United States Patent

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[72] Inventor **Josef Huszar**
Styria, Austria

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[73] Assignee **Gebr. Bohler & Co. Aktiengesellschaft**
Vienna, Austria
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[33] **Austria**
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[54] **HOLE DRILLING IN MOUNTAIN RANGES COVERED BY EARTH OR LOOSE ROCKS**
9 Claims, 4 Drawing Figs.

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[51] **Int. Cl.** **E21b 21/00**
[50] **Field of Search** ..... 175/65, 67, 171, 257, 210—215, 415

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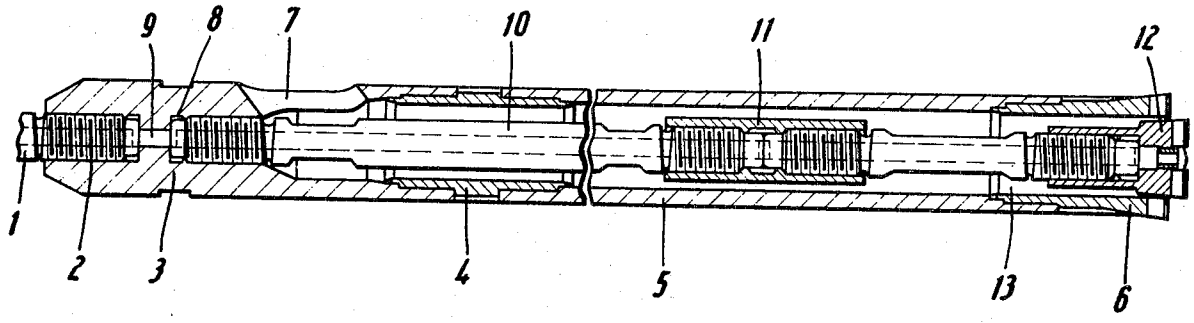
Primary Examiner—James A. Leppink
Attorney—Holman, Glascock, Downing and Seebold

ABSTRACT: When drilling holes in the earth and loose rock covering mountain ranges, serious problems exist in the bringing of the drill cuttings to the surface. To better remove cuttings an annular rock cutting bit attached to casing pipe has within it a percussive rock bit attached to an anger stem, which bit and stem have a central flushing channel. As drilling proceeds by either bit alone or simultaneously, the cuttings are flushed up within the casing pipe by a flushing agent exited from the percussive rock bit. This way there can be no external stoppage of the removal route of the cuttings.



