May 7, 1968 J. CARNEGIE 3,381,581

ROOF SUPPORT ASSEMBLY HAVING ELECTRICALLY OPERATED SIGNALLING MEANS

Filed Oct. 11, 1965 2 Sheets-Sheet 1

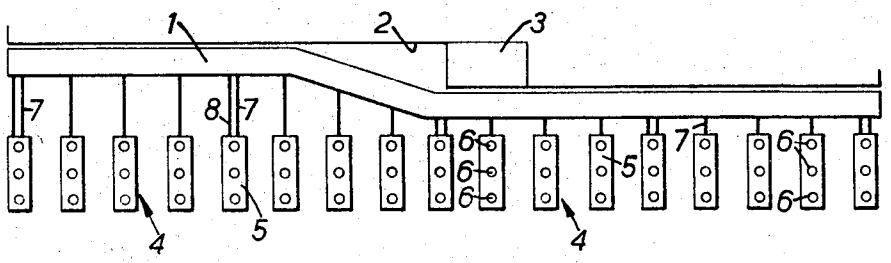


FIG. 1.

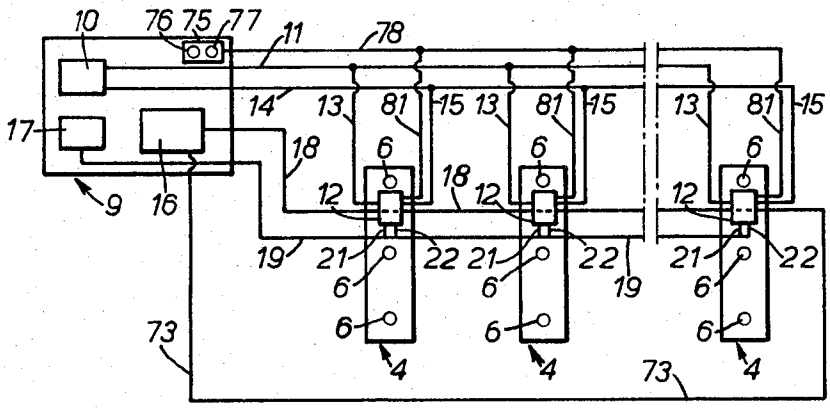


FIG. 2.

