MINING MACHINE WITH WEDGE-TYPE CUTTER

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MINING MACHINE WITH WEDGE-TYPE CUTTER

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1. This invention relates to machines for mining coal or other material and belonging to a previously proposed type having a cutter head adapted to strip off the mineral from a seam in the advance of the machine by wedging or splitting off the mineral along a plane approximately parallel to the face of the seam. Where, as is usually desirable, the machine is double-ended—that is to say, is designed to work in each of its two directions of travel—there are two such cutter heads.

The cutter head may incorporate two or more superposed wedge-like cutters arranged to strip off the face at different levels; these cutters having edges which are coplanar, or approximately so, in order that the cutters act along a plane behind and roughly parallel to the face of the seam.

In use of such a machine in a mine, the varying conditions of any seam tend to cause variations in the depth at which the machine cuts into the face. Therefore, it is desirable that the cutter head shall maintain itself at an appropriate constant depth of cut; that is to say, at an appropriate extent behind the face of the seam being stripped.

The object of the present invention is to provide improved means by virtue of which the machine will wholly or partly overcome tendencies to work at varying depths of cut. According to the invention, in a mining machine of the type stated, a cutter is mounted so as to be movable laterally under the influence of the coal or other mineral being cut from a seam and has a heel which can bear upon the newly cut face of the seam and which is movable laterally relative to but under the control of the cutter; and the arrangement is such that if the cutter moves to cut deeper the heel is advanced to press against said face and withdraw the cutter appropriately, whereas if the cutter moves to cut shallower the heel is withdrawn and permits the cutter to return to the desired depth.

An example of a mining machine according to the invention is shown in the accompanying diagrammatic drawings, in which:

Fig. 1 is an elevation of the machine and Fig. 2 is a plan partly in section, the section being approximately on the line 2—2 of Fig. 1. Fig. 3 is a view drawn to a larger scale corresponding to that part of Fig. 2 which is in section.

The general arrangement of the mining machine to which the present invention is applied is shown in simple outline in Figs. 1 and 2, the construction and operation of the machine in general not being material to the present invention. In order that the relationship of the invention to the machine can be adequately understood, the following brief description of the machine is given.

The machine shown is double-ended, comprising mainly a frameline body 7, 8, 9, and 10, a carriage 11 and two cutter heads 12 and 13. The body consists of two transverse end walls 1 and 8, to which the heads are connected, the two longitudinal guide bars 9 and 10, on which the carriage is slidably mounted.

The carriage incorporates hydraulic propulsion apparatus. This apparatus includes a vertical hydraulic jack consisting of a cylinder 14 with a foot 15, the cylinder being vertically movable in a holder 16 incorporated in the carriage, and a piston-operated head 17 which normally rests upon the holder. The propulsion apparatus also includes a hydraulic ram unit consisting of a horizontal cylinder 18 and a ram 19 extending from both ends of the cylinder and engageable at its ends with the walls 7 and 8.

In order that the machine shall be propelled say from left to right (as viewed in Figs. 1 and 2) the jack is operated firstly to depress its foot 15 against the floor of the mine and secondly to lift its head 17 against the mine roof. The jack thus extended provides a securely anchored abutment. Next the ram unit is operated so that the ram 18 is forced to the right, the ram thus engaging the wall 8 and pushing the frameline body 7—10, with the head 13 leading, upon the mine floor towards the right, the guide bars 9, 10 sliding through the now stationary carriage 11. The head 13 now performs its cutting stroke. Thereafter the jack is operated so that its head is lowered and its foot raised, thus contracting the jack and freeing it from the roof and floor. Finally, the ram unit is operated so that the ram 18 is forced to the left, the ram thus engaging the rear wall 7 so that the carriage 11 is pushed to the right. The carriage freely slides to the right hand end of the guide bars 9, 10 to take up a new position of anchorage for the next cutting stroke. This completes the cycle of operations.

Both cutter heads 12 and 13 are of similar construction. Therefore only one of the heads, namely the right hand head 13 is shown in Fig. 3 and is hereinafter described.

