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D. H. H. BOLTON ET AL

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MINING APPARATUS WITH AUTOMATICALLY ADVANCING JACKS

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2 Sheets-Sheet 1

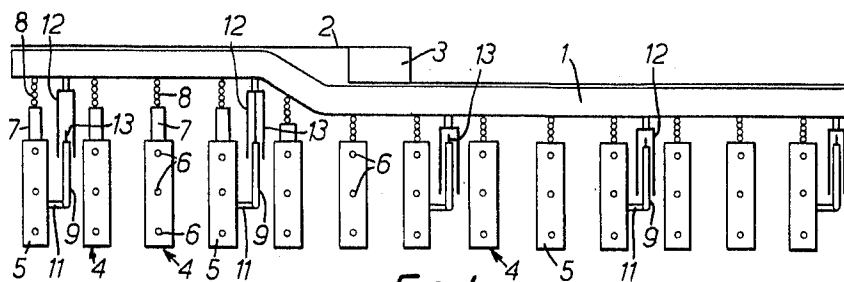


FIG. 1.

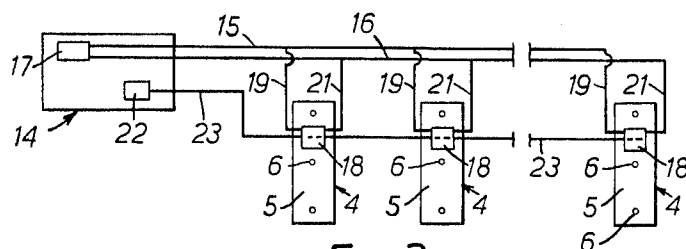


FIG. 2.

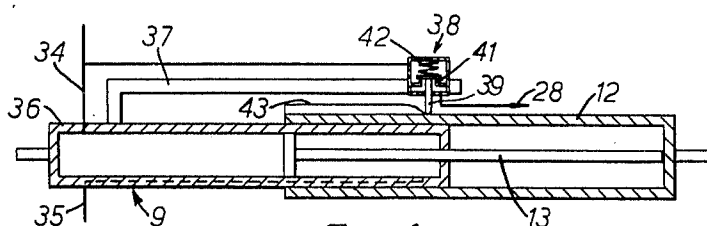


FIG. 4.

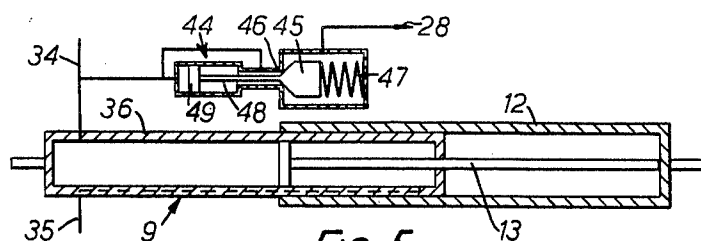


FIG. 5.

