March 21, 1967 M. C. POTTS ET AL 3,309,880

MINING APPARATUS

Filed July 21, 1964 3 Sheets-Sheet 1

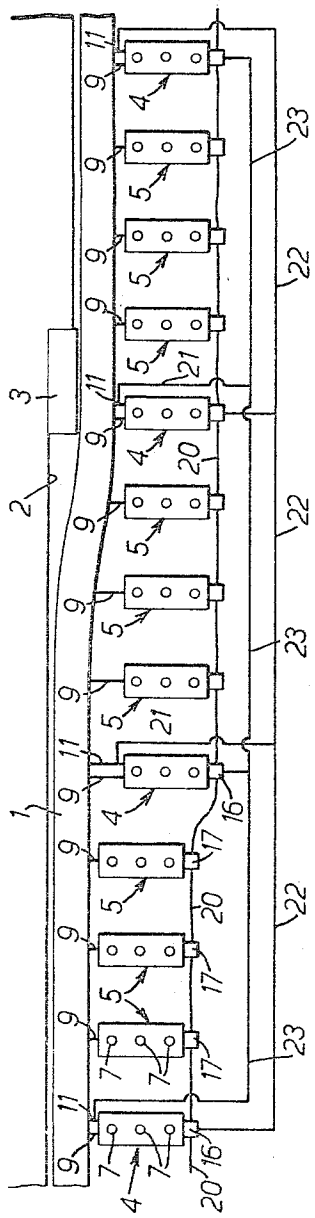


FIG. 1.

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MINING APPARATUS

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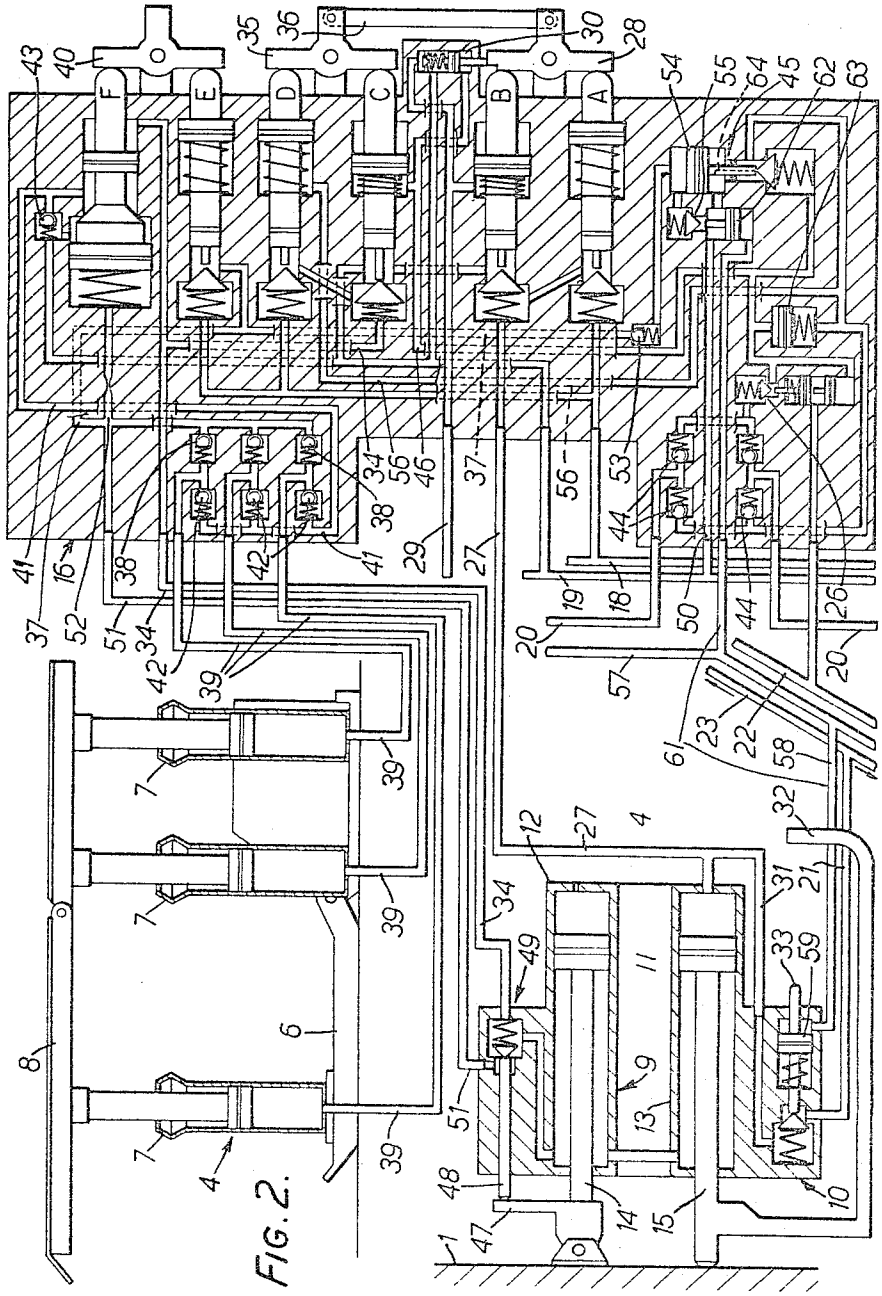