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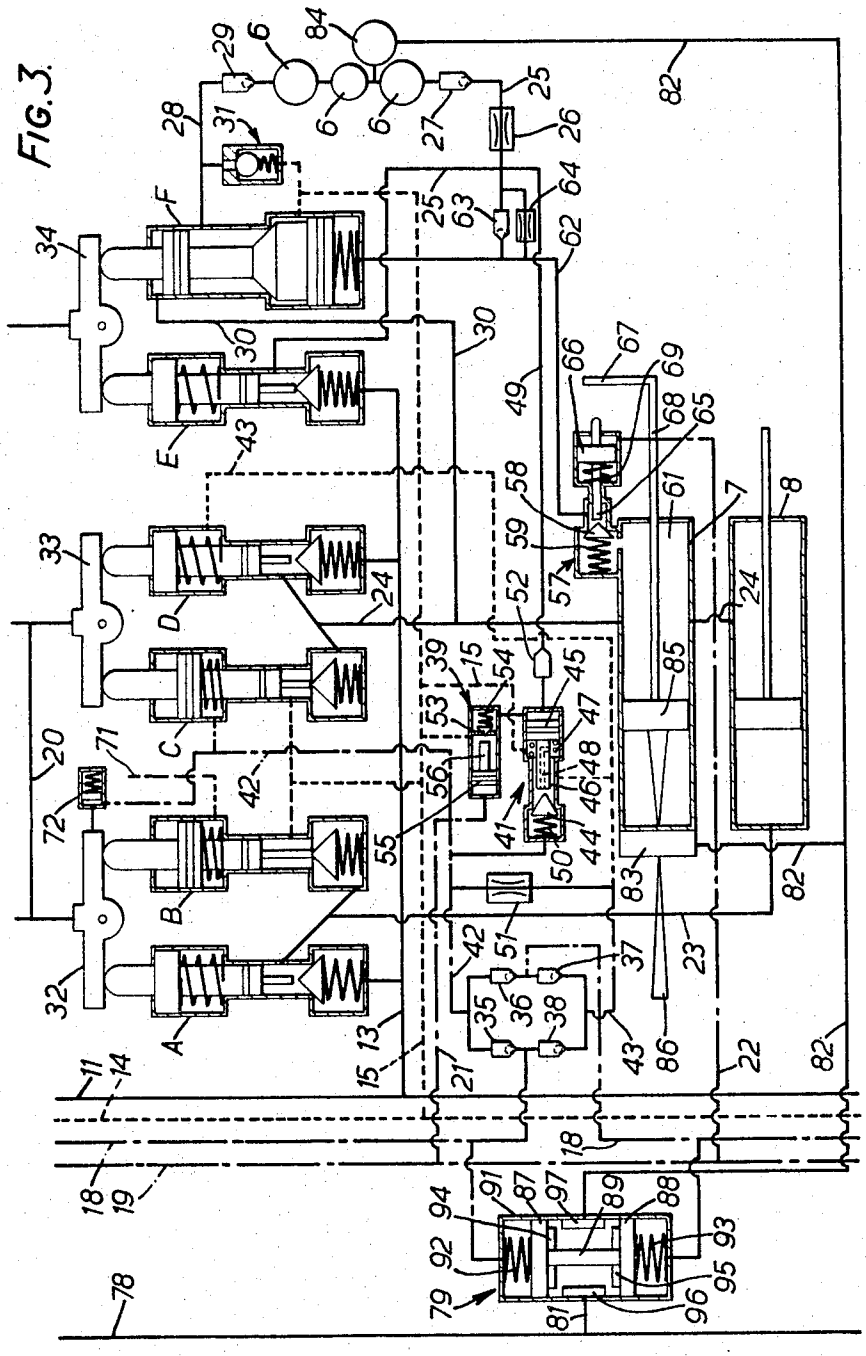
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FIG. 3.



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ROOF SUPPORT ASSEMBLY HAVING ELECTRICALLY OPERATED SIGNALLING MEANS

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Claims priority, application Great Britain, Oct. 12, 1964, 41,628/64
5 Claims. (Cl. 91—1)

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a mine roof support assembly which includes a series of fluid pressure operated advanceable roof supports. Such assemblies typically include means for providing fluid pressure for hydraulic advancement of the roof supports toward the mine face. This disclosure teaches a system for indicating to the operator the condition of successively advanced roof supports, each roof support having signaling means operable to give an electrical signal of a condition of the roof support. Electrically operated indicating means and a single electric signal conveying means are connected to all of the roof supports. Each roof support further includes switch means responsive to the means for providing fluid pressure and operable automatically to connect the signaling means of the roof support to the single signal conveying means upon occurrence of a change in fluid pressure associated with an advancing operation, whereby to cause the indicating means to indicate the condition of that roof support. Thus a single electric signal conveying means is connected sequentially to successive ones of the roof supports so that the operator knows the condition of each roof support as it is advanced. The assembly preferably includes signal line means interconnecting the switch means of adjacent roof supports, the means for providing fluid pressure having means associated with each of the roof supports and coupled with the signal line means to provide a first fluid pressure signal to the signal line means upon completion of the advancing operation of the associated roof support. The switch means of each roof support is responsive to the first fluid pressure signal sent along the signal line means from the previous roof support to connect the associated signaling means to the signal conveying means. The switch means of each roof support is also preferably responsive to its own first fluid pressure signal to disconnect its associated signaling means from the signal conveying means.

Summary and description of the invention

This invention relates to roof support assemblies, suitable for use in mines, and including fluid-pressure-operated advanceable roof supports.

