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Condolios et al.

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[54] **HYDRAULIC CRUSHING DEVICE FOR USE WITH A BORING TOOL**

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[51] **Int. Cl.** **E21b 9/16**

[58] **Field of Search** 175/404, 54, 333, 383, 175/60, 309-314, 215, 65, 67

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[57] **ABSTRACT**

Crushing device using the hydraulic power of high-pressure jets, comprising a hydraulic crushing chamber surrounded by an annular closure, high pressure jets being sprayed into that chamber, crushing the substances brought into that chamber through a central duct in the boring tool, the crushed substances being removed through orifices in the wall of the crushing chamber.

6 Claims, 4 Drawing Figures

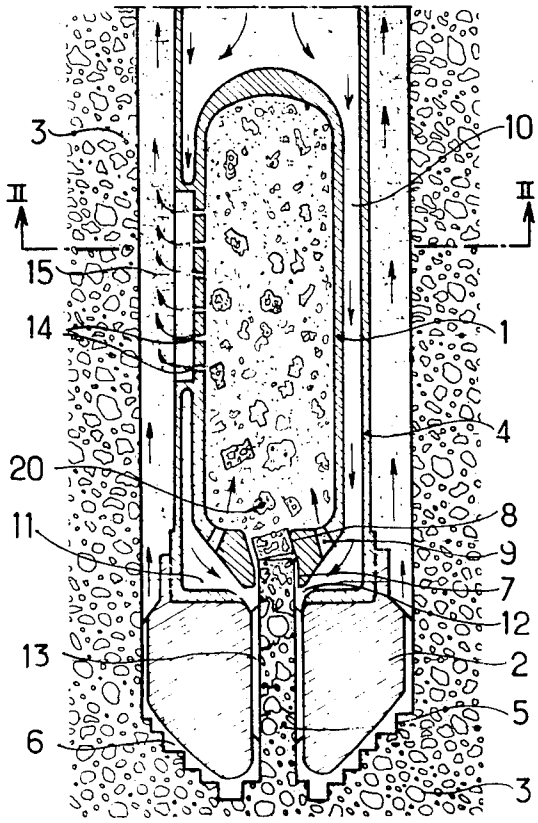


FIG.1

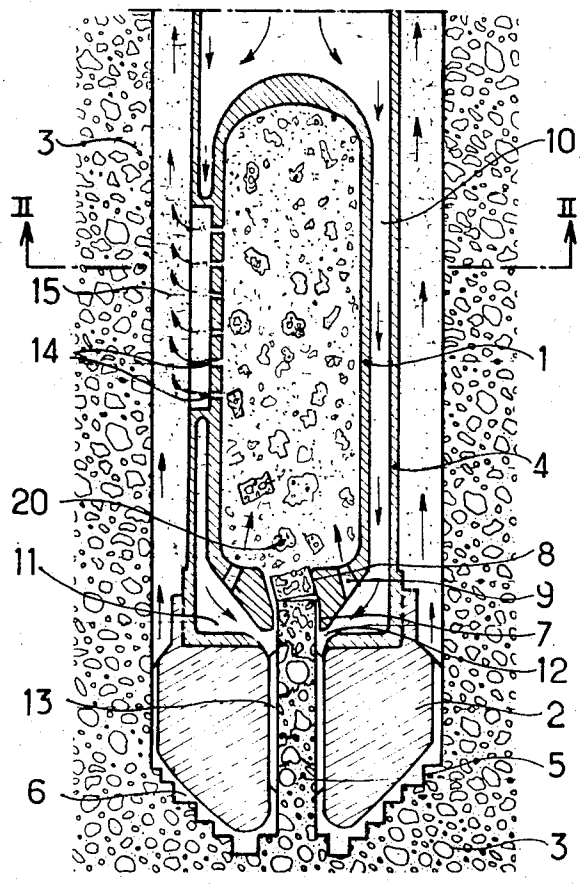


FIG.2

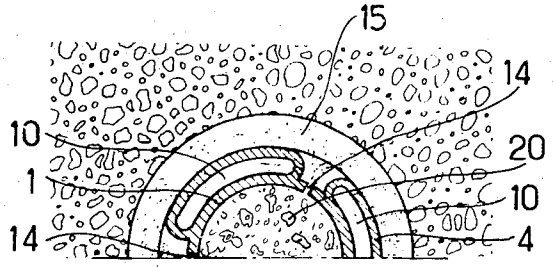


FIG. 3

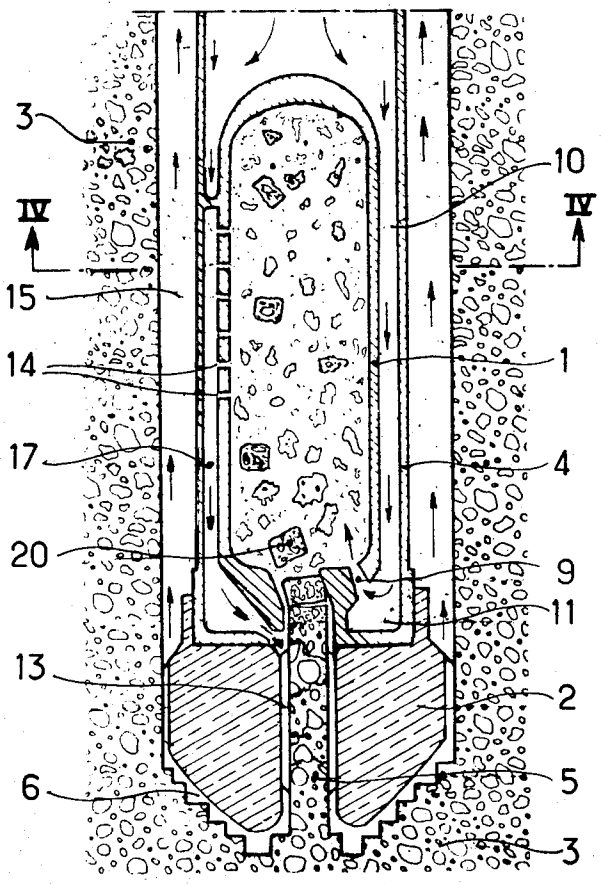
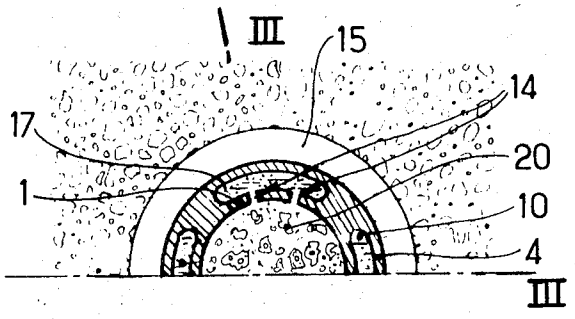


FIG. 4



HYDRAULIC CRUSHING DEVICE FOR USE WITH A BORING TOOL

U.S. Pat. application Ser. No. 258,729 filed June 1, 1972, relates to a hydraulic crusher which may be applied more particularly in connection with a boring tool for breaking the core sample, comprising a crushing chamber into which are brought the materials to be crushed and which contains a certain number of metallic balls, the balls and materials as a whole being energetically stirred by jets of liquid, this having the effect of breaking the materials down to a certain dimension of grains determined by the fluid output orifices.

The present invention has for its object a similar hydraulic crusher for use in connection with a boring tool for breaking the core sample but not containing any balls and therefore effecting what in mining may be called autogenous crushing, that is, crushing in which the materials are broken by striking one another.

The autogenous hydraulic crusher affords a particular advantage in that use behind a boring tool. Indeed, in that case, the crusher is placed underground and therefore the replacing of worn or broken balls would require that the tool be raised to the surface, which would cause a loss of time and hence expenses for the boring site.

In the case of difficulty during boring, it happens that circumstances lead to the stopping of the operation of the boring tool while keeping up the flow of mud, for a period of many consecutive tens of hours. In the case of a ball crusher, the latter will operate uselessly without any load to be crushed. This will result in useless wear of the balls and of the crusher body. On the other hand, with autogenous crushing, as soon as all the grains have been climinated, that wear will not exist, this being an appreciable advantage.

The use of the hydraulic crusher according to the invention behind a boring tool sets a particular problem. Indeed, the central core sample will have to be broken up into pieces having sufficiently small dimensions to enable the operation of the crusher without any blocking. In the case of the hydraulic ball crusher, the proper breaking up of the core sample as soon as it enters the crushing chamber was obtained by the shock of the balls.