FIG. 2.

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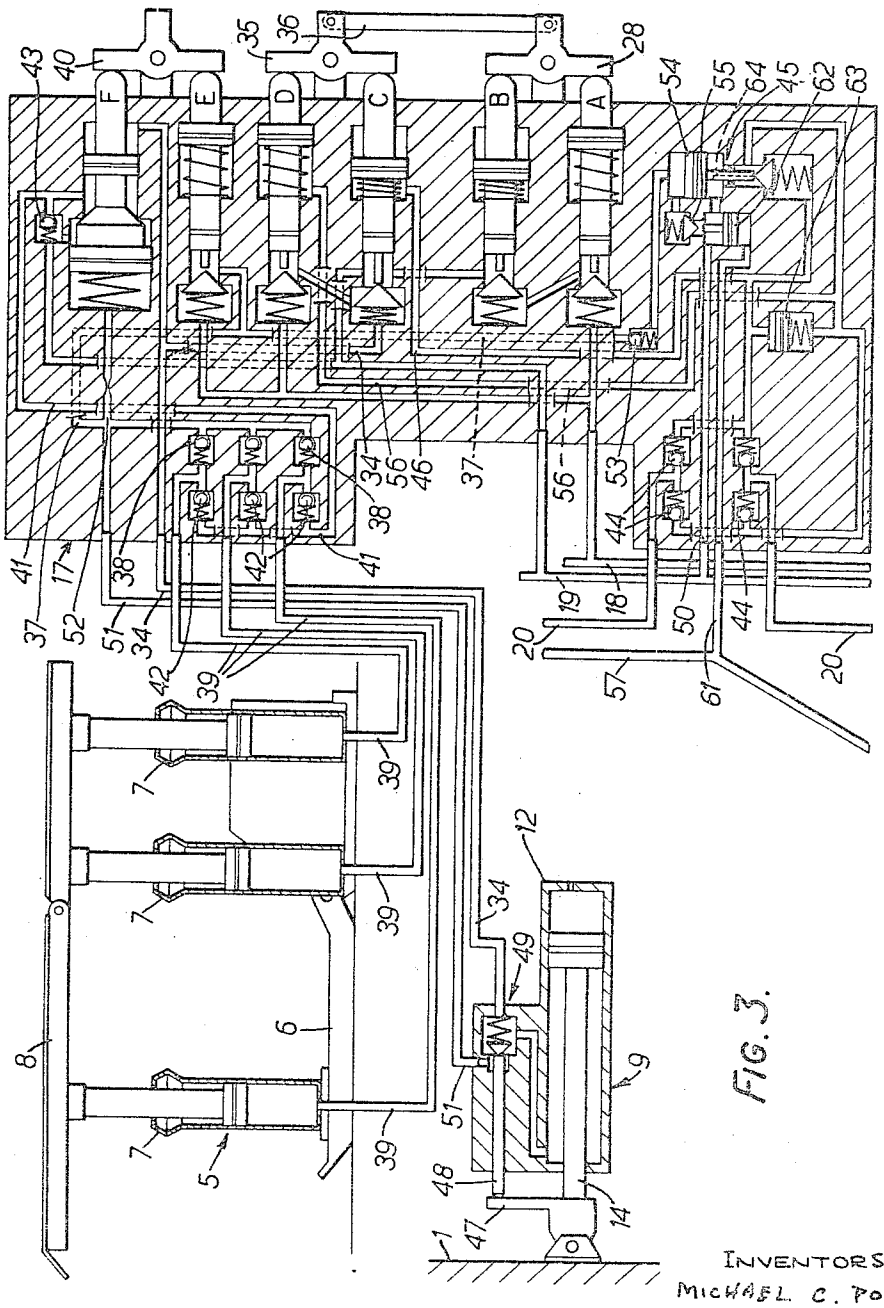