In such roof support assemblies, the roof supports are usually advanced one at a time. It is frequently desirable, for example when the roof supports are remotely or automatically operated, to be able to indicate at a remote position information relating to a roof support which is undergoing an advancing operation. Such signalling of information from the roof supports to the remote position can conveniently be achieved electrically, and it is an object of this invention to provide an electrically-operated signalling arrangement which does not require a large number of wires travelling along the series of roof supports.

The present invention provides a roof support assembly including a series of fluid-pressure-operated advanceable roof supports, each roof support having signalling means operable to give an electric signal of a condition of the roof support, electrically-operated indicating means, and electric-signal-conveying means extending along the series of roof supports and connected to the indicating means, each roof support including switch means responsive to a change in fluid pressure indicative of an advancing operation or impending advancing operation of the roof support to connect the signalling means of the roof support to the signal-conveying means to cause the indicating means to indicate the said condition of the roof support.

The signalling means of each roof support will be disconnected from the signal-conveying means before or when the signalling means of the next roof support is connected to the signal-conveying means.

The switch means of each roof support may be responsive to a fluid pressure signal which is sent along a signal line from the previous roof support, on completion of its advancing operation, to the roof support to initiate its advancing operation, the occurrence of the signal causing the signalling means to be connected to the signal-conveying means. The switch means of each roof support may also be responsive to the fluid pressure signal sent along a signal line from the roof support, on completion of its advancing operation, to the next roof support to disconnect the signalling means from the signal-conveying means. Where the fluid pressure signal can travel along each signal line in either direction, the switch means of each roof support may be responsive to a pressure difference between the signal lines connected between one roof support and the adjacent roof supports such that, when there is no pressure difference, the signalling means is not connected to the signal-conveying means and, when there is a pressure difference, the signalling means is connected to the signal-conveying means. Thus initially there will be no fluid pressure signal in either signal line and therefore no pressure difference. When a fluid pressure signal is sent from the previous roof support to the roof support to initiate its advancing operation, a pressure difference will occur. Then when the roof support has completed its advancing operation, the fluid pressure signal is passed on to the next roof support and the pressure difference is reduced to a negligible value.

The switch means of each roof support may be responsive to a fluid pressure which occurs when its roof support commences or is about to commence an advancing operation and which is lost when the roof support has completed its advancing operation or a stage in its advancing operation, the occurrence of the fluid pressure causing the signalling means to be connected to the signal-conveying means and the loss of the fluid pressure causing the signalling means to be disconnected from the signal-conveying 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 advanceable roof supports, the hydraulic and electric connections being omitted,

FIGURE 2 is a diagrammatic view of part of the mining apparatus showing the hydraulic and electric connections between the power unit and the roof supports and,

FIGURE 3 is a diagrammatic view of the hydraulic valve assembly and signalling means of a roof support.

With reference to the accompanying drawings, the mining apparatus includes a snakeable conveyor **1** extending along the working face **2** of a coal mine, and a cutting machine **3** which travels along the working face **2** and is situated between the working face **2** and the conveyor **1**. The mining apparatus also includes an advanceable roof support assembly having a series of roof supports **4** located on the opposite side of the conveyor **1** to the working face **2** and cutting machine **3**. Each roof support **4**

includes a ground-engaging sole beam 5 carrying three hydraulically-operated telescopic props 6, and the three props 6 carry a roof beam (not shown). Each roof support 4 is connected to the conveyor 1 by a hydraulically-operated single-acting jack 7 for advancing the roof support 4 towards the conveyor 1. Some roof supports, for example every fourth roof support as shown, have a hydraulically-operated double-acting jack 8 for advancing the conveyor 1 relative to the roof supports 4. The jack 8 is not connected to the conveyor 1 and engages the conveyor 1 only when applying an advancing force to it.