The present invention therefore comprises a device for breaking up the core sample. According to an arrangement designed for that purpose, the cylindrical core sample which enters through the shaft of the crusher, which itself is in rotation in relation to the core sample and to the bored ground, is guided by the cylindrical input orifice and bears against an inclined plane which forces it to bend and to break.

The device as a whole will be dimensioned so that the pieces of core sample will have a length which is, at the most, equal to half or a third of the crusher diameter, that condition being necessary for avoiding the blocking up of the load in the crusher. The forces required for breaking the core sample (rotational torque and vertical effort) will be a function of the diameter of the core sample, of the maximum length which it is to have and of the hardness of the rock. The torque and vertical thrust capacities of the boring machine will therefore impose minimum limits for the length of the core sample which it would be preferred, however, would be as slight as possible.

By way of example, for a core sample diameter of 35 mm, a length of 40 mm will be chosen, this leading to slight efforts for breaking the core samples even in the case of hard rocks.

For core sample diameters greater than 40 or 50 mm, greater lengths (70mm, for example) must be allowed if acceptable efforts are still to be obtained in the case of hard rocks. A great length of pieces of core sample obviously reduces the capacity of the crusher, since this is the equivalent of feeding it with larger grains.

FIG. 1 is a vertical axial cross section view of a hydraulic crusher according to the invention, incorporated in a boring device;

FIG. 2 is a horizontal half cross section view according to II—II in FIG. 1;

FIG. 3 is a vertical cross section view according to III—III in FIG. 4 of a variant of a hydraulic crusher, according to the invention; and

FIG. 4 is a horizontal half cross section view according to IV—IV in FIG. 3.

FIGS. 1 and 2 show the general diagram of a hydraulic autogenous crusher **1**, connected with a diamond boring tool **2** operating on a site **3**.

As shown in FIG. **1**, the tool **2** bores the ground, using its diamond knife blades and removes the waste material between the support tube of the tool **4** and the wall of the bored well.

At the center of the tool is formed a central core sample **5** which is difficult to remove through the irrigation and waste material removal ducts **6** with which the tool is provided for that purpose.

The central core sample **5** rises towards the hydraulic crusher **1** placed at the center of the support tube **4** of the tool.

That cylindrical core sample **5** enters the crusher **1**, which rotates, through the cylindrical orifice **7** and abuts against an inclined plane **8** which forces it to bend and to break.

The device **7** and **8** for breaking the core sample, as a whole, is dimensioned so that the pieces of broken core sample have a length equal at the most to half or a third of the diameter of the crusher. The pieces **20** enter the chamber of the crusher **1**, where they are destroyed by striking one another under the effect of the high-speed jets brought into the crusher through the orifices **9**.

The boring liquid comes through the support tube **4** and flows through the passages **10** arranged between the chamber **1** and the tube **4**. These passages feed an annular chamber **11** and distribute the boring liquid either towards the ducts **9** of the crushing chamber, or towards the orifices **12** and the tool irrigation grooves **13**.

The ducts **9** are inclined in relation to the vertical position to direct the jets at very high speed in the direction of the axis of the chamber so as to make the pieces of core sample move in such a way that, after having struck the top of the chamber, they fall again along the lateral walls towards the bottom, where they are taken up again by the jets and so on. This vigorous stirring causes multiple shocks between the pieces **20** of core sample, these shocks causing the rapid crushing thereof.

The liquid brought by the jets into the crusher **1** is removed with the waste material of the crushed core sample through orifices **14** in the wall of the crusher.

In the annular space **15** comprised between the ground **3** and the support tube **4**, they find again the waste material and the liquid coming from the ducts **6** of the tool **2.**

FIG. **2** shows the boring liquid feed passages **10** for the irrigation of the tool and for feeding the jets of the crusher. It also shows the orifices **14** for removing the waste material of the crushed core sample towards the annular space **15.** These orifices **14** have a dimension corresponding to the size of the grains of the broken core sample which it is required to obtain.

The power consumed by the hydraulic crusher is provided by the boring pump placed at the surface.

FIGS. **3** and **4** show a variant consisting in making all the boring fluid flow through the crushing chamber and then in directing that fluid which draws away the crushed material into the boring tool through the outlet orifices of the crushing chamber before bringing the whole to the surface through the annular space of the well.

In that variant, the boring liquid coming through the support tube **4** flows through the passages **10,** which feed the chamber **11** and distribute the boring liquid towards the ducts **9** of the crushing chamber.