FIG. 3.

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3,309,880

MINING APPARATUS

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7 Claims. (Cl. 61—45)

This invention relates to mining apparatus including a series of roof supports and a guide means (for example a conveyor) for a cutting machine.

The present invention provides mining apparatus including a series of roof supports, of which certain roof supports may be termed master roof supports and the others slave roof supports, a guide means for a cutting machine, at least some of the roof supports (the master roof supports) having a fluid-pressure-operated jack operable to apply an advancing force to the guide means, each roof support (master and slave alike) having a fluid-pressure-operated prop operable to set the roof support against a roof, each roof support, whether master or slave, being advanceable towards the guide means by fluid pressure operated support advancing means, each roof support including a valve assembly controlling the supply of fluid under pressure to the prop and to the support advancing means, each valve assembly being operable to cause the roof support to undergo an advancing operation and being operated or selected for operation by a signal from the previous roof support in the series, and at least some of the roof supports (the master roof supports) having sensing means operable to halt the advance of the series of roof supports at a predetermined point until the portion of the guide means in front of the roof support has been advanced by a predetermined amount relative to the roof support.

Each sensing means may include a valve associated with a jack carried by the roof support, said valve being operated by a predetermined extension of the jack to allow an advancing sequence to continue. The signal may be a fluid-pressure signal which passes from roof support to roof support, a valve interrupting the signal until the portion of the guide means has been advanced by the predetermined amount.

Each sensing means may operate to prevent the advance of a preceding roof support. Alternatively, each sensing means may operate to prevent the advance of its own roof support, while allowing advance of the preceding roof supports.

The mining apparatus may include additional means for operating each sensing means to allow an advancing sequence to continue, the additional means being independent of the amount of advance of the guide means.

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

FIGURE 1 is a diagrammatic view of mining apparatus including a series of roof supports,

FIGURE 2 is a diagrammatic view showing the hydraulic valve assembly of each master roof support, and

FIGURE 3 is a diagrammatic view showing the hydraulic valve assembly of each slave roof support.

With reference to the accompanying drawings, FIGURE 1 shows mining apparatus including a conveyor 1 extending along the working face of a mine, for example a coal mine, a cutting machine 3 travelling from left to right along the working face 2 and guided by the conconveyor 1, and a series of advanceable roof supports including master roof supports 4 and slave roof supports 5,

the roof supports being so arranged that every fourth roof support is a master roof support 4.

As shown in FIGURES 2 and 3, each roof support 4, 5 includes an articulated floor-engaging member 6 carrying three hydraulically-operated telescopic props 7, the props 7 carrying an articulated roof-engageable member 8. Each master roof support 4 carries two hydraulically-operated jacks 8, 11 whose cylinders 12, 13 respectively are carried by the floor-engaging member 6. The jack 9 can be operated to advance the roof support towards the conveyor 1, when the roof support is released from the roof, the piston rod 14 being pivotally secured to the conveyor 1. The jack 11 can be operated to advance the conveyor 1 relative to the roof support, when the roof support is set against the roof, the piston rod 15 being capable of engaging the conveyor 1 although it is not actually connected to the conveyor 1. Each slave roof support 5 has a support-advancing jack 9, but does not have a conveyor advancing jack 11.

