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ROOF SUPPORT ASSEMBLIES SUITABLE FOR USE IN MINES

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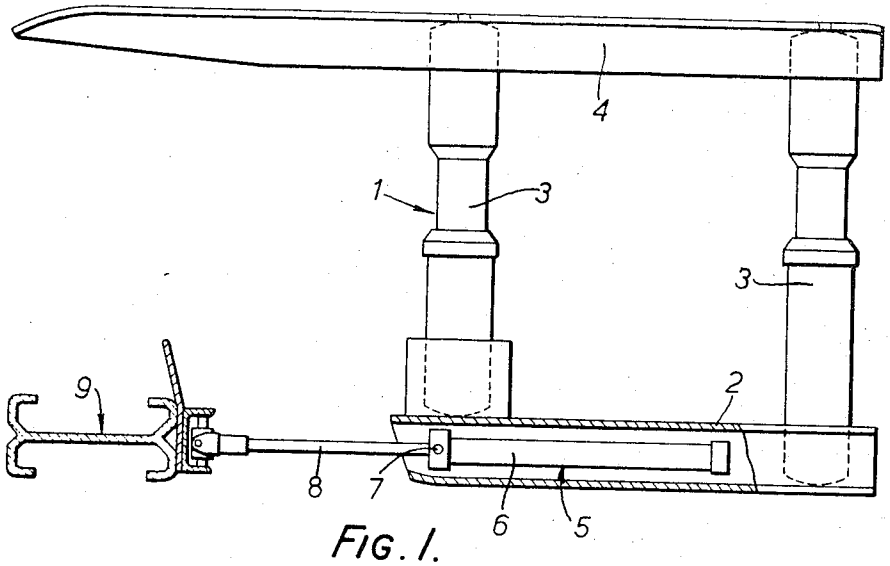


FIG. 1.

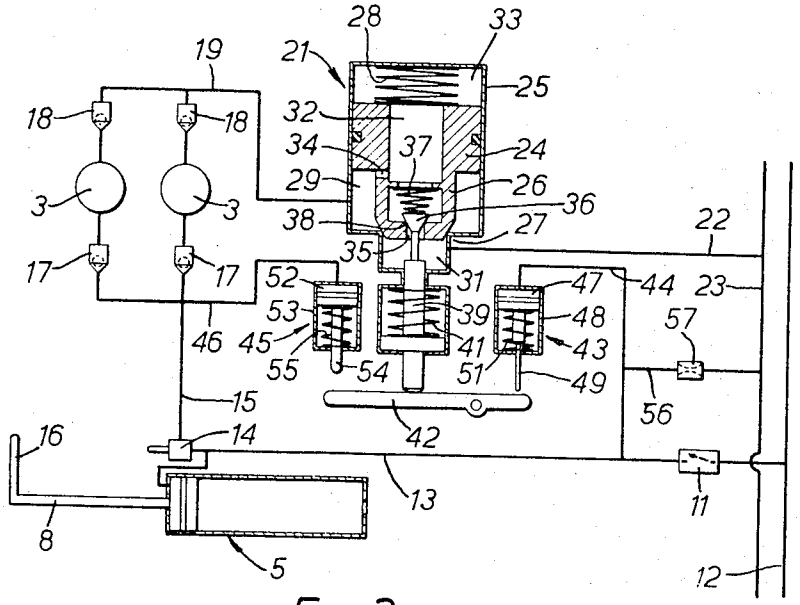


FIG. 2.

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ROOF SUPPORT ASSEMBLIES SUITABLE FOR USE IN MINES

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This invention relates to roof supports suitable for use in mines, for example coal mines.

Hydraulic prop means used to support the mine roof from the floor must be advanced periodically, and in order to do this the prop means of individual roof supports must be relieved of pressure, in order that they may advance. It is desirable, however, to reset the prop means, in order to support the roof, as soon as possible following an advance. The farther the roof-engaging beam has been moved from the roof, the more pumping is required to reengage it with the roof, and hence the longer time it takes to do so. Rapidity of resetting can therefore be effected by insuring that the roof beam moves only a short distance away from the roof when its prop means is relieved. Irregularities in the roof may interfere with advance, however, and further movement of the roof beam away from the roof may be necessary.

The valve that controls "collapse" of the roof beam, according to the present invention, is initially opened only through its pilot stage, for minimum collapse, and the prop then needs only to sustain the weight of the roof beam. The main stage of the valve remains closed. Should the roof beam in its advance engage an irregularity in the roof, and the pressure within the prop means be thereby increased, the main stage of the valve is opened; rapid flow of liquid from the prop means ensues, and the roof beam collapses further until it is just below the irregularity. Thereupon pressure within the prop means is stabilized and the main stage is reclosed. It follows that collapse of the roof support is only to the extent that the roof beam is never lowered by more than a minimum amount below the roof, and can be quickly raised and reset thereagainst, in the minimum of time.