The ducts **9** are inclined in relation to the vertical position to direct the jets at very high speed in the direction of the axis of the chamber so as to make the pieces of core sample move in such a way that, after having struck the top of the chamber, they fall down again along the lateral walls towards the bottom, where they are taken up again by the jets and so on. This vigorous stirring causes multiple shocks of the pieces **20** of core sample one against another, these shocks causing the rapid crushing of the core sample.

The liquid and the pieces of crushed core sample are removed from the crusher **1** through the orifices **4** and are led through the passage **17** and the tool irrigation grooves **13** and rise to the surface through the annular space **15** between the tube **4** and the ground **3.**

FIG. **4** shows the passage **10** for feeding the jets of the crusher. It shows also the orifices **14** for the removal of the waste material of the crushed core sample towards the passages **17.**

What is claimed is:

1. In combination with a hollow boring device including a boring tool at one end thereof having a central duct, a crushing device comprising means forming a crushing chamber having an elongated shape in the direction of the axis of the boring device and being secured to the wall of said boring device in the portion of the hollow of said boring device adjacent the boring tool, said boring device having an outside wall spaced from said chamber to form therebetween at least one passage for conveying boring fluid to said boring tool, the end of said crushing chamber facing said boring tool having a central input orifice communicating directly with said central duct in said tool, said crushing chamber additionally having at least one opening of small cross section arranged adjacent said central input orifice and communicating with said passage conveying boring fluid, so that at least one fluid jet will enter said chamber through said opening at high speed and high pressure in the direction of the axis of the chamber from the bottom towards the top thereof, a plurality of removal orifices in said chamber and passing through the wall of said boring device for removal of fluid and crushed waste material, the total cross section of said orifices being sufficient to cause only a small loss of head in consideration of the output of said fluid jet.

2. The combination defined in claim **1** wherein the unit cross section of said removal orifices in said chamber being at the most equal to the maximum permissible dimension for the crushed substances.

3. The combination defined in claim **2** wherein said central input orifice includes means for breaking a boring core sample passing therethrough into pieces of predetermined size.

4. The combination defined in claim **2** wherein said central input orifice has an angular bend therein dimensioned to break a boring core sample passing therethrough into pieces of predetermined size.

5. In combination with a hollow boring device including a boring tool at one end thereof having a central duct, a crushing device comprising means forming a crushing chamber having an elongated shape and being arranged in the portion of the hollow of said boring device adjacent the boring tool, said boring device having an outside wall spaced from said chamber to form therebetween at least one passage for conveying boring fluid to said boring tool, the end of said crushing chamber facing said boring tool having a central input orifice communicating directly with said central duct in said tool, said crushing chamber additionally having at least one opening of small cross section arranged adjacent said central input orifice and communicating with said passage conveying boring fluid, so that at least one fluid jet will enter said chamber through said opening at high speed and high pressure in the direction of the axis of the chamber from the bottom towards the top thereof, a plurality of removal orifices in said chamber for removal of fluid and crushed waste material, the total cross section of said orifices being sufficient to cause only a small loss of head in consideration of the output of said fluid jet, said removal orifices communicating with the annular space comprised between the walls of the hole being bored and the boring device, and said boring tool having a plurality of irrigation ducts communicating with said boring fluid passage.

6. In combination with a hollow boring device including a boring tool at one end thereof having a central duct, a crushing device comprising means forming a crushing chamber having an elongated shape and being arranged in the portion of the hollow of said boring device adjacent the boring tool, said boring device having an outside wall spaced from said chamber to form therebetween at least one passage for conveying boring fluid to said boring tool, the end of said crushing chamber facing said boring tool having a central input orifice communicating directly with said central duct in said tool, said crushing chamber additionally having at least one opening of small cross section arranged adjacent said central input orifice and communicating with said passage conveying boring fluid, so that at least one fluid jet will enter said chamber through said opening at high speed and high pressure in the direction of the axis of the chamber from the bottom towards the top thereof, a plurality of removal orifices in said chamber for removal of fluid and crushed waste material, the total cross section of said orifices being sufficient to cause only a small loss of head in consideration of the output of said fluid jet, said removal orifices communicating with at least one removal passage provided between the inside wall of the body of the device and the wall of said chamber, said boring tool having a plurality of irrigation ducts communicating with said removal passage.

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