Each master roof support 4 includes a valve assembly 16 operable to cause the jack 11 to advance the conveyor 1 relative to the roof support and also to cause the jack 9 to advance the roof support towards the conveyor 1. Each slave roof support includes a valve assembly 17 operable to cause the jack 9 to advance the roof support towards the conveyor 1. The valve assemblies 16, 17 will be described in detail later with reference to FIGURES 2 and 3 respectively.

A hydraulic pilot line 20, which can be pressurised from a source not shown, is connected to the valve assembly 16, 17 of each roof support in turn in such a manner that a hydraulic pressure signal in the pilot line 20 can actuate each valve assembly 16, 17 in turn to cause the roof supports to advance in turn towards the conveyor 1.

For simplicity, certain hydraulic lines have been omitted in FIGURE 1, although they have been shown in FIGURES 2 and 3. For example, a hydraulic pressure supply line 18 and a hydraulic return line 19 extend along the mine and are connected to each valve assembly 16, 17 by branch lines. The conveyor-advancing jack 11 of each master roof support 4 actuates a valve 10 when the jack 11 becomes fully extended, that is to say when the conveyor 1 is fully advanced relative to the roof support, to cause pressurisation of a line 21 and consequent pressurisation of lines 22 and 23. Line 22 is connected to the valve assembly 16 of the adjacent left hand master roof support 4, and line 23 is connected to the valve assembly 16 of the adjacent right hand master roof support 4. This arrangement enables the roof supports to be advanced in a sequence which passes from left to right along the mine or in a sequence which passes from right to left, depending upon the direction of travel of the cutting machine 3. In the mining apparatus shown in FIGURE 1, the sequence is passing from left to right. Pressurisation of the lines 22 and 23 opens a valve 26 (FIGURE 2) in the portion of the pilot line 20 connected to the relevant valve assembly 16.

The operation of the mining apparatus will firstly be described in a general manner. As the cutting machine 3 travels from left to right along the working face 2, the conveyor 1 is advanced in a snaking manner by the conveyor-advancing jacks 11, each jack 11 being caused to apply an advancing force to the conveyor 1 after the cutting machine 3 has passed the master roof support 4 associated with the jack 11. In the left to right operation, the full extension of the jack 11 of the first master roof support and the consequent opening of the valve 26 associated with the next master roof support 4 has no effect since the pilot line 20 is only pressurised up to the first master roof support 4.

When the jack 11 of the next master roof support 4 is fully extended, its associated line 21 and consequently lines 22 and 23 are pressurised. Pressurisation of line 22 leading to the first master roof support 4 opens the associated valve 26, and, since the pilot line 20 is pressurised up to that point, the first master roof support 4 undergoes an advancing operation. As it does so, its jack 11 contracts with resultant loss of pressure in its associated lines 21 and 23 so that the valve 26 associated with the second master roof support 4 shuts. Each valve 26 is so constructed, as shown in FIGURE 2, that if it is opened when the portion of the pilot line 20 connected to it is pressurised, the pilot line pressure holds the valve 26 open even though the pressure in the line 22 or 23 is subsequently lost.

When the first master roof support 4 has completed its advancing operation, its valve assembly 16 opens the pilot line 20 to the adjacent slave roof support 4 and consequently each of the three adjacent slave roof supports 5 advance in turn. When the third slave roof support 5 has completed its advancing operation, its valve assembly 17 opens the pilot line 20 to the second master roof support 4. However, the valve 26 of the second master roof support 4 is closed and remains closed until the jack 11 of the third master roof support 4 has fully extended. The valves 10 and 26 form sensing means which operates to halt the advancing sequence by preventing advance of the preceding master roof support 4 until the valve 10 is opened by the jack 11.

Thus each master roof support 4 and its three slave roof supports 5 do not advance until the conveyor 1 has advanced fully in front of the next master roof support 4.

