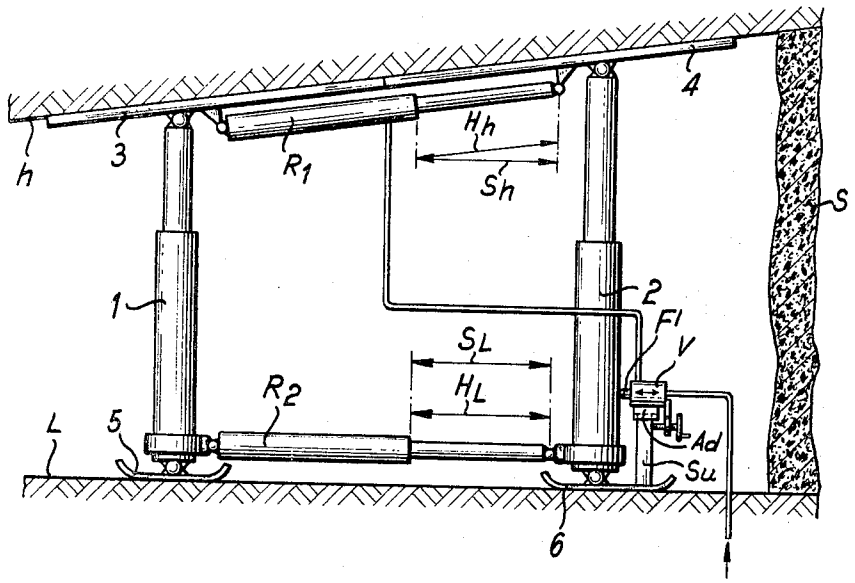
April 8, 1969 H. IRRESBERGER ET AL 3,436,922

