Nov. 16, 1965 D. H. H. BOLTON ETAL 3,217,608

MINING APPARATUS

Filed Oct. 15, 1964 2 Sheets-Sheet 1

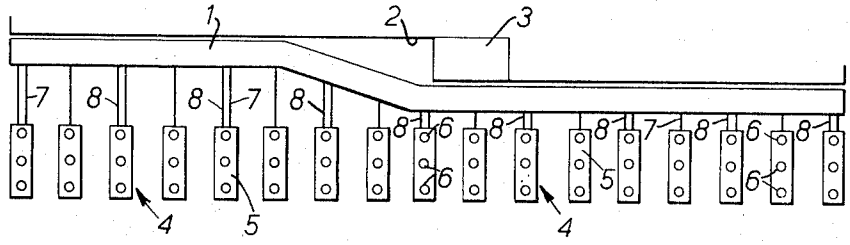

FIG. 1.

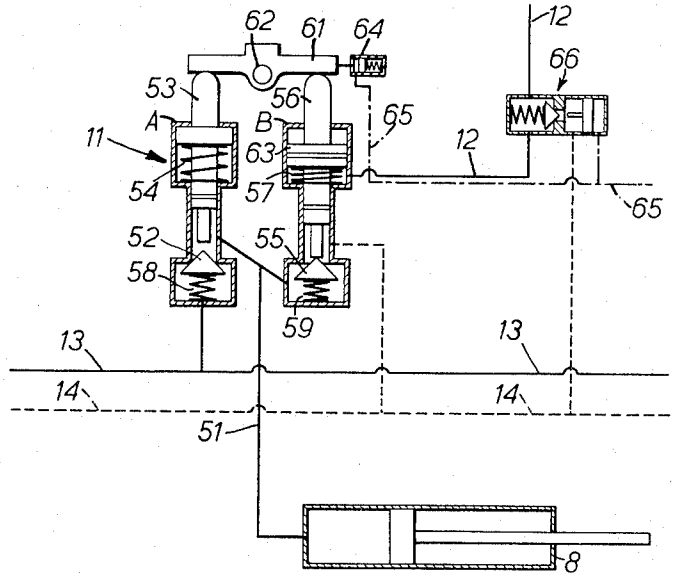

FIG. 3.

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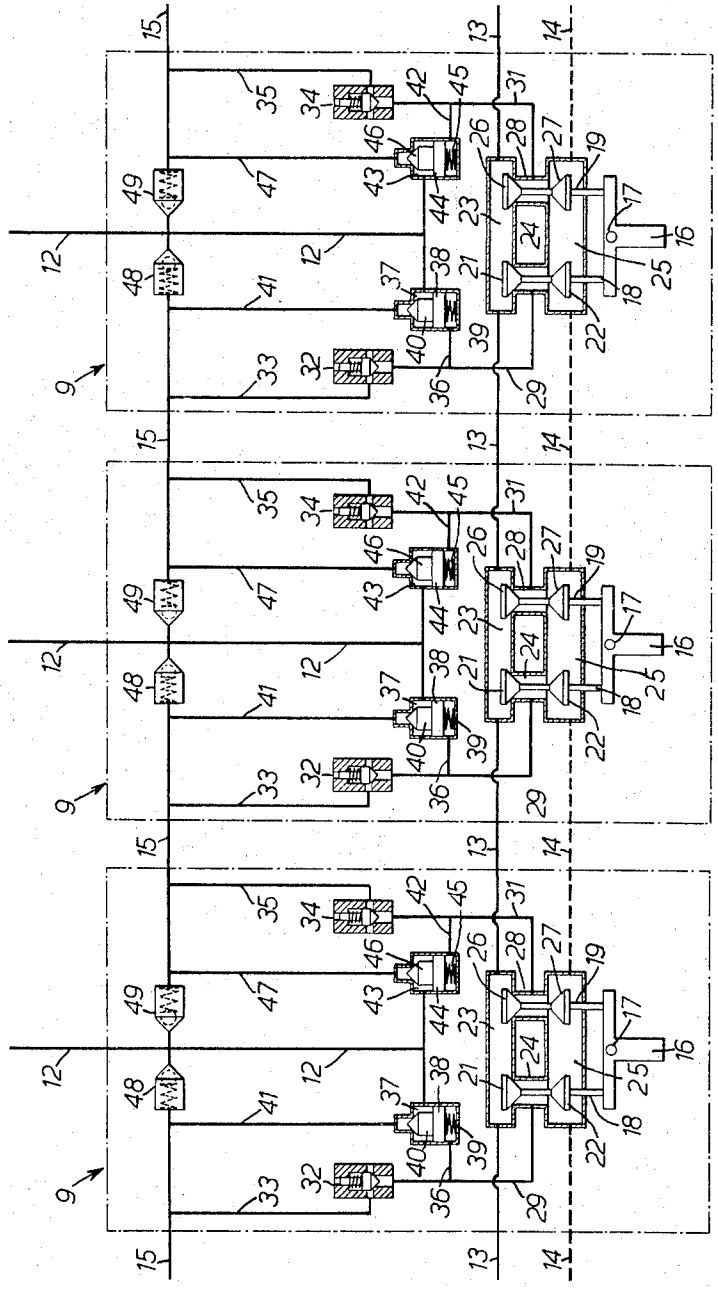