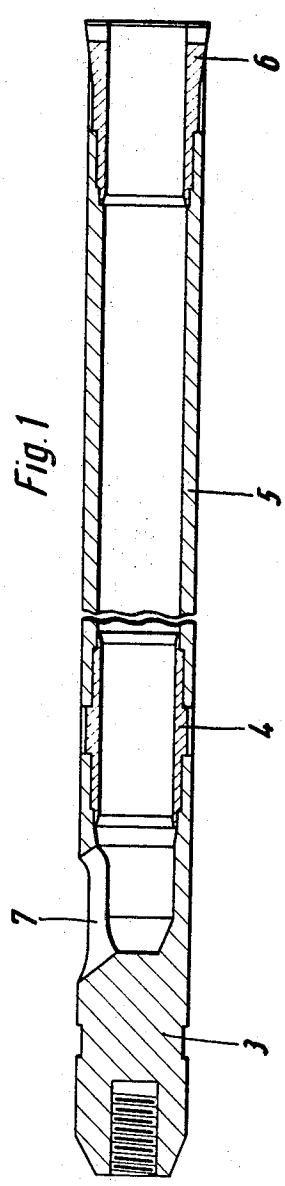


Fig. 1

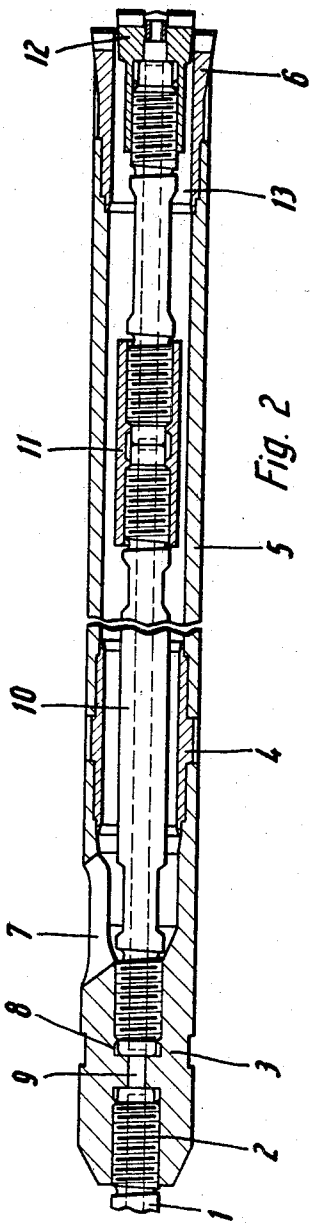


Fig. 2

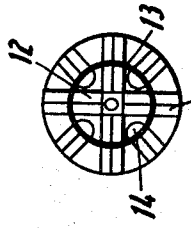


Fig. 4

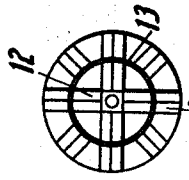


Fig. 3

Inventor:
J. HUSZAR
By: Glascock, Downing & Seibold
ATTORNEYS

HOLE DRILLING IN MOUNTAIN RANGES COVERED BY EARTH OR LOOSE ROCKS

The invention concerns a process for the drilling of holes in a mountain range covered by earth or loose rocks, with an annular rock cutter bit attached on a casing pipe and adapted for percussive rotary drilling as well as with a percussive rock bit provided with a central flushing channel and arranged on an auger stem, whereby, if need be, the auger stem and/or the casing pipe are attached in a crown piece transmitting the strokes of the hammer.

For the drilling of holes in a mountain range covered by loose rocks, drilling devices have been known where the free end of the auger stem is equipped with a plug-in stump which is screwed in on one side of a crown piece and in which, on the other side, an auger stem and a casing pipe have been inserted. In the case of the drilling process with this device, the auger stem and the casing pipe are driven forward together for the purpose of drilling through the superposed layers. After drilling through the superposed layers, the auger stem is left in the bore hole in the position it has reached and drilling is continued solely with the auger stem. During the drilling with the auger stem and the casing pipe, the flushing agent is fed to the bottom of the bore hole through the central bore in the auger stem. The drill cuttings are carried along by the pressure of the flushing agent, and they will rise to the surface and into the open outside of the casing pipe. Sometimes, through clogging of the cuttings around the outside jacket of the casing pipe, stoppages occur in the flushing agent pipe outside of the casing pipe which prevent or impede the constant removal of the drill cuttings, as a result of which the progress of drilling is unfavorably retarded.

In order to avoid this uncontrolled movement of the drill cuttings through the loose layer of rocks, the proposal is make, according to the invention, to force up the drill cuttings with the flushing agent fed in through the central bore in the auger stem, inside of the casing pipe, and to bring them into the open through an ejection opening in the crown piece.

The object of the invention will be explained on the basis of drawings, given by way of example, in which:

FIG. 1 shows the longitudinal section through a crown piece with a casing pipe;

FIG. 2 shows a crown piece with a casing pipe and an auger stem;

FIG. 3 shows the front view of the two rock cutter bits; and

FIG. 4 is the front view of the two rock cutter bits of a different design.