The apparatus functions in the opposite manner when the cutting machine 3 is travelling from right to left, the advancing sequence then passing from right to left instead of from left to right.

The valve assemblies 16 of a master roof support 4 will now be described with reference to FIGURE 2. The valve assembly 16 includes six valve units A, B, C, D, E and F. Valve units A and B control the conveyor advancing jack 11 and are connected to the pushing side of jack 11 by line 27. Valve unit A is connected to the pressure supply line 18 and valve unit B is connected to the return line 19. Valve units A and B are connected by a pivotally-mounted lever 28. A line 29 connected to valve unit B can be pressurised to cause valve unit B to actuate lever 28 with consequent opening of valve unit A and pressurisation of the pushing side of conveyor-advancing jack 11. A spring-actuated latch 30 holds the lever 28 in this position and the conveyor advancing jack 11 therefore continues to be pressurised in the conveyor-advancing sense even though the pressure in the line 29 is not maintained. The line 29 of each master roof support 4 may be pressurized by manual operation of a valve or automatic operation of a valve, for example a valve (not shown) actuated by the cutting machine 3 as it travels along the working face 2.

Line 27 communicates with valve 10 through a line 31 and when the jack 11 becomes fully extended, an arm 32 carried by the piston rod 15 of the jack 11 engages an actuating rod 33 and opens the valve 10 to pressurise line 21 leading to lines 22 and 23 which in turn lead to the left and right hand adjacent master roof supports 4.

Valve units C and D control the support-advancing jack 9 and are connected to the contracting side of the jack 9 by a line 34. Valve unit C is connected to the return line 19 and valve unit D is connected to the pressure supply line 18. Valve units C and D are connected by a pivotally-mounted lever 35 which is ganged to the pivotally-mounted lever 28 by a connection 36.

Valve units E and F control the setting and release respectively of the props 7. Valve unit E is connected to the pressure supply line 18 and to the props 7 through line 37, non-return valves 38 and lines 39. Valve unit F is connected to the return line 19 and to the props 7 through line 41, non-return valve 42 and lines 39. Valve units E and F are connected by a pivotally-mounted lever 40. A pressure relief valve 43 is connected in parallel with valve unit F so that excess pressure in the props 7 can be relieved from line 41 into the return line 19.

Assuming pressure to be present in the portion of the pilot line 20 leading from the slave roof support 5 on the left-hand side of the master roof support 4, the pilot pressure passes one of four non-return valves 44 and reaches valve 26. When valve 26 is opened by the attainment of full extension of the jack 11 of the next master roof support 4, the valve 26 self-latches in the open position, and pilot pressure reaches a closed control valve 45 and also passes along a line 46 to release the latch 30 and actuate valve unit C. This causes valve units A and C to close and valve units B and D to open, with the result that the pushing side of jack 11 is connected to the return line 19 instead of to the pressure supply line 18 (so that pressure in line 21 is lost) and that the pulling side of jack 9 is connected to the pressure supply line 18 instead of to the return line 19. The pulling side of jack 9 is connected to the jack-contracting side of jack 11 by conduit 34 with the result that the jack 11 immediately fully contracts and valve 10 closes.

Line 34 which is now pressurised from valve unit D is connected to valve unit F as well as to jack 9, and valve unit F is opened by pressure in line 34 with the result that the props 7 are released from the roof. The master roof support 4 moves forward and when it is fully forward, that is to say when the jack 9 becomes fully contracted, an arm 47 carried by the piston rod 14 of the jack 9 engages an actuating rod 48 and causes the opening of a prop re-setting valve 49 connected to line 34. The opening of valve 49 causes the pressurisation from line 34 of a line 51 connected to line 37 and to a line 52 connected to valve unit F. The pressure in line 52 closes valve unit F, and the props 7 are reset against the roof by passage of hydraulic fluid through line 51, non-return valves 38 and lines 39.

When the pressure in the props 7 reaches a satisfactory value, this satisfactory pressure which is present in line 37 actuates a piston 54 to cause the control valve 45 to open. Fluid becomes trapped between piston 54, a non-return valve 53 and a locking valve 55, and thus control valve 45 is held in the open position.