FIG. 2.

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United States Patent Office 3,217,608 Patented Nov. 16, 1965

3,217,608

MINING APPARATUS

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Filed Oct. 15, 1964, Ser. No. 404,060
Claims priority, application Great Britain, Oct. 16, 1963, 40,892
2 Claims. (Cl. 91—412)

This invention relates to mining apparatus including a conveyor extending along the working face of a mine and a series of fluid-pressure-operated conveyor-advancing devices spaced along the length of the conveyor.

The present invention provides mining apparatus including a conveyor extending along the working face of a mine and a series of fluid-pressure-operated conveyor-advancing devices spaced along the length of the conveyor, each device being associated with a valve assembly, each valve assembly being connected to its adjacent valve assembly by a conduit and including a pressure reducing valve through which fluid flows when passing from one conduit to another, each pressure reducing valve being arranged to reduce fluid pressure by a predetermined amount, each valve assembly being responsive to the attainment of a predetermined fluid pressure in a conduit connected to it to cause the device associated with the valve assembly to be operated, and each valve assembly being operable to pressurise the conduit connected to it to such a value that sufficient fluid pressure reaches a predetermined number of adjacent valve assemblies to cause operation of their devices.

Each valve assembly may be operable in one manner to pressurise the conduit leading to the adjacent valve assembly in one direction along the series without causing pressurisation of the conduit leading to the adjacent valve assembly in the other direction along the series, and operable in another manner to pressurise said second-mentioned conduit without causing pressurisation of said first-mentioned conduit.

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 a mining apparatus including a series of roof supports and a conveyor extending along the working face of a mine,

FIGURE 2 is a hydraulic circuit diagram showing the hydraulic selector circuits associated with three conveyor-advancing jacks, and

FIGURE 3 is a hydraulic circuit diagram showing the hydraulic actuating circuit associated with a conveyor-advancing jack.

With reference to the accompanying drawings, mining apparatus includes a snakable 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 including 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-operable 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-operable single-acting jack 7 for advancing the roof support 4 towards the conveyor 1, and some of the roof supports 4, for example each alternate roof support as shown, each have a hydraulically-operable single-acting jack 8 for advancing the conveyor 1 relative to the roof supports 4. The jacks 8 are not connected to the conveyor 1, but are capable of exerting a pushing force against it.

This invention is concerned with the manner in which the conveyor-advancing jacks 8 are actuated to cause them to apply an advancing force to the conveyor 1. The props 6 of roof supports 4 and the support-advancing jacks 7 may be controlled in any suitable manner for example, in the manner described in U.S. application Serial No. 360,882, filed April, 20, 1964.