The present invention provides a roof support including a fluid-pressure-operated prop carrying a roof-engageable member and carried by a floor-engaging member, first valve means operable to release the prop from a roof-supporting condition by allowing fluid to drain from the prop at a relatively slow rate, and second valve means responsive to fluid pressure in the prop to increase said rate when the fluid pressure in the prop is above a predetermined value.

The first valve means may include a pilot valve through which, when the pilot valve is open, fluid drains at the relatively slow rate, the second valve means including a main valve in parallel with the pilot valve, the main valve being opened by the attainment of a predetermined pressure drop across an orifice in series with the pilot valve and located between the prop and the main valve, and the predetermined pressure drop across the orifice occurring when the pressure in the prop is at the predetermined value.

The predetermined value may be equal to or slightly greater than the pressure in the prop when the prop is supporting the roof-engageable member and the roof-engageable member is not supporting the roof.

The roof support may include a fluid-pressure-operated jack operable to advance the roof support relative to an anchorage, the first valve means being operated by actuation of the jack in a support-advancing manner.

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 side view, partly in section, of a roof support secured to a conveyor, the hydraulic connections being omitted, and

FIGURE 2 is a diagram showing the hydraulic circuit of the roof support, incorporating the valve means of this invention.

With reference to the accompanying drawings, FIGURE 1 shows a roof support including a floor beam 2 carrying two hydraulically-operated telescopic props 3. The props 3 carry a roof beam 4. A hydraulically-operated single acting jack 5 has its cylinder 6 located within the floor beam 2 and pivotally connected thereto by a pin 7. The piston rod 8 of the jack 5 projects from the floor beam 2 and is pivotally connected to a conveyor 9 which extends along the working face of a mine. This jack 5 at the proper time effects advance of the roof support by reaction from the conveyor 9. In practice, a series of such roof supports will be provided in the mine.

The hydraulic circuit of the roof support is shown in FIGURE 2. A valve 11, operable manually or otherwise, valve 11 is connected to a main hydraulic pressure supply line 12 and is operable to connect the supply line 12 to a line 13. Line 13 is connected to the jack 5 such that pressurization of line 13 causes the jack 5 to contract, and thus to effect advance of the roof support. Line 13 is also connected to a valve 14 which, in the position shown in FIGURE 2, isolates the line 13 from a line 15 but which, when the jack 5 is fully contracted (as it would be by full advance of floor beam 2 towards the conveyor 9), is actuated by a projection 16 on the piston rod 8 to bring line 13 into communication with line 15. Line 15 is connected to each prop 3 through separate non-return valves 17.

The props 3 are connected through separate non-return valves 18 and a line 19 to a release valve assembly 21 which, in its closed position, isolates line 19 from a line 22 connected to a main return line 23. The release valve assembly 21 includes a main valve having a piston 24 slidable in a cylinder 25, a valve member 26 integral with the piston 24, and a valve seat 27 at one end of the cylinder 25. A spring 28 acting on the piston 24 urges the valve member 26 towards the valve seat 27.

The line 19 is connected to the variable-volume chamber 29 between the valve seat 27 and the piston 24. The line 22 is connected to a chamber 31 which is isolated from chamber 29 when valve member 26 is in engagement with valve seat 27. The valve member 26 and piston 24 together form a chamber 32 which communicates directly with the variable-volume chamber 33 on the opposite side of piston 24 to chamber 29. Chamber 32 also communicates through an orifice 34 in valve member 26 with chamber 29.

The valve member 26 has an orifice 35 extending from chamber 32 and hence by way of orifice 34 from chamber 29 to chamber 31. The orifice 35 is normally closed by a pilot valve 36, which is urged to its seat 38 by a spring 37. An actuating rod 39, aligned with pilot valve 36, is urged away from the latter by a spring 41. A pivoted lever engageable with the actuating rod 39 can be acted upon by a first hydraulically-operated actuator 43 connected by a line 44 to line 13, and by a second hydraulically-operated actuator 45 connected by a line 46 to line 15.

Actuator 43 includes a piston 47 slidably mounted in a cylinder 48, a piston rod 49 carried by the piston 47 and projecting from the cylinder 48, and a spring 51 urging the piston 47 and piston rod 49 to a retracted position. Pressurisation of line 44 causes piston 47 and piston rod 49 to move against the force exerted by the spring 51 such that piston rod 49 engages and pivots lever 42 in a

clockwise direction. Similarly, actuator **45** includes a piston **52** slidably mounted in a cylinder **53**, a piston rod **54** carried by the piston **52** and projecting from the cylinder **53**, and a spring **55** urging the piston **52** and piston rod **54** to a retracted position. Pressurisation of line **46** causes piston **52** and piston rod **54** to move against the force exerted by spring **55** in a manner which will be described later. Line **44** is connected to the return line **23** by a line **56** which includes a restrictor **57**.