The opening of the control valve 45 opens the pilot line 20 to the adjacent slave roof support 5 which then undergoes an advancing operation, and so on as previously described. The opening of control valve 45 also causes the pressurisation from pilot line 20 of a line 56 connected to valve unit D, and this pressure returns valve unit D and consequently valve unit B to the position shown in FIGURE 2.

If desired, the valve 10 can be opened, if the conveyor 1 fails to advance the necessary amount, by pressurisation to a predetermined value of a line 57 which extends along the mine and is connected to each valve 10 by a branch line 58 communicating with a piston 59 carried by the actuating rod 33. The pressurisation of line 57 may be manually controlled.

The line 57 is also connected by a branch line 61 to a piston 62 associated with the locking valve 55, such that pressurisation of line 57 to a predetermined value (higher than that required to open valve 10) actuates the pistons 62 to open locking valve 55, thus releasing the fluid trapped behind the piston 54 into a line 50 communicating with the return line 19 and allowing control valve 45 to close. This will be done when all the roof supports have advanced.

FIGURE 3 shows the valve assembly 17 of each slave roof support 5 which is similar to the valve assembly 16 of the master roof support 4 except that those parts associated with the conveyor-advancing jack 11 are omitted.

If desired, the valve assembly 16 or 17 may be operated manually by operation of the valve units A, B, C, D, E

and F. A hydraulic accumulator **63** prevents valve unit C from becoming hydraulically locked by pressure in pilot line **20**. When control valve **45** is shut, a conduit **64** in the piston rod associated with piston **54** brings the pilot line **20** on the downstream side of control valve **45** into communication with the line **50** and return line **19**. When the piston rod associated with piston **54** engages control valve **45** so as to open control valve **45**, the conduit **64** is closed by control valve **45**.

Instead of the described arrangement in which a valve **10** was associated with a jack of every fourth roof support, a jack of each roof support may have a value which closes the pilot line to its own roof support until the jack is fully extended.

We claim as our invention:

1. Mining apparatus including a series of advanceable roof supports, a guide means for a cutting machine, at least some of the roof supports having a fluid-pressure-operated jack means operable to apply an advancing force to the guide means, means for advancing each roof support, at least one fluid-pressure-operated prop incorporated in each roof support and operable to set the roof support against the mine roof, or to release the same preparatory to its advance, a control valve assembly operatively connected with each roof support and operable to control the supply of fluid under pressure to said prop, and also operable to control the supply of such fluid to said jack means, to cause the roof support to undergo and advancing operation following release of said prop, means for sending a fluid-pressure signal from each roof support to the control valve assembly of the next roof support to actuate the latter, at least some of the roof supports including sensing means responsive to the amount of advance of that portion of the guide means in front of the roof support to halt the advance of the series of roof supports at a predetermined position until such portion has been advanced by a predetermined amount relative to the roof support, each sensing means including a fluid-flow control valve associated with said jack means and operated by a predetermined advance of the jack means to allow the advance of the series of roof supports to continue.

2. Mining apparatus according to claim **1** including a device associated with each sensing means and which blocks the passage of the signal to a roof support until actuated by sensing means to unblock the passage of the signal.

3. Mining apparatus according to claim **2** wherein the signal-sending means sends a fluid-pressure signal and each device is a fluid-flow control valve.

4. Mining apparatus according to claim **1** wherein each sensing means of a roof support is connected to a preceding roof support to prevent advance of said preceding roof support until said portion of the guide means has been advanced by the predetermined amount.

5. Mining apparatus according to claim **1** wherein each sensing means is associated with its own roof support to prevent advance of its own roof support, and allow advance of the preceding roof supports, until said portion of the guide means has been advanced by the predetermined amount.

6. Mining apparatus according to claim **1** wherein means are provided to override the sensing means if said portion of the guide means fails to advance by the predetermined amount.

7. Mining apparatus according to claim **6** wherein the override means is fluid-pressure-operated.

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