INVENTORS
MICHAEL C. POTTS &
BY DOUGLAS H. H. BOLTON

Reynolds & Christensen
ATTORNEY

March 22, 1966

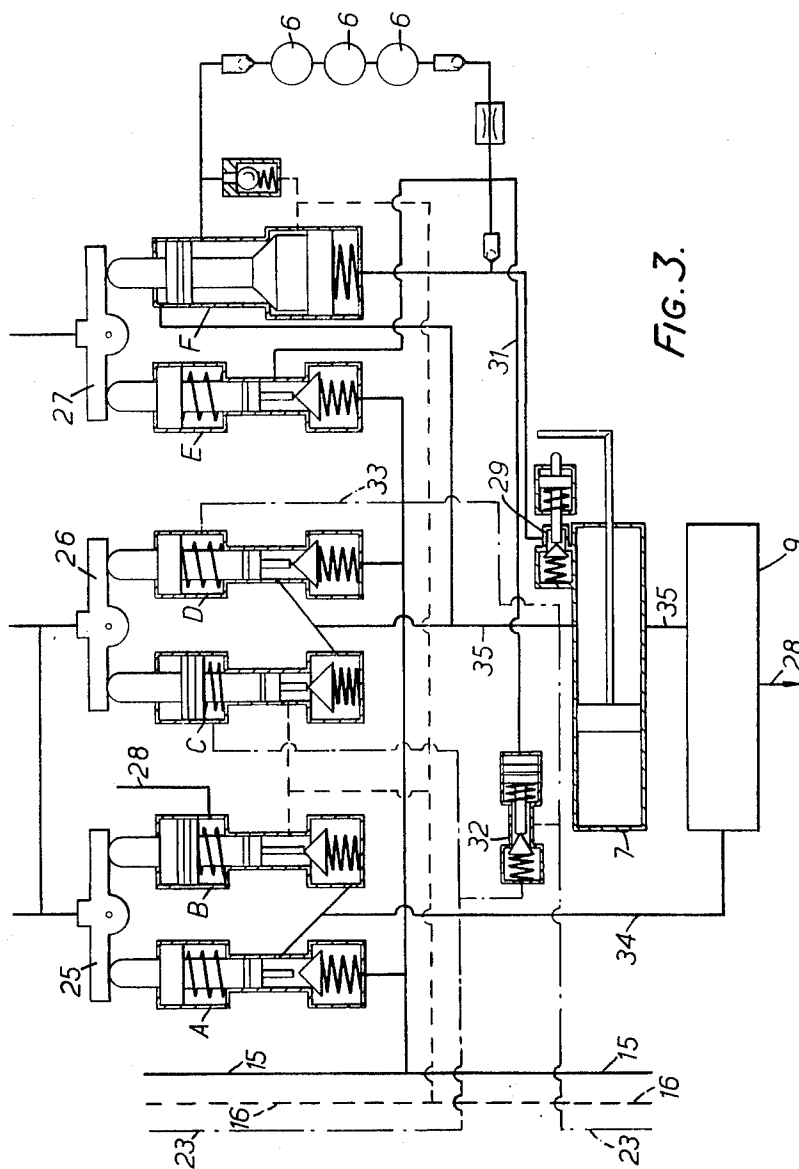
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INVENTORS
MICHAEL C. POTTS &
BY DOUGLAS H. H. BOLTON
Reynolds & Christensen
ATTORNEY

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MINING APPARATUS WITH AUTOMATICALLY
ADVANCING JACKS

Douglas H. H. Bolton, "Trelawney," Langley Road,
Winchcombe, near Cheltenham, England, and Michael
C. Potts, Mill Close, Mill St., Prestbury, Cheltenham,
England

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1 Claim. (Cl. 198—126)

This invention relates to mining apparatus.

In longwall mining, a snakable conveyor usually extends along the working face of the mine, such a conveyor being made in portions which are capable of a small amount of relative movement about a vertical axis to enable the conveyor to be advanced in the manner commonly known as "snaking" during which, when one portion of the conveyor is advanced the adjacent portion advances by a smaller amount.

The present invention provides a mining apparatus including a snakable conveyor extending along the working face of the mine, and a series of fluid-pressure-operated jacks each operable to apply an advancing force to the conveyor, the jacks being associated with one another in such a manner that, when the first jack in the series has been caused to apply an advancing force to the conveyor, each of the other jacks in the series is caused to apply an advancing force to the conveyor by the attainment of a predetermined operating condition of the preceding jack in the series. When applying an advancing force to the conveyor, each jack will react against a roof support or other device wedged between the roof and floor.

The predetermined operating condition may be a predetermined fluid pressure in the jack or a predetermined extension of the jack.

Two embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings of which,

FIG. 1 is a diagrammatic view of mining apparatus, with the hydraulic connection and roof bars omitted,

FIG. 2 is a similar view on a larger scale of part of the mining apparatus showing the hydraulic power unit and its connections to the roof supports,

FIG. 3 is a similar view showing details of the hydraulic control valve associated with each roof support,

FIG. 4 is a similar view of a conveyor-advancing jack assembly according to the first embodiment of the invention and,

FIG. 5 is a similar view of a conveyor-advancing jack assembly according to the second embodiment of the invention.

With reference to the accompanying drawings, coal mining apparatus includes a conveyor 1 which extends along the working face 2 of a coal mine and acts as a guide means for a coal cutting machine 3 in addition to conveying coal cut by the cutting machine 3. A series of hydraulically-operated roof supports 4 are arranged along the working face 2 and lie on the opposite side of the conveyor 1 to the working face 2.

Each roof support 4 includes a ground-engaging sole beam 5 which carries a number, for example three as shown, of hydraulically-operable telescopic props 6 and a roof-engageable bar (not shown) carried by the props 6. Each roof support 4 has a single-acting hydraulically-operable jack 7 mounted in the sole beam 5, the piston rod of the jack being secured to the conveyor 1 by a chain 8. This jack 7 is used to advance the roof support 4 towards the conveyor 1, with the conveyor 1 acting as an anchorage. The chain 8 reduces the risk of any damage such as bending of the jack 7 which would be caused if the jack 7 was secured directly to the con-

veyor 1 and creep of the conveyor 1 relative to the roof supports 4 occurred, conveyor creep being movement of the body of the conveyor 1 along the working face 2.