In the example, each cutter head comprises a leading cutter 20 arranged at an intermediate level, two cutters 21 and 22 above the cutter 20, a floor cutter 23 and a roof cutter 24. The cut-
ters 20—24 have edges 20A—24A all nearly in the same vertical plane A—A, Figs. 2 and 3. Both the floor and roof cutters 23, 24 also have horizontal edges 23B, 24B. The floor cutter is associated with a sloping ramp 23C for lifting the coal from the floor and deflecting it sidewise from the path of the machine for conveyance from the mine workings.

Each head is made as a hollow casing 25 inside which the cutters 20, 21 and 22 are mounted. As shown in Figs. 2 and 3, the cutter 22 is the forepart of one arm 20 of a lever which is pivotally mounted on a vertical-axis fulcrum pin 27 in the casing 25. The arrangement is such that the cutter 22 is laterally movable in relation to the casing 25 and therefore also in relation to the coal face newly cut by the machine, said face being in the plane A—A and being parallel to the previously cut face B, Fig. 2. As usual in machines of the type stated, the cutter 22 is of wedge form in plan. The cutter is set at an acute angle to the new coal face.

The cutter 22 is associated with a heel 28 which in the same example is a metal body having a flat vertical face 29 which is approximately coplanar with the cutter edge 22A in the normal working positions of the cutter and the heel. The heel 28 is mounted on the rear of the cutter so as to be movable laterally in relation to the casing 25 in unison with the cutter about the fulcrum 27; but, in addition, the heel is slidable mounted on the cutter so as to be movable relatively to it lengthwise thereof; that is, in either direction parallel to the cutter's inclination to the new coal face. The end of the heel 28, including the face 29, is also of wedge form, said end being arranged to act wedgewise against the new coal face in the acute angle between the cutter and the face.

The movements of the heel 28 relatively to the cutter 22 are under the control of the cutter. In the example, this control is exercised by a rearwardly extending arm 30 of the same lever as the cutter arm 25 through the intermediary of hydraulic cylinder devices incorporated in a closed hydraulic system. In the example, these devices comprise a double-acting cylinder-and-piston device 31, 32, 33, 34 and 35, 36 attached to the control arm 30. The piston 32 is connected to the heel by means of a piston-rod 31, and opposite ends of its cylinder 31 are connected by conduits 32, 33 to the outer ends of the cylinders 33 and 35 of the respective cylinder-and-ram devices. The cylinders of these devices are mounted as a unitary assembly in the casing 25 and their rams 34 and 36 cause the arm 30 between them. The arrangement is such that if the cutter 22 moves laterally, so does the arm 30, and this arm moves one ram 34 (or 36) in one direction, the other ram following; and this movement of the rams is associated with a corresponding movement of the piston 32 and of the heel 28 attached to it.

The cylinders 33 and 35 have the same cross-sectional area. This area may be so related to the effective area of the piston 32, and the lengths of the two arms 26 and 30 may be so relatively proportioned, that any movement of the cutter edge 22A would be accompanied by a greater movement of the heel face 29.

In operation of the machine, assume that an unusually resistive portion of the seam of coal C is encountered by the cutter 22; this will force the cutter to turn so as to dig more deeply into the new face A—A. The resultant movement of the movable components 32, 34 and 36 of the hydraulic devices is such that the heel face 29 is moved forcibly relative to the cutter edge 22A against the coal face and, by wedging itself in the acute angle between the cutter and the face, will act to turn the cutter 22 laterally back towards its initial position. This return movement of the cutter will cause the heel also to slide back to its initial position under the action of the hydraulic devices. Conversely, should the resistive face of the seam be materially reduced, the cutter 22 may tend to withdraw to a shallower depth of cut. This movement will cause a corresponding but greater withdrawal of the heel face 29 from the coal face with the result that the cutter will be free to return under the reaction of the seam to its proper depth. Again, this return movement of the cutter will have the effect of returning the heel to its normal setting under the action of the hydraulic devices.

Although, in the example, the invention has been described as applied to a single cutter 22, it will be manifest that each of the other cutters 20 and 21 may be provided correspondingly with a heel and hydraulic devices to regulate the cutting depth at levels at which these cutters work.