The hydraulic circuit may also include a pressure relief valve arranged to relieve excess pressure in the props **3**. Such a valve is well-known and has not been shown in FIGURE 2.

Before each roof support can be advanced, the conveyor **9** is advanced relative to the roof support in some convenient manner, while the roof support is in a roof-supporting condition, so that the jack **5** becomes fully extended. To advance the roof support, valve **11** is actuated to cause pressurisation of line **13**. Pressurisation of line **13** actuates the jack **5** in a jack-contracting manner and also actuates the actuator **43** to cause clockwise movement of lever **42**. This movement of lever **42** causes movement of rod **39** which engages the pilot valve **36** and moves it off the valve seat **38**, thus opening the pilot valve. The props **3** are thus released from their roof-supporting condition since fluid escapes from the props **3** through non-return valves **18**, line **19**, orifice **34**, the pilot valve and line **22** to the return line **23**. Movement of rod **39** by the actuator **43** is not sufficient to cause the rod **39** to engage the main valve member **26**.

Initially, the pressure in the props **3** is high and hence the rate of flow of fluid through the orifice **34** is relatively high, thus causing a relatively large pressure drop across the orifice **34** and therefore across the piston **24**. This pressure drop causes movement of the piston **24** against the force exerted by the spring **28** and consequent movement of main valve member **26** away from the valve seat **27**, thus opening the main valve. Hence, fluid is lost from the props **3** at a relatively high rate, with resultant contraction of the props **3** and lowering of the roof beam **4**.

As the pressure in the props **3** falls, the pressure drop across the orifice **34** also falls and eventually becomes insufficient to maintain the main valve in an open condition, and the main valve thus closes. The pilot valve remains open. The main and pilot valves may be so constructed that the main valve opens whenever the pressure in the props rises above the prop pressure present when the props **3** are supporting the roof beam **4** and the roof beam **4** is not engaging the roof.

As the props **3** become released from the roof-supporting condition, the jack **5** contacts with consequent advance of the roof support towards the conveyor **9**, which acts as an anchorage. If the roof beam **4** re-engages the roof during an advance of the support, for example if the roof lowers, the pressure in the props **3** will rise and cause the main valve to re-open with consequent further collapse of the props **3** until the roof beam **4** is again released from the roof.

The pilot valve may be so constructed that, when only the pilot valve is open, the rate of lowering of the roof beam **4** is almost negligible, the only appreciable lowering of the roof beam **4** occurring when the main valve is also open.

When the roof support is fully advanced, the consequent full contraction of the jack **5** causes the projection **16** to actuate valve **14**, thus pressurising line **15** from line **13**. Pressurisation of line **15** results in operation of actuator **45** which returns lever **42** to the position shown in FIGURE 2. Spring **41** withdraws rod **39** from the pilot valve member **36**, and spring **37** moves valve member **36** to close the pilot valve. If the main valve was open, it would also close since there would then be no flow of fluid through orifice **34** and hence no pressure drop across piston **24**. Thus the release valve **21** closes completely. Also, pressurisation of line **15** results in resetting of the props **3**.

When the props **3** are reset, valve **11** is operated to isolate line **13** from the supply line **12**. The remaining pressure in lines **13**, **15**, **46** and **44** is lost through line **56** and the restrictor **57** to the return line **23**. Thus actuators **43**, **45** return to the positions shown in FIGURE 2.

If it is necessary to be able to release the props **3** from a roof-supporting condition without actuating the jack **5**, a manually-operable lever may be provided for causing movement of actuating rod **39** by an amount sufficient to open the main valve as well as the pilot valve.

I claim as my invention:

1. In a mine roof support having a fluid-pressure-operated prop means, a pair of members operable to engage the floor and the roof of the mine, respectively, when the pressure in the prop means is elevated to a given value, and a fluid-pressure-operated jack to advance the support in relation to an anchorage, the improvement comprising first valve means operable to relieve the pressure in the prop means at a relatively slow rate of relief, in response to actuation of the jack in a support advancing manner, and second valve means operable responsively to relieve the pressure in the prop means at a relatively high rate of relief, when the first valve means is in operation and the pressure in the prop means exceeds the value below the given value, at which the support was disengaged from the roof.

2. A mine roof support according to claim **1** wherein the first valve means includes a pilot valve which is interconnected with the prop means to relieve pressure fluid from the prop means, when open, and the second valve means includes a main valve which is arranged in parallel with the pilot valve to relieve pressure fluid from the prop means when the pilot valve is open and the pressure in the prop means exceeds the value below the given value, at which the support was disengaged from the roof.

3. A mine roof support according to claim **2** wherein there is an orifice in the interconnection between the pilot valve and the prop means, and the second valve means also includes a fluid-operated piston device which is operable to open the main valve at any pressure drop across the orifice above that at which the support was disengaged from the roof.

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