Some roof supports 4 (for example every fourth roof support as shown) have a double-acting hydraulically-operable jack 9 for advancing the conveyor 1 relative to the roof support 4 using the roof support 4 as an anchorage. The cylinder of the jack 9 is pivotally secured to a lug 11 projecting from the side of the sole beam 5, and is a loose fit within a sleeve 12 pivotally secured to the conveyor 1. When advancing the conveyor 1, the piston rod 13 of the jack 9 acts against the end of the sleeve 12 adjacent the conveyor 1. When advancing the roof support 4, the jack 9 is first contracted and the loose fit of the jack 9 in the sleeve 12 ensures that no side loads are applied to the roof support 4 by the jack 9 during the advance of the roof support 4.

A hydraulic power unit 14 is located at one end of the working face 2 and a main pressure line 15 and a hydraulic return line 16 extend from a source 17 of hydraulic pressure in the power unit 14 along the working face 2. Each roof support 4 includes a hydraulic control valve 18 to which the pressure line 15 and return line 16 are connected by lines 19 and 21 respectively. The control valve 18 of each roof support 4 is connected to its props 6, jack 7 and jack 9 (if provided), in the manner shown in FIG. 3.

Each roof support 4 with a jack 9 includes a main valve assembly which includes valve units A, B, C, D, E, and F. Valve units A, B, C and D control the supply of hydraulic fluid to the jacks 7 and 9 and are connected to the jacks 7 and 9 and to the supply line 15 and the return line 16 in the manner shown in FIG. 3. The drawing shows valve units A, B, C and D in their neutral positions, that is to say connecting the jacks 7 and 9 to the return line 16. Valve units A and B are associated with a pivotally-mounted lever 25 which is connected to a similar lever 26 associated with valve units C and D. The levers 25 and 26 co-ordinate the action of valve units A, B, C and D. In those roof supports without a jack 9, this is to say with only the single-acting jack 7, valve units A and B and lever 25 are omitted.

Valve units E and F control the supply of hydraulic fluid to and the return of hydraulic fluid from the props 6 and their action is coordinated by a pivotally-mounted lever 27.

When a mining operation is taking place, the conveyor will first be advanced by means of the jacks 9. A hydraulic pressure is caused to occur (in a manner to be described) in a line 28 connected to valve unit B. This pressure operates valve unit B, whose operation causes levers 25 and 26 to move angularly in an anti-clockwise direction and operate valve units A and C. The pushing side of the jack 9 becomes pressurised through line 34 and an advancing force is applied to the conveyor.

When it is desired to advance the roof supports, the pilot line 23 leading to the first roof support in the series is pressurised by the pilot-pressure source 22 and this pressure operates valve unit C. Operation of valve unit C causes clockwise movement of levers 25 and 26 and operation of valve units B and D. Hydraulic pressure is thereby caused to act through line 35 on the pulling side of the jacks 7 and 9 and to operate valve unit F. Operation of valve unit F causes the props 6 to be released and thus the roof support is released from the roof.

The roof support 4 is then advanced towards the conveyor 1 by the jack 7 which, when it becomes fully contracted, operate a prop resetting valve 29, which results in hydraulic pressure acting on valve unit F to return valve unit F to its original position. This results in the props 6 being reset and thus the roof support 4 is reset against the roof.

When the roof support 4 is satisfactorily reset against the roof, as indicated by the attainment of a predetermined hydraulic pressure in the props 6, which pressure will also exist in a line 31 connected to a pilot line control valve 32, this pressure in line 31 acts on control valve 32 to operate the valve and cause the line 23 leading from the pilot-pressure source 22 to be brought into communication with the line 23 leading to the next roof support 4 in the series, which is then caused to undergo an advancing operation. Thus each roof support 4 in turn is caused to undergo an advancing operation. The pressure in line 23 leading to the next roof support 4 also pressurises a line 33 connected to valve unit D. This pressure acts on valve unit D to return this valve unit and valve units A, B and C to the positions shown in FIG. 3.

This invention is concerned with the manner of advancing the conveyor 1, that is to say with the manner of operation of the jacks 9, and the preceding description relating to the hydraulically-controlled advancing operations of the roof supports has been included to show one arrangement with which this invention can be used. In the previous description, it will be remembered that, to cause a jack 9 of a roof support 4 to apply an advancing force to the conveyor 1, it is necessary to pressurise the line 28 leading to its valve unit B.