An auger stem 1 has been inserted into a rock drilling machine, not shown in the drawing, preferably a hammer drill (sinker drill), which casing has at its free end a plug-in stump 2, which is screwed into one end of a crown piece 3. Into the other end of the crown piece an inside sleeve 4 has been screwed in with which a casing pipe 5 is connected. It is possible, depending upon the drilling progress, to add additional casing pipes 5 via additional sleeves 4. At the end of the lowest casing pipe, an annular rock cutter bit 6 has been attached. The crown piece 3 has a sufficiently large opening 7 lateral its axis.

During the work process according to the invention, the percussion piston of the rock cutter drill transmits the percussion energy via the auger stem 1 to the plug-in stump 2 which conducts it further to the crown piece 3 and from the latter via the casing pipe(s) 5 to the annular rock cutter bit 6. Through these percussions of the rock cutter bit, the pertinent layer of ground or gravel is crushed and is displaced mostly laterally, whereby the material of the layer concerned is forced partly outward around the jacket of the head, while the rest escapes inward, arches up, and reaches the open air through the ejection opening 7 in the crown piece.

After the casing pipe has been driven ahead by one length of pipe, it is separated from the crown piece and left in the bore hole in this position. Thereupon, the auger stem, with the plug-in stump 2 and the crown piece 3, is pulled out of the rock cutting drill. Subsequently, an auger stem, provided with a percussion rock cutter bit, which is used generally, is inserted into the rock cutting drill and now the layer inside of the pipe casing located in the bore hole is drilled under ample flushing. At the same time, the flushing agent will emerge at the free end of the casing pipe, together with the drill cuttings.

After reaching the depth of the bore hole obtained by the casing pipe, the auger stem is pulled out of the bore hole and is removed from the drilling machine. Now it is possible to screw an additional casing pipe, by means of a sleeve, to the free end of the casing pipe projecting from the bore hole, and said pipe can be connected with the auger stem provided with the crown pipe and newly inserted into the rock cutting drill, and drilling with the casing pipe can be continued. After drilling has been completed over this length of the pipe, the crown piece is again removed and the core is again drilled with the auger stem inside of the casing pipe. This process is repeated until the earth and loose rock is penetrated and the mountain is reached, and the bore hole can be advanced (driven in) exclusively with the auger stem.

From time to time, the drilling with the auger stem inside of the casing pipe, stuck in the bore hole, is troublesome or there is danger that either the casing pipe or the rock cutter bit will suffer some damage through this drilling process, in which case it will be advantageous to use a rod system according to FIG. 2, to which alternatingly a casing pipe or an auger stem has been attached. At the same time, the crown piece has not only a thread for joining on of the casing pipe 4, but it also has a central bore 8 with a flushing channel 9, so that for the drilling of the material which is inside of the casing pipe 5, which is stuck in the bore hole, a percussive rock bit 12 can be used whose auger stem 10 is inserted into the axial bore 8 of the crown piece 3 and thus can be guided centrally inside of the casing pipe.

If, in the case of this embodiment of the rod system, the end of the length of the casing pipe 5 has been reached through drilling, then the pipe remaining in the bore hole is unscrewed from the crown piece 3, the hammer of the drill is pulled back, and the end of the auger stem 10, with the percussive rock bit 12, is screwed into the central bore 8 of the crown piece 3 and the material inside the casing pipe is drilled. Subsequently the hammer of the drill is moved up and the next casing pipe is added and drilling is continued with it. In this manner one will achieve a step-by-step advance into the depth of the bore hole.

At times it is practical during the progress of the drilling with the annular rock cutter bit to leave the lengths of the auger stem for which drilling has been completed on the crown piece in order to feed to the bore hole a flushing agent through the flushing channel of the auger stem. During this process in drilling, the percussive rock bit does not reach to the bottom of the bore hole and, therefore, does not drill either. Since, in this case, the auger stem dips deeply into the drilling mud, the liquid used for flushing is fed in below the level of the drilling mud and, as a result of that, a particularly good flushing effect will be achieved.

In the case of drilling in accordance with this process, one can start drilling, according to circumstances, either with the auger stem or with the casing pipe.

