross-sectional area of the tube being less near the working end of the tool than at the point of entry of the exhaust gases, whereby the gases issue from the tube with substantial velocity, at least a portion of the connector tube being flexible.

3. Drilling apparatus of the character described, including: a drill; an internal combustion motor for delivering periodic impacts to the drill, said motor having an exhaust fitting with a downwardly extending opening and another opening; a delivery tube extending alongside the drill to the working end thereof to clear debris therefrom; a connector tube with easy curves connecting the exhaust fitting and delivery tube; and a cap adapted to cover the other opening during drilling but readily removable during starting of the motor.

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