Each roof support 4 with a conveyor-advancing jack 8 has a valve assembly including a jack-selector assembly 9 and jack-actuating assembly 11. Three adjacent selector assemblies 9 are shown in FIGURE 2 and an actuating assembly 11 is shown in FIGURE 3. Each selector assembly 9 is connected to its associated actuating assembly 11 by an actuating line 12.

As will be later described, each jack 8 is actuated in a conveyor-advancing manner when a predetermined fluid pressure occurs in its actuating line 12 and operates its actuating assembly 11. Firstly, however, the operation of the selector assemblies 9 will be described with reference to FIGURE 2.

Each selector assembly 9 is connected to main hydraulic pressure and return lines 13, 14 respectively which extend along the series of roof supports 4, and each selector assembly 9 is connected to its adjacent selector assembly 9 by a signal line 15.

Each selector assembly 9 includes a manually-operable handle 16 pivotally mounted on a fulcrum 17. The handle 16 controls two valve push rods 18, 19. The push-rod 18 carries two valve closure members 21, 22. The valve closure member 21 controls fluid flow between a chamber 23, connected to the pressure line 13, and a chamber 24. The valve closure member 22 controls fluid flow between chamber 24 and a chamber 25 connected to the return line 14. The push-rod 19 also carries two valve closure members 26, 27. The valve closure member 26 controls fluid flow between chamber 23 and a chamber 28, and the valve closure member 27 controls fluid flow between chamber 28 and chamber 25.

When the handle 16 is in its neutral position, shown in FIGURE 2, valve closure members 21, 26 isolate chambers 24, 28 respectively from the chamber 23 connected to the pressure line 13. Valve closure members 22, 27 allow communication between chambers 24, 28 respectively and chamber 25 connected to the return line 14. If the handle 16 is moved in a clockwise manner from its neutral position, push-rod 19 is not affected but push-rod 18 is moved to cause valve closure member 22 to isolate chamber 24 from chamber 25, and to cause valve closure member 21 to allow chamber 23 to communicate with chamber 24 with consequent pressurisation of chamber 24 and of a line 29 connected to chamber 24. Similarly, anti-clockwise movement of handle 16 from its neutral position does not affect push-rod 18, but push-rod 19 is moved with the result that chamber 28 isolated from chamber 25 and brought into communication with chamber 23 with resultant pressurisation of chamber 28 and of a line 31 connected to chamber 28.

In practice, the valve closure members 21, 22 and 26, 27 are so arranged that chambers 24 and 28 respectively are always isolated from chamber 25 connected to the return line 14 before they are brought into communication with chamber 23 connected to the pressure line 13. Thus, the pressure line 13 can never be "short-circuited" to the return line 14 through chamber 24 or chamber 28.

Line 29 is connected to one side of a non-return valve 32 whose other side is connected to a line 33 in such a manner that fluid can flow only from line 29 to line

33, which is connected to the signal line 15 extending to the adjacent left hand selector assembly 9. Similarly, line 31 is connected to one side of a non-return valve 34 whose other side is connected to a line 35 in such a manner that fluid can flow only from line 31 to line 35, which is connected to the signal line 15 extending to the adjacent right hand selector assembly 9.

Line 29 is connected by a line 36 to one end of a chamber 37 in which a piston 38 is slidably mounted. The piston 38 is urged by a spring 39 against a valve closure member 40 located on the opposite side of the piston 38 to the spring 39 and the connection of the line 36 to the chamber 37. Line 12 is connected to a portion of the chamber 37 on the opposite side of piston 38 to the spring 39, and the valve closure member 40 can isolate line 12 from a line 41 connected between the chamber 37 and the signal line 15 connected to the adjacent left hand selector assembly 9.

Similarly, line 31 is connected by a line 42 to a chamber 43 in which a piston 44 acted upon by a spring 45 is slidably mounted. The piston 44 is urged by the spring 45 against a valve closure member 46. Line 12 is also connected to chamber 43, and the valve closure member 46 can isolate line 12 from a line 47 connected between the chamber 43 and the signal line 15 connected to the adjacent right hand selector assembly 9.