The advanceable roof support assembly also includes a power unit 9 which has a main hydraulic pressure source 10 from which a line 11 supplying hydraulic fluid under pressure extends along the series of roof supports 4. Each roof support 4 has a valve block 12 connected to the supply line 11 by a branch supply line 13. A hydraulic fluid return line 14 also extends along the series of roof supports 4, and the valve block 12 of each roof support 4 is connected to the return line 14 by a branch return line 15.

The power unit 9 also includes two secondary hydraulic pressure sources 16, 17. A signal line 18 connected to the secondary pressure source 16 is connected to the valve block 12 of the first roof support 4 and a similar signal line 18 is connected between the valve blocks 12 of adjacent roof supports. A control line 19 extends from the secondary pressure source 17 along the series of roof supports 4, and the valve block 12 of each roof support 4 is connected to the control line 19 by branch control lines 21, 22.

As shown in FIGURE 3, the valve block 12 of each roof support 4 with a double-acting jack 8 includes a first valve assembly which has six valve units A, B, C, D, E and F. Valve unit A controls the supply of hydraulic fluid to the jack 8 in a jack-extending sense, and is connected to the branch supply line 13 and to a line 23 leading to the jack 8. Valve unit B is connected to the line 23 and to the branch return line 15.

Valve unit D controls the supply of hydraulic fluid to the jacks 7 and 8 in a jack-contracting sense, and is connected to the branch supply line 13 and to a line 24 leading to jacks 7 and 8. Valve unit C is connected to the line 24 and to the branch return line 15.

Valve unit E controls the supply of hydraulic fluid to the props 6 when it is desired to set the props 6 by manual operation. Valve unit E is connected to the branch supply line 13 and to the props 6 through a line 25 including a restrictor 26 and a non-return valve 27. Valve unit F controls the release of hydraulic fluid from the props 6, and is connected to a line 28 leading from the props 6 and to the branch return line 15. The line 28 includes a non-return valve 29, and a pressure relief valve 31 is connected in parallel with the valve unit F between the line 28 and the branch return line 15. Line 24 is connected to valve unit F by line 30 in such a manner that pressurisation of lines 24 and 30 opens valve unit F.

The valve units A and B are associated with a pivotally-mounted lever 32 which is connected to a similar lever 33 associated with the valve units C and D. The levers 32, 33 co-ordinate the action of valve units A, B, C and D. In those roof supports 4 without a double-acting jack 8, valve units A and B and lever 32 are omitted. The levers 32, 33 are ganged to one another by a connection 20. Valve units E and F are associated with a pivotally-mounted lever 34. If desired, the first valve assembly can be operated manually by operation of levers 32, 33 and 34.

The valve block 12 of each roof support 4 also includes a second valve assembly including four non-return valves 35, 36, 37 and 38, an unlocking valve 39 and a control valve 41. The four non-return valves 35, 36, 37, 38 are connected together in the manner shown in FIGURE 3. The signal line 18 connected to the adjacent left hand roof support is connected to the ring of non-return valves 35, 36, 37, 38 in such a manner that fluid arriving from the adjacent left hand roof support along signal line 18 can flow through non-return valve 35 only and pass into a line 42 connected to valve unit C and to the control valve 41. The signal line 18 connected to the adjacent right hand roof support is connected to the ring of non-return valves in such a manner that fluid arriving from the right hand roof support along signal line 18 can flow through non-return valve 36 only and pass into the line 42. A line 43, whose other connections will be described in more detail later, is connected to the ring of non-return valves in such a manner that fluid under pressure in line 43 can pass through non-return valve 38 into signal line 18 leading to the adjacent left hand roof support and can also pass through non-return valve 37 into signal line 18 leading to the adjacent right hand roof support.

The control valve 41 includes a valve closure member 44 biased towards a closed position by a spring 50. In the closed position, valve member 44 prevents free communication of line 42 with line 43. Control valve 41 also includes a piston 45 carrying a piston rod 46. A spring 47 acting on piston 45 urges the piston rod 46 away from the valve closure member 44. The piston rod 46 has a passage 48 extending from its free end to a position adjacent the piston 45 where it communicates with the branch return line 15. In the position shown in FIGURE 3, piston rod 46 is spaced from the valve closure member 44 and the line 43 is in communication with the branch return line 15 through passage 48 in the piston rod 46.