I claim:

1. A machine for mining coal or other mineral by moving along a seam and of the type stated comprising a cutter head, a cutter which is mounted on said head so as to cut a new face longitudinally of the seam and so as to be movable laterally under the influence of the mineral, said cutter being arranged on the head to make an acute angle with the new face, a heel associated with the cutter and arranged within said angle between the cutter and the face, means for moving the heel laterally relative to the cutter, control apparatus for controlling the operation of the movably means, and means operatively connecting the cutter and said control apparatus, said connecting means acting whenever the cutter moves to cut deeper into the mineral to operate the movably means to thrust the heel wedgewise against the new face and the cutter and thus withdraw the cutter, whereas if the cutter moves to cut shallower the heel is withdrawn by the operation of said movably means so that the cutter can return.

2. A machine according to claim 1 in which said heel is mounted in combination with said cutter and in which hee guiding means on said cutter constrains the heel to take part in any lateral movement of the cutter.

3. A machine according to claim 2 in which the movably means and the hee guiding means together comprise a hydraulic cylinder-and-piston device mounted on the cutter and applied to the heel and the control apparatus comprises hydraulic devices which communicate with said first mentioned device and are actuated by the said connecting means to actuate this device.

4. A machine for mining coal or other mineral and of the type stated comprising a cutter head, a cutter which is pivotally mounted on said head so as to be pivotable laterally under the influence of mineral in which a new workings are made by the cutter, said cutter being arranged on the head to make an acute angle with the new face, a heel mounted on the cutter so as to pivot through, the heel being arranged within said angle between the cutter and the face, means for moving the heel linearly relative to the cutter, control apparatus for controlling the operation of
said heel-moving means, and means operatively connecting the cutter and said control apparatus, said connecting means acting whenever the cutter pivots to cut deeper into the mineral to operate the heel-moving means to thrust the heel pivoting with the cutter wedgewise into the angle between the face and the cutter and thus withdraw the cutter, whereas if the cutter pivots to cut shallower the heel pivoting with it is, in addition, withdrawn by the operation of said heel-moving means so that the cutter can return.

5. A machine according to claim 4 in which the heel-moving means comprises a hydraulic cylinder-and-piston device mounted on the cutter and applied to the heel and the control apparatus comprises hydraulic devices which communicate with said first-mentioned device and are actuated by the said connecting means to actuate this device.

6. A machine for mining coal or other mineral and of the type stated comprising a cutter head, a cutter which is mounted on said head so as to be movable laterally under the influence of mineral in which a new face is being cut by the cutter, said cutter being arranged on the head to make an acute angle with the new face, a double-acting hydraulic cylinder-and-piston device provided on the head, a heel associated with the cutter and arranged within said angle between the cutter and the face, said heel being laterally movable relative to the cutter by said device, a control element movable with said cutter, hydraulic means operable by said element and hydraulically communicating with said device so as to operate it in either direction, said hydraulic device and means constituting a hydraulic control system such that if the cutter moves to cut deeper into the mineral the heel is advanced relative to the cutter by the cylinder-and-piston device to press against the face and wedge itself into the angle between the face and the cutter in order to withdraw the cutter, whereas if the cutter moves to cut shallower the heel is withdrawn relative to the cutter by said device so that the cutter can return.

7. A machine according to claim 6 in which the cutter, the heel and the hydraulic cylinder-and-piston device are all pivotally mounted on the head so that, when the cutter pivots relative to the head in order to advance or withdraw with respect to the mineral being cut, the said heel and device pivot with the cutter.

8. A machine according to claim 1 in which the heel is a body that is slidable lengthwise of the cutter and has a wedge-like end surface adapted to bear upon the new face cut in the mineral.

9. A machine according to claim 4 in which the heel is a body that is slidable lengthwise of the cutter and has a wedge-like end surface adapted to bear upon the new face cut in the mineral.

10. A machine according to claim 6 in which the heel is a body that is slidable lengthwise of the cutter and has a wedge-like end surface adapted to bear upon the new face cut in the mineral.

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