Line 12 is connected to the signal line 15 leading to the adjacent left hand selector assembly 9 by a pressure reducing valve 48 which will pass fluid from line 12 to this signal line 15, such that the fluid pressure in this signal line 15 is reduced by a predetermined amount from the pressure in line 12. Similarly, line 12 is connected to the signal line 15 leading to the adjacent right hand selector assembly 9 by a pressure reducing valve 49 which will pass fluid from line 12 to this signal line 15 such that the fluid pressure in this signal line 15 is reduced by a predetermined amount from the pressure in line 12.

An actuating assembly 11 is shown in FIGURE 3 and includes two valve units A, B. Valve unit A is connected to the main pressure line 13 and by a line 51 to the jack 8, and includes a valve closure member 52 operable to isolate line 51 from the main pressure line 13. The valve unit A also includes a push rod 53 urged away from a valve-actuating position by a spring 54. Valve unit B is connected to the return line 14 and to line 51, and includes a valve closure member 55. The valve unit B also includes a push-rod 56 urged away from a valve-actuating position by a spring 57. Valve closure members 52, 55 are urged towards closure positions by spring 58, 59 respectively.

A lever 61 is pivotally mounted on a fulcrum 62 and opposite end portions engage push-rods 53, 56 respectively. In valve unit B, the push-rod 56 carries a piston 63 which is acted upon by the spring 57, and the signal line 15 is connected to valve unit B in such a manner that fluid under pressure in line 12 acts on piston 63 in the same sense as the spring 57.

In the position of the valve units A, B shown in FIGURE 3, valve unit A is isolating line 51 from pressure line 13, and valve unit B is allowing line 51 to communicate with the return line 14. If by operation of a selector assembly 11, as will be described later, a pressure of a predetermined value occurs in line 12, the pressure acts upon piston 63 and, with the assistance of spring 57, overcomes the force exerted by spring 54. As a result, push-rod 56 moves upwardly to allow spring 59 to move valve closure member 55 to a position in which line 51 is isolated from return line 14. Also, push-rod 56 moves lever 61 in an anti-clockwise manner to cause movement of push-rod 53, which then engages valve closure member 52 and moves it against the force exerted by spring 58 to a position in which line 51 is brought into communication with pressure line 13. Thus line 51 and jack 8 are pressurized, and the

jack 8 is actuated in an extending manner and applies an advancing force to the conveyor 1. When the lever 61 is moved in this anti-clockwise manner, a spring-operated latch 64 engages the lever 61 and retains it in this position, so that the jack 8 remains actuated in the conveyor-advancing manner even when the predetermined pressure in line 12 is subsequently lost. The latch 64 can be moved to a release position, to allow the lever 61 and valve units A, B to return to the position shown in FIGURE 3, by pressurisation of a hydraulic line 65 connected to the latch 64. The latch 64 will usually be released immediately before advance of the associated roof support for example, as in U.S. Serial No. 360,882, referred to above. Pressurization of line 65 also opens a valve 66, connected to line 12 and return line 14, to release the pressure in line 12.

Referring now to FIGURES 1 and 2, the selector assemblies 9 operate in the following manner. Assuming that an operator has reached the roof support 6 associated with the left hand selector assembly 9 in FIGURE 2, and that the cutting machine 3 is travelling from left to right along the face and is a sufficient distance past the operator, the operator moves the handle 16 in an anti-clockwise manner. Push-rod 18 is not affected but push-rod 19 is moved to cause chamber 28 to be isolated from chamber 25 and brought into communication with chamber 23 with the result that line 31 becomes pressurised from the pressure line 13.