MINE ROOF SUPPORTS

Filed Oct. 13, 1967

Sheet 1 of 3

FIG. 1



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Sheet 2 of 3

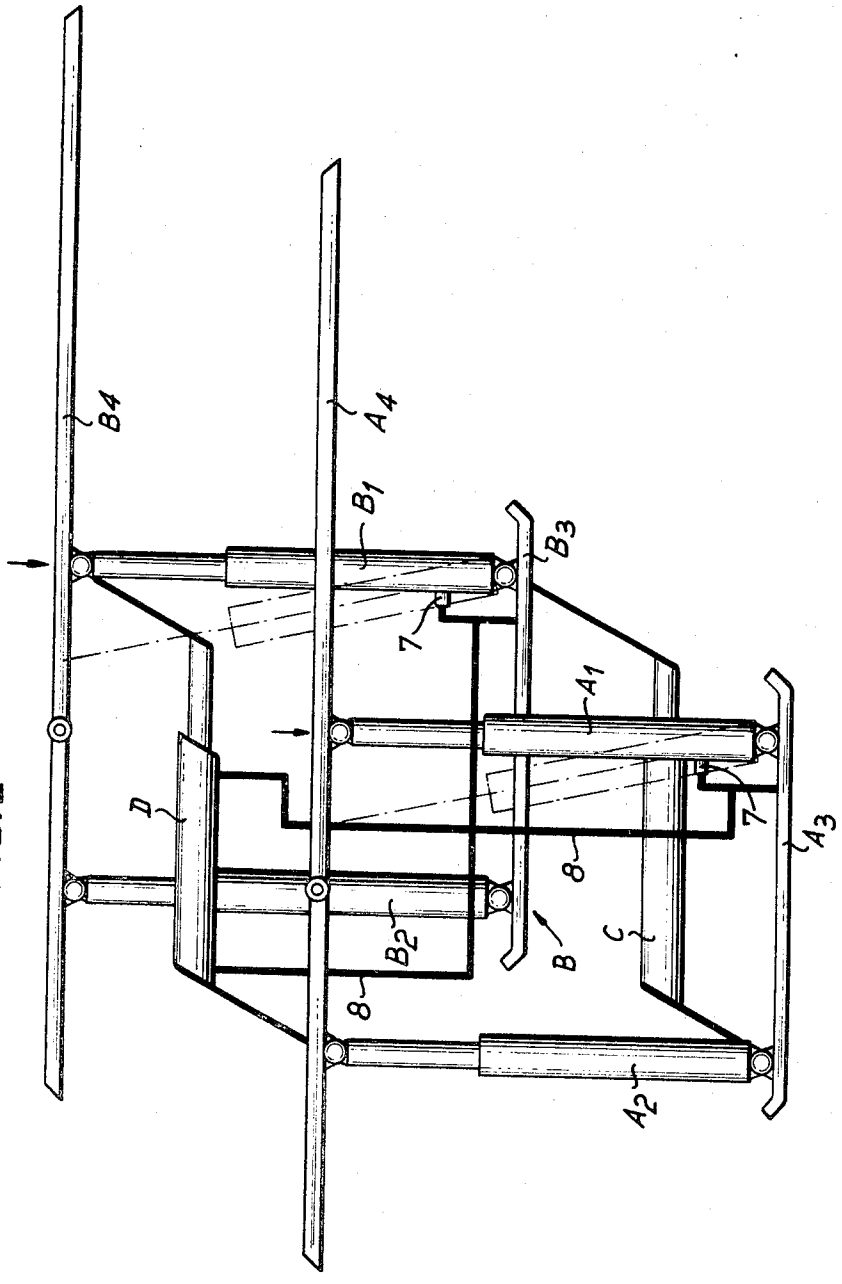


FIG. 2

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MINE ROOF SUPPORTS

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Sheet 3 of 3

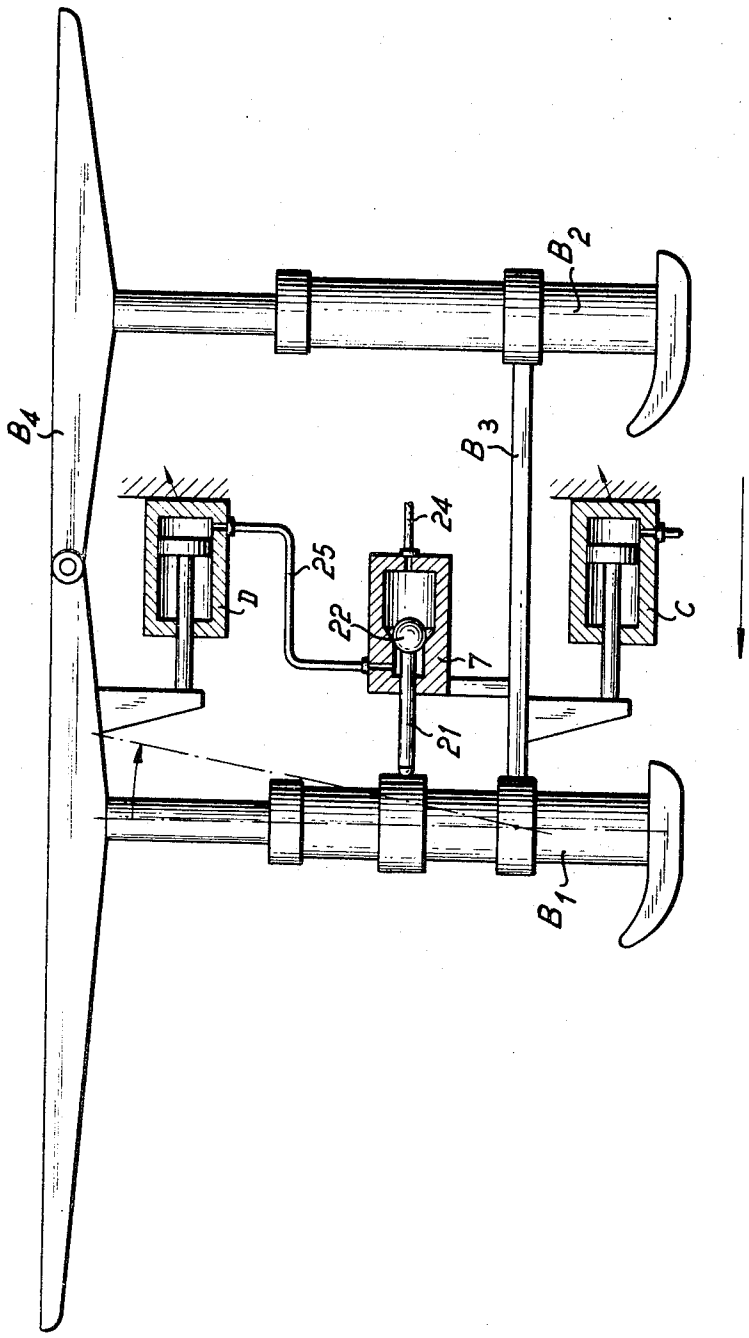


FIG. 3

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3,436,922

MINE ROOF SUPPORTS

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U.S. Cl. 61—45

3 Claims

ABSTRACT OF THE DISCLOSURE

The specification describes self-advancing mine roof supports with means for preventing angular misalignment of the vertical roof support cylinders, making use of a feeler which detects angular displacements of one of the cylinders and by means of a valve and hydraulic circuitry controls the relative advance of the top and bottom of the cylinders.

The present invention relates to mine roof supports, and more particularly to self-advancing mine roof supports of the type used in longwall coal mining and comprising frame parts engaging the mine roof and floor respectively and upper and lower advancing rams arranged respectively near the mine roof and near the mine floor.

Such a mine roof support with upper and lower advancing rams has the advantage that in some forms of construction operation of advancing can be carried out with the roof support cylinders under full or at least partial pressure. This is because the required advancing thrusts are developed at the top and bottom adjacent to the positions at which the thrusts are required. Advancing the support frame under pressure avoids damage to the rock of the roof which occurs when depressurisation is carried out. In mine roof supports of the type of which the invention is concerned, that is to say those with upper and lower advancing rams, it is important that the roof support cylinders should maintain a position perpendicular to the lie of the stratum of coal or other material being mined in order that they may exert their full force against the mine roof and floor.