FIG. 4 shows a conveyor-advancing jack assembly according to the first embodiment of the invention. The cylinder 36 of the jack 9 carries an arm 37 which extends along the outside of the sleeve 12. Adjacent the free end portion of the arm 37 is a valve assembly 38 including a valve member 39 resiliently urged towards a valve seat 41 by a spring 42. The valve assembly 38 is connected to the line 34 and to the line 28 of the next roof support 4 in the series which has a jack 9. When the valve member 39 is seated on the valve seat 41, line 28 is shut-off from line 34. The open end portion of the sleeve 12 has an external cam surface 43 engageable with the valve member 39.

Before the line 28 of a roof support 4 with a jack 9 is pressurised, the jack 9 will be fully contracted, but the relative positions of the jack 9 and sleeve 12 depends upon the position of the conveyor 1 relative to the roof support 4. If the valve member 39 is not engaging the cam surface 43, the line 34 will be shut-off from the line 28 leading to the next roof support 4 with a jack 9 and, if the valve member 39 is engaging the cam surface 43, the line 28 will be pressurised from line 34. For simplicity of description, it will be assumed that initially the valve member 39 of each jack assembly is not engaging the cam surface 43.

To advance the conveyor 1, the first jack 9 of the series of roof supports 4 is caused to apply an advancing force to the conveyor 1 by pressurisation of the line 28 of its roof support 4. The pressurisation of line 28 is associated with the first jack 9 may be brought about in any desired manner, for example by a manual control, by a remote control or by a device travelling with the cutting machine 3. The first jack 9 will extend until its piston rod 13 engages the closed end of the sleeve 12 and will then begin advancing the portion of the conveyor 1 in front of its roof support 4. As this portion of the conveyor 1 advances, the sleeve 12 moves relative to the cylinder 36 until, when the jack 9 has extended a predetermined amount, the end of valve member 39 rides up onto the

cam surface 43 and is caused to leave the valve seat 41, thus causing the pressurisation of the line 28 leading to the next roof support 4 with a jack 9. Thus the next jack 9 is then caused to apply an advancing force to the conveyor 1 and, when this next jack 9 has extended a predetermined amount, the next jack 9 again in the series will be caused to apply an advancing force to the conveyor 1. Thus the conveyor 1 will advance in a "snaking" manner, the conveyor 1 itself being made in such a manner that it can assume the configuration required in snaking.

If, initially, the first jack 9 will not be powerful enough on its own to advance the conveyor 1, the cam surface 43 of the first jack 9 may be of such a length that the second jack 9 will come into operation when the first jack 9 is actuated. If desired, the first three or four jacks 9 may be arranged to come into operation when the first jack 9 is actuated.

In the second embodiment shown in FIG. 5, each jack 9 (apart from the first) is caused to come into operation not by a predetermined extension of the preceding jack 9, as in the first embodiment shown in FIG. 4, but by a predetermined pushing pressure in the preceding jack 9. Line 34 is connected to a valve assembly 44 which normally shuts-off line 34 from the line 28 leading to the next roof support 4 with a jack 9. The valve assembly 44 includes a valve member 45 resiliently urged toward a valve seat 46 by a spring 47. Valve member 45 is connected by a rod 48 to a piston 49. When the pressure in line 34 is below a predetermined value, spring 47 maintains the valve member 45 in contact with valve seat 46 to prevent pressurisation of line 28 and, when the pressure in line 34 rises above the predetermined value, the force exerted on piston 49 causes the valve member 45 to be moved away from the valve seat 46 so that line 28 becomes pressurised from line 34.

This predetermined pressure is a pressure near the maximum attainable in the jack 9 so that the next jack 9 is caused to come into operation either when a jack 9 has extended its full amount or when it is having difficulty in advancing the conveyor 1, for example if the conveyor 1 has met an obstruction.

We claim as our invention:

Mining apparatus including a snaking conveyor extending along the working face of the mine, a series of fluid-pressure-operated jacks each operable to apply an advancing force to the conveyor, and control means coupled with said jacks and responsive to a predetermined fluid pressure in one jack to cause a succeeding jack in the series to apply an advancing force to the conveyor, whereby each of the jacks in the series is caused to apply an advancing force to the conveyor by the attainment of a predetermined pressure in the preceding jack in the series.

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SAMUEL F. COLEMAN, *Primary Examiner.*