Pressure in line 31 causes pressurisation of line 42 and the portion of chamber 43 on the side of piston 44 upon which spring 45 acts. The pressure in line 31 also passes non-return valve 34 to pressurise line 35 and the signal line 15 leading to the adjacent right hand selector assembly 9. Line 47 in the operated selector assembly 9 becomes pressurised from line 15, but cannot move valve closure member 46 and piston 44 because the similar pressure and spring 45 on the other side of piston 44 prevent such movement. When the pressure in signal line 15 reaches the adjacent right hand selector assembly 9, line 33 becomes pressurised but non-return valve 32 prevents flow to lines 29 and 36 which are in communication with a return line 14 through chambers 24 and 25. Also line 41 becomes pressurised and this pressure moves valve closure member 40 and piston 38 against the force exerted by spring 39 to pressurise line 12.

It is arranged that this pressure in line 12 is sufficient to operate the associated actuating assembly 11 with consequent operation of its jack 8 in a conveyor-advancing manner.

The pressure in line 12 also passes through pressure reducing valve 49 in such a manner that the signal line 15 leading to the next adjacent selector assembly 9 is pressurised to a value which is a predetermined amount lower than the pressure in line 12. The line 12 in this next adjacent selector assembly 9 thus becomes pressurised and, if the pressure is high enough, the associated actuating assembly 11 will be operated.

Thus the fluid pressure is passed along the respective signal lines 15 from one selector assembly to another at progressively reducing values and depending upon the pressure required to operate the actuating assemblies 11, a predetermined number of jacks 8 will be operated and latched in the conveyor-advancing manner.

If the mining operation is taking place in a right to left direction, the operator moves the handle 16 in a clockwise manner, with a consequent similar operation of other parts of the selector assemblies 9.

Assume, for example, that the pressure in the supply line 13, is 3,000 pounds per square inch, each pressure-reducing valve 48 or 49 reduces pressure by 750 pounds per square inch, and each actuating assembly 11 is operated only when pressure in the line 12 exceeds 1,400 pounds per square inch. When a handle 16 is operated, the full main pressure reaches the next selector assembly

whose associated actuating assembly **11** is operated. A pressure of 2,250 pounds per square inch reaches the next selector assembly whose associated actuating assembly **11** also operated. A pressure of 1,500 pounds per square inch reaches the next selector assembly **9** whose actuating assembly **11** is also operated. However, the pressure reaching the next selector assembly **9** is only 750 pounds per square inch and its associated actuating assembly **11** is therefore not operated. Therefore, manual operation of a selector assembly **9** causes operation of the three adjacent actuating assemblies **11** with resultant operation of the three adjacent jacks **8** in the conveyor-advancing manner.

In practice, of course, the manual operation of a selector assembly **9** will only cause operation of the third jack **8** since the first two jacks **8** will have been brought into operation by manual operation of the previous selector assembly **9**.

Although in the described embodiment only one jack **8** is associated with each selector assembly **9**, two or more jacks **8** may be associated with each selector assembly **9** if desired.

We claim as our invention:

1. Mining apparatus including a conveyor extending along the working face of a mine, a series of fluid-pressure-operated conveyor-advancing devices spaced along the length of the conveyor, a valve assembly associated with each device, and a conduit connecting each valve assembly to an adjacent valve assembly, each valve assembly including a pressure reducing valve through which

fluid flows when passing from one conduit to another conduit, each pressure reducing valve operating to reduce fluid pressure by a predetermined amount, each valve assembly including means responsive to the attainment of a predetermined fluid pressure in a conduit connected to it to cause the device associated with it to be operated, and each valve assembly including selecting means operable to pressurise the conduit connected to the valve assembly to such value that sufficient fluid pressure reaches a predetermined number of adjacent valve assemblies to cause operation of their conveyor-advancing devices.

2. Mining apparatus accordinig to claim **1**, wherein the selecting means of each valve assembly is operable in one manner to pressurise the conduit leading to the adjacent valve assembly in one direction along the series without causing pressurisation of the conduit leading to the adjacent valve assembly in the other direction along the series, and in another manner to pressurise said second-mentioned conduit without pressurising said first-mentioned conduit.

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