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Hasewend

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[54] **EARTH BORING METHOD AND APPARATUS**

[75] Inventor: **Florian Hasewend,** Kapfenberg, Austria

[73] Assignee: **Gebr. Bohler & Co. Aktiengesellschaft,** Vienna, Austria

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **175/53;** 175/62; 175/405

[51] **Int. Cl.²** **E21c 23/00**

[58] **Field of Search** 175/53, 62, 406, 407, 405

[56] **References Cited**

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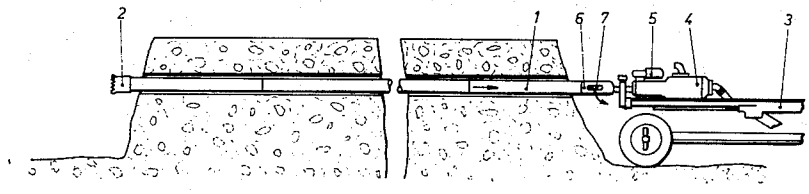
Primary Examiner—Frank L. Abbott

Assistant Examiner—Richard E. Favreau

[57] **ABSTRACT**

Earth boring process and apparatus in which a dam or the like is first bored through in a substantially horizontal direction, after which the leading first borehead used for the first boring is removed from the borestring and is replaced by a second drilling borehead having a larger diameter, the second borehead then being pulled in the opposite direction through the bore hole, so as to enlarge it. During both boring operations the respective boreheads are both turned and percussed or impacted.

5 Claims, 2 Drawing Figures



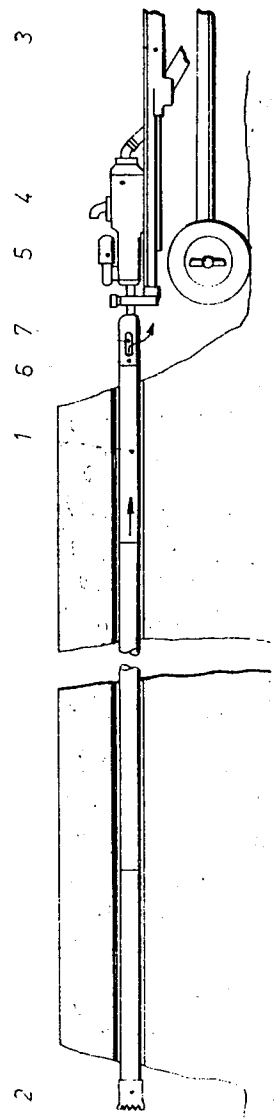


Fig. 1

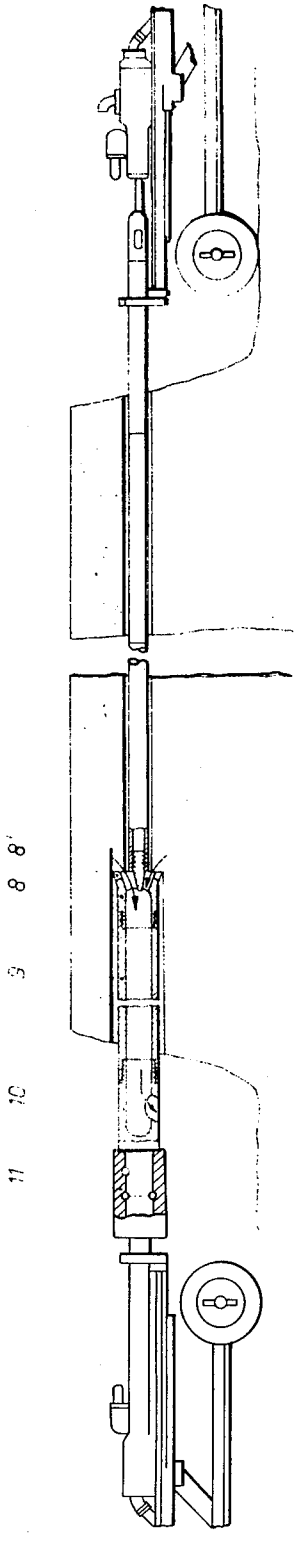


Fig. 2

EARTH BORING METHOD AND APPARATUS

The invention relates to an earth boring process and apparatus in which a dam or the like is substantially bored through in a horizontal direction, after which the borehead used for boring is removed from the forward end of the borestring and is replaced with a leading borehead of a larger diameter than the prior borehead. The bore hole is enlarged by boring with this larger borehead in the opposite direction.

It is known to bore a hole into soft material such as soil by means of a purely rotary boring with a leading borehead, in one direction carrying out a pre-boring and thereafter, also by pure rotary boring in the opposite direction with a borehead having a larger outer diameter than the previously used borehead, to continue the boring operation. One such arrangement is shown, e.g., in U.S. Pat. No. 2,928,468, issued to H. Wienands on Mar. 15, 1960.

It is furthermore known to push into the soil a cable which is partially driven by means of rollers and which is under tension and to enlarge the thus created hole by means of a helically shaped borer. Both of the aforedescribed processes have the drawback of not being suitable for producing holes in loose or solid rock.