Piston 45 can be urged towards valve closure member 44, by a predetermined fluid pressure in a line 49 connected to line 25, to cause piston rod 46 to engage valve closure member 44, which then blocks passage 48 and so isolates line 43 from the branch return line 15, and to force valve closure member 44 off its seat to bring line 42 into communication with line 43. This will be further described later. A restrictor 51 is connected in parallel with control valve 41 between lines 42 and 43.

Line 49 includes a non-return valve 52 which traps fluid between piston 45 and locking valve 39. Locking valve 39 includes a valve closure member 53 urged to a closed position by a spring 54. The locking valve 39 also includes a piston 55 and piston rod 56, and a sufficient fluid pressure applied to piston 55 along control line 19 and branch control line 21 causes the piston 55 to move towards valve closure member 53 so that piston rod 56 engages the valve closure member 53 and moves it to the open position to allow fluid trapped against piston 45 by non-return valve 52 to escape to the branch return line 15.

The first valve assembly of the valve block 12 also includes a prop re-setting valve 57 associated with the jack 7. The re-setting valve 57 includes a valve closure member 58 urged to a closed position by a spring 59 to isolate a chamber 61 in the jack 7 from a line 62. Line 62 is connected to valve unit F and to line 25 through a non-return valve 63 and through a restrictor 64 in parallel with the non-return valve 63. A piston rod 65 carrying a piston 66 can be moved to engage valve closure member 58 and move it to the open position, as the jack 7 becomes fully contracted, by a trip 67 carried by the piston rod 68 of the jack 7. A spring 69 urges the piston 66 away from the valve closure member 58. The branch control line 22 is connected to the prop re-setting valve 57 and, when the control line 19 and branch control line 22 have been pressurised to a predetermined value, lower than the pressure required to open locking valve 39, the hydraulic pressure acts on piston 66 to move the piston 66 and piston rod 65 in the same manner as if this had been moved by trip 67. The prop re-setting valve 57 may be self-latching by arranging that, when the valve closure member 58 has been moved to the open position, the hydraulic pressure in line 62 maintains the valve closure member 58 in the open position.

The power unit 9 also includes an electrically-operated indicating means 75 having two indicators 76, 77 of the type in which a pointer moves angularly over a dial. The indicators 76, 77 are connected to electric-signal conveying means in the form of wires 78 which extend along the series of roof supports. To avoid complicating the drawings, the wires 78 have been shown as a single line. Each roof support 4 includes switch means 79 connected to the wires 78 by a branch wire 81. The switch means 79 is also connected by wires 82 to a rotary electrical potentiometer 83 and to the potentiometer 84 associated with the props 6. Again, to avoid complication, wires 82 have been shown as a single line.

The potentiometer 83 is adjusted by the jack 7 in such a manner that the potentiometer 83 will give an electrical signal indicative of the length of the jack 7. The piston 85 of the jack 7 carries a suitably twisted strip 86 passing through a slot (not shown) in the potentiometer 83, such that a change in length of the jack 7 adjusts the potentiometer 83 accordingly. The potentiometer 84 is responsive to the fluid pressure in the props 6 such that the potentiometer 84 will give an electric signal indicative of the fluid pressure in the props 6.

The switch means 79 includes two pistons 87, 88 connected by a piston rod 89 and slidable in a cylinder 91. Piston 87 is acted upon by a spring 92 and piston 88 is acted upon by a spring 93 such that the springs 92, 93 urge the pistons 87, 88 to a position in which they are spaced equally from their adjacent ends of the cylinder 91. The pistons 87, 88 carry electrical contacts 94, 95 respectively. On the inside of the cylinder 91 at a position half-way along its length are spaced contacts 96, 97. Each contact 96 is connected to one of the wires 81, and each contact 97 is connected to one of the wires 82.