In accordance with a previous proposal such roof support cylinders were to be provided with hydraulic means for bringing about the required angular alignment, for instance, hydraulically operated aligning cylinders acting on the frame caps or other means engaging the mine roof. The use for the same purpose of leaf springs or other mechanical elements for alignment is also known. The disadvantage common to all these aligning elements resides in that they complicate the construction and in many cases also the control of the frame support. They are also unreliable.

In accordance with a further prior art proposal means were to be provided to meter out equal volumes of hydraulic fluid to the upper and lower rams. However it was found in practice that the aim of such an arrangement that is to say ensuring that both the upper and lower cylinders performed precisely the same strokes was not achieved owing to differences in the diameters of the two rams and leaks.

Furthermore such a device for ensuring that both the upper and lower rams receive the same volume of hydraulic fluid can only prevent the roof support cylinder losing angular alignment, that is to say so as to be perpendicular to the lie of the stratum being mined, when the mine roof and mine floor are parallel. In most cases however this is not so and as a result, although the strokes

of the two rams are equal, the top, say, of the roof support cylinder advanced is moved less than the bottom owing to the roof sloping and thereby causing the top ram to take up an oblique position so that its effective stroke, that is to say the length of its stroke projected on a line parallel to the lie of the stratum is less than the effective stroke of the lower ram which, in the case in consideration, remains parallel to the lie of the stratum.

As a result of this an additional manual control is required to make corrections in the strokes of the advancing rams. However the complexity and therefore unreliability of such arrangements make it difficult to fulfill the prevailing requirements for full automisation in mines.

One object of the present invention is to avoid these disadvantages and not to make use of complicated aligning systems as used in prior art constructions.

Accordingly the present invention consists in a mine roof support comprising:

(a) A frame structure made up of generally horizontal abutment means for engaging a mine roof, generally horizontal abutment means for engaging the mine floor, and front and rear hydraulic mine roof support cylinders connected at their tops and bottoms with the abutment