In special cases it will be advantageous to drill simultaneously with the annular rock cutter bit and with the percussive rock bit. In that case, the casing pipe 5 and also the auger stem 10 are attached to the crown piece 3. The percussive energy of the hammer drill is transmitted through the crown piece to the casing pipe and the auger stem. After completion of drilling for one stem length, an additional stem length is attached to the auger stem by outside sleeve 11 and an extra casing pipe length is connected by inside sleeve to the casing pipe, and subsequently, drilling is continued with the casing pipe and the auger stem simultaneously. The flushing agent emerging from the percussive rock bit lifts the drill cuttings from the bottom of the drill hole and forces the drilling mud through the annular space 13 between the auger stem 10 and the casing pipe 5 to the crown piece 3 and through its opening 7 into the open.

The views of the front surface of the cutter bits show the annular channel **13**, through which the drilling mud is removed. The percussive rock bit **12** of the FIG. **4** has recesses **14** at its periphery through which the drill cuttings can be conducted more favorably into the channel **13** between the casing pipe and the auger stem.

I claim:

1. A method of drilling holes through earth and loose rocks covering solid rock comprising:

a. providing a crown piece for transmitting percussive energy, said crown piece having an injection opening;

b. first percussive drilling an annular hole with an annular rock cutting bit attached to casing pipe thereby forming a core in said annular hole;

c. then percussive drilling said core within said casing pipe with a percussive rock bit provided with a central flushing channel in its auger stem exiting from said rock bit;

d. feeding a flushing medium through said flushing channel at least during step c;

e. forcing the drill cuttings up through an annular space between said rock bit and auger stem and said casing pipe and out said ejection opening in said crown piece by means of said flushing medium; and

f. repeating the above drilling and flushing steps alternately until solid rock is reached whereupon percussive drilling is continued solely by said rock bit and auger stem.

2. A method as claimed in claim **1** comprising the additional step of adding new sections of casing pipe and auger stem as required.

3. A method as claimed in claim **1** wherein when the drilling is being carried out by said annular rock cutting bit, said percussive rock bit is coaxial therewith, does not reach the bottom of the bore hole, and the hole is flushed by said flushing medium exiting from an axial opening in the working face of said percussive rock bit.

4. Hole drilling apparatus for drilling holes through earth and loose rocks covering solid rock comprising:

a. a crown piece for transmitting percussive energy, said crown piece having an ejection opening in its wall for drill cuttings and coupling means for being removably attached to at least one casing pipe and auger stem;

b. an annular rock cutting bit attached to said casing pipe and adapted for cutting an annular bore hole having a core;

c. a percussive rock bit attached to said auger stem, said rock bit and auger stem having an axial flushing channel and both being spaced from said casing pipe to form an annular passage;

d. means for feeding a flushing medium through said crown piece and said axial flushing channel to force the drill cuttings up through said annular passage and directly out said ejection opening; and

e. means for relatively axially moving said annular rock cutting bit and said percussive rock bit so they can alternately drill through said earth and loose rock.

5. Hole drilling apparatus as claimed in claim **4** wherein the external diameter of said percussive rock bit is sufficiently less than the internal diameter of said annular rock cutting bit so that when they are coaxially adjacent one another an annular channel exists therebetween to allow the drill cuttings to be flushed through said annular channel into said annular passage.

6. Hole drilling apparatus as claimed in claim **4** wherein additional casing pipes can be attached by means of sleeves as the hole deepens.

7. Hole drilling apparatus as claimed in claim **4** wherein additional auger stems can be attached by means of sleeves as the hole deepens.

8. Hole drilling apparatus as claimed in claim **4** wherein said means for feeding the flushing medium is an axial flushing channel in said crown piece.

9. Hole drilling apparatus as claimed in claim **4** wherein said percussive rock bit has an axial opening in the working face to exit flushing medium and radially extending recesses in said working face to augment the removal of said drill cuttings.