The end portion of the cylinder 91 adjacent piston 87 is connected to the signal line 18 connected to the adjacent left hand roof support, and the end portion of the cylinder 91 adjacent piston 88 is connected to the signal line 18 connected to the adjacent right hand roof support. If neither signal line 18 is pressurised or if both signal lines 18 are pressurised, the pistons 87, 88 will be in the positions shown in FIGURE 3 and wires 81 will not be connected to wires 82. If only one of the signal lines 18 is pressurised, the appropriate piston 87 or 88 will be moved by the hydraulic pressure such that the contacts 94 or 95 bridge the respective contacts 96, 97 such that each wire 81 is connected to the respective wire 82. The number of contacts 94, 95, 96 and 97 depends of course upon the number of wires 78, 81 and 82.

FIGURE 1 shows the cutting machine 3 travelling from left to right along the working face 2. Every roof support is set against the roof and, after the cutting machine 3 has passed the first few roof supports 4 in the series, it is necessary to advance the conveyor 1 in front of the roof supports 4 and then to advance the roof supports 4. Each roof support 4 having a conveyor-advancing jack 8 is operated in turn to cause the jack 8 to apply an advancing force to the conveyor 1, the roof support 4 being set against the roof and acting as an anchorage. This is achieved by pivoting lever 32 in an anti-clockwise direction to open valve unit A and allow valve unit B to close, thus pressurising line 23 and the pushing side of jack 8. This movement of lever 32 may be caused by manual operation of lever 32 or by pressurisation of a line 71 connected to valve unit B. Pressurisation of line 71 may be controlled by a manually-operated valve or by an automatically-operated valve, for example a valve operated by the cutting machine 3 as it travels along the working face 2. After the lever 32 has been pivoted in the anti-clockwise direction to cause the jack 8 to be pressurised in the conveyor-advancing sense, a spring-operated latch 72 holds the lever 32 in this position. The anti-clockwise movement of lever 32 causes a similar movement of lever 33, but such movement does not change the state of valve units C and D from that shown in FIGURE 3. The latch 72 is connected to line 42 in such a manner that pressurisation of line 42 releases the latch 72 to allow valve unit A to close and return lever 32, valve unit B and lever 33 to the position shown in FIGURE 3.

In practice, several jacks 8 will be pressurised in turn, and when the first portion of the conveyor 1 has been advanced in a snaking manner, as shown in FIGURE 1, the advance of the roof supports 4 can then be commenced. The pressure source 16 in power unit 9 is then operated to pressurise the signal line 18 leading to the first roof support 4. Referring now to FIGURE 3, the hydraulic pressure signal reaches the roof support along the portion of signal line 18 shown in the upper left hand part of FIGURE 3. The hydraulic pressure signal acts upon piston 87 in the switch means 79 to cause contacts 94 to bridge contacts 96 and 97. Thus the indicators 76, 77 at the power unit 9 indicate the length of the jack 7 and the pressure in the prop 6 of the roof support which is about to advance.

The hydraulic pressure signal in line 18 also passes non-return valve 35 and pressurises line 42. Pressurisation of line 42 first releases latch 72 and then operates on valve unit C to cause clockwise movement of levers 33 and 32. As a result, valve unit A closes, valve unit B opens, valve unit C closes, and valve unit D opens, Thus the pushing or jack-extending side of jack 8 is connected to the branch return line 15, and the jack-contracting sides of the jacks 7 and 8 are connected through line 24 and valve unit D with the branch supply line 13.

The conveyor-advancing jack 8 is not actually connected to the conveyor 1 but merely pushes against the conveyor 1 when applying an advancing force to it. Therefore, at this stage, jack 8 contracts and plays no part in advancing the roof support. The jack-extending side of jack 7 is permanently connected to the atmosphere.