It is an object of this invention to avoid the aforedescribed drawback and to provide a process which can, in a simple and economical manner, create bore holes having relatively large diameters in loose or solid rock in a substantial horizontal direction. In accordance with the invention the boring process of the aforedescribed type achieves this results in that during boring the leading borehead which is formed as a percussion bore crown as well as the percussion bore crown which is formed as a drill borehead are not only rotated but also are percussed or pounded.

Hereafter there is described the process in accordance with the invention in conjunction with a drawing in which there is illustrated schematically an arrangement for carring out the process.

In the drawing:

FIG. **1** is viewed partly in section and partly in elevation showing the aforementioned arrangement with the first smaller leading borehead formed as a percussion bore crown, and

FIG. **2** is a partial side view of the same arrangement wherein a second larger drilling borehead is formed as a percussion bore crown.

Referring now to the drawing, the drill string or pipe string which carries the first, smaller leading borehead **2** consists of pipes **1** screwed into each other and secured to a percussion boring machine **4** of a known type having its own rotary mechanism **5.** This pipe string is driven in a substantial horizontal direction by the percussion boring machine **4** while pipes **1** are added as needed. The bored material or detritus travels through the ring shaped leading borehead **2** as well as the pipe sections **1** in the direction of the ejection bell **6** which is provided at the percussion bore machine **4** and is conducted by laterally disposed openings **7** into the open. Assume (as is illustrated in FIG. **1**) the leading borehead **2** has bored through the dam, borehead **2** is removed from the borestring and is replaced by a ring shaped driven borehead **8** which has a substantially larger diameter. The cutting edges **8'** of the driven head **8** are directed towards the ejecting bell **6.** On the side of drilling borehead **8** which faces away from the percussion boring machine **4** a pipe section **9** as well as a second ejection bell **10** are screwed into each other. They are also loosely connected with a second percussion mechanism **11.** Thereafter the enlarging boring operation is carried out whereby on one side of the drilling borehead **8** pipe sections **1** are removed at all times and on the other side there is added an equally long pipe section **9.** The borestring and leading borehead **2,** as well as the drilling borehead **8,** are turned by the rotary mechanism **5** of the percussion bore machine **4.** The forward and retracting sliding of the borestring is carried out by means of the bore carriage **3** on which the percussion boring machine **4** is mounted. When the force is exerted by the boring carriage **3** is not sufficient to obtain the desired boring output, then there are mounted on to the second percussion mechanism **11** an additional rotary and pushing motor. After the drilling head **8** has issued from the side of the dam facing the percussion boring machine **4,** the drilling head **8,** ejection bell **10** and percussion means **11** are replaced by means of a connection piece to a known pulling arrangement, by means of which there is inserted a supply conduit, for example a plastic pipe, into the thus formed bore in the earth.

In accordance with the process of this invention the possibility exists to produce even larger bore holes if in accordance with the aforedescribed boring process the respective bore hole is drilled with a drill head **8** of a larger diameter, such a drill head being moved away from the bore carriage **3.**

In comparison to known boring processes the boring process of this invention has the advantage of carrying out in a simple and economical manner in loose as well as solid rock a substantially horizontal bore hole having relatively large diameter.

Although the invention is illustrated and described with reference to one preferred embodiment thereof, it is to be expressly understood that it is in no way limited to the disclosure of such a preferred embodiment, but is capable of numerous modifications within the scope of the appended claims.

What is claimed is:

1. A process for boring holes of relatively large diameter through a dam or the like in rocky terrain, comprising the steps of first boring through the dam in a substantially horizontal direction with a first leading borehead by rotating said first borehead while simultaneously pushing it forwardly under a rapidly repetitive horizontal impact, then replacing the first borehead by a second drilling borehead having a larger diameter than the first borehead and then boring in the opposite direction through the first borehole with the second borehead by rotating said second borehead while simultaneously pushing it rearwardly under a rapidly repetitive horizontal impact, whereby the first borehole is enlarged.

2. Apparatus for drilling a horizontal bore in a dam or the like in rocky terrain, comprising a first bore string consisting of pipe sections screwed to each other and having a first ejection bell with outlet openings adjacent the rear end of the first bore string, a borehead removably screwed on the forward end of the first bore string, said borehead being selectively a first leading borehead and a second larger ring-shaped drilling borehead, the cutting edges of the first leading borehead facing forwardly and the cutting edges of the second borehead facing rearwardly, a first percussion bore ma-

chine coupled to the rear end of the first bore string and having a bore string rotating means to which the first bore string is secured; and percussion boring means coupled to the second borehead for selectively pushing said second borehead rearwardly.

3. Apparatus according to claim 2, further comprising an arrangement including a second ejection bell firmly secured to the second drilling borehead and forwardly thereof and a second percussion bore machine loosely connected to the forward side of the second ejection bell.

4. Apparatus according to claim 3, further comprising a second bore string insertable between the second drilling borehead and the second ejection bell, the length of the second bore string being equal to the length of the first bore string.

5. Apparatus according to claim 3, wherein the second percussion bore machine includes an additional rotating and percussion motor.

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