Since line 24 is also connected by line 30 to valve unit F, the pressurisation of line 24 causes valve unit F to be opened to bring the line 28 into communication with the branch return line 15, thus releasing the hydraulic pressure in the props 6 and so releasing the roof support 4 from the roof. The jack 7 then contracts and advances the roof support 4 towards the conveyor 1 with the conveyor 1 acting as an anchorage. The consequent actuation of the potentiometers 83, 84 adjusts the indicators 76, 77.

When the jack 7 is fully contracted, or in other words when the roof support 4 is fully advanced up to the conveyor 1, the trip 67 on the piston rod 68 of the jack 7 engages the piston rod 65 and opens the resetting valve 57. The line 62 is therefore brought into communication with the main supply line 11 through the branch supply line 13, valve unit D, line 24, jack 7 and re-setting valve 57. The pressure in line 62 acts upon valve unit F to close it, and then passes non-return valve 63, restrictor 26 and non-return valve 27 to extend the props 6 and so reset the roof support 4 against the roof, this being indicated on the appropriate indicator 76 or 77.

If the roof support 4 had failed to advance the full distance, trip 67 would not open the re-setting valve 57, but this could be done by pressurising control line 19 to the predetermined value.

The hydraulic pressure in line 62 is also present in line 49. When a satisfactory roof-supporting pressure is present in the props 6, as evidenced by a build-up of pressure in line 49 to a predetermined value, this pressure overcomes the force exerted by spring 47 in control valve 41 and moves piston 45 to the left. Thus piston rod 46 engages valve closure member 44, resulting in closure of passage 48 and isolation of line 43 from the branch return line 15, and moves valve closure member 44 to the open position to bring line 42 into communication with line 43, thus pressurising line 43.

The pressure in line 43 can pass through both non-return valves 37 and 38. However, the signal line 18 connected to the other side of valve 38 is already pressurised, so that fluid under pressure in line 43 passes through non-return valve 37 to pressurise the signal line 18 leading

to the next roof support 4 in the series, which is thus caused to undergo an advancing operation. The pressure in the last-mentioned signal line 18 acts upon piston 83 in the switch means 79 to return the pistons 87, 88 to the positions shown in FIGURE 3, thus breaking the connections between wires 81 and 82.

The pressure in line 43 also acts upon value unit D to cause valve unit D, levers 33 and 32 and valve unit C to return to the position shown in FIGURE 3. Thus, pressure is lost in lines 24, in chamber 61 of jack 7 and in line 62. Also pressure in line 25 and in the portion of line 49 between non-return valve 52 and line 25 can drain through restrictor 64 into line 62.

Control valve 41 remains in the open position independently of any loss in pressure from the pressure source 16, since piston 45 is held by fluid trapped under pressure between piston 45, non-return valve 52 and locking valve 39.

When every roof support 4 has advanced, the pressure source 16 in the power unit 9 is switched off, and the control line 19 is pressurized to a value sufficient to open the locking valve 39 and release the trapped fluid into branch return line 15. The control valves 41 then return to their original positions, and line 43 of each roof support again becomes connected to the branch return line 15 through passage 48 in piston rod 46. Thus, the pressure in signal line 18 and line 42 can leak away through the restrictor 51 into the line 43.

While a roof support 4 is undergoing an advancing operation, line 43 cannot become pressurised before control valve 41 is operated by a predetermined pressure in line 49, since the small flow of fluid through the restrictor 51 from line 42 into line 43 is lost through the passage 48 in piston rod 46 to the branch return line 15.

With the ring of non-return valves 35, 36, 37, 38, the advancing sequence can travel along the series of roof supports 4 in either direction, that is to say either from left to right as described, or from right to left. If an advancing sequence from right to left is required, pressure source 16 is operated to pressurise a signal line 73 connected to the position between non-return valves 36 and 37 of the last roof support at the right hand end of the series. Referring to FIGURE 3, it will be seen that pressurisation of signal line 18, whether from the adjacent left hand roof support or from the adjacent right hand roof support, causes the pressure signal to pass non-return valve 35 or 36 respectively and pressurise line 42. Line 42 may therefore be referred to as an "advance-start" line whose pressurisation causes the roof support to undergo an advancing operation. When a roof support has completed its advancing operation, as evidenced by a satisfactory build-up of pressure in the props 6, control valve 41 is operated to cause pressurisation of line 43. This pressure signal in line 43 passes non-return valve 37 or 38 to pressurise the signal line 18 not previously pressurised and so cause the advance of the next roof support 4 in the series.

Besides assisting in the draining of signal line 18 and line 42 when all the roof supports 4 have advanced, the presence of restrictor 51 also enables the advance of the roof support 4 to be stopped part-way through the advancing operation, by switching off the power source 16 or opening a signal line 18 to return, since pressure in line 42 will then drain away through resistor 51, and valve units C and D will return to the positions shown in FIGURE 3.

Thus, as each roof support 4 undergoes an advancing operation, information regarding the pressure in its props 6 and the length of its jack 7 (which indicates the position of the roof support 4 relative to the conveyor 1) is received at the power unit 9. A relatively few number of wires 78 travelling along the mine are required since the same wires 78 are utilised for each roof support.

Instead of the switch means 79 being actuated by the pressure difference between the two signal lines 18, the switch means 79 could be arranged to be responsive to pressure in lines 24 or 30, since pressure in these lines occurs as the roof support starts its advancing operation and is lost as the roof support finishes its advancing operation.

The potentiometers 83, 84 of each roof support 4 may be given a different characteristic from the potentiometers 83, 84 of the other roof supports, and the indicating means 75 may include means for discriminating between the characteristics in such a manner that the indicating means 75 indicates to which roof support it is connected. The different characteristics of the potentiometers 83, 84 may be obtained by the use of resistances of suitable values in parallel with the potentiometers.

What is claimed is:

1. A roof support assembly including a series of fluid-pressure-operated advanceable roof supports, means for providing fluid pressure to advance said roof supports, each roof support having signalling means operable to give an electrical signal of a condition of the roof support, electrically-operated indicating means, and a single electric-signal-conveying means connected to all of said roof supports and to said indicating means, each roof support further including switch means responsive to said means for providing fluid pressure and operable automatically to connect the signalling means of said roof support to said signal-conveying means upon occurrence of a change in fluid pressure associated with an advancing operation to cause said indicating means to indicate the condition of said roof support.

2. A roof support assembly according to claim 1 including signal line means interconnecting the switch means of adjacent roof supports; said means for providing fluid pressure having means associated with each of said roof supports and coupled with said signal line means to provide a first fluid pressure signal to said signal line means on completion of the advancing operation of the associated roof support, and wherein the switch means of each roof support is responsive to a said first fluid pressure signal sent along said signal line means from the previous roof support to connect the associated signalling means to the signal conveying means.

3. A roof support assembly according to claim 2 wherein the switch means of each roof support is also responsive to its own said first fluid pressure signal to disconnect its associated signalling means from the signal-conveying means.

4. A roof support assembly according to claim 3 wherein said fluid pressure signals can travel along said signal line means in either direction, and the switch means of each roof support is responsive to a pressure difference between its fluid pressure signal means and that of the adjacent roof supports such that, when there is no pressure difference, the signalling means thereof is not connected to the signal-conveying means and, when there is a pressure difference, the signalling means thereof is connected to the signal-conveying means.

5. A roof support assembly according to claim 1 wherein the switch means of each roof support disconnects the associated signalling means from said electric-signal-conveying means upon completion of the advancing operation of its roof support.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,381,581 May 7, 1968

James Carnegie

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, lines 4 and 5,'"Black Sails," Greenway Lane, Charlton Kings, Cheltenham, Gloucester, England' should read -- Cheltenham, Gloucester, England, assignor to Dowty Electrics Limited --.

Signed and sealed this 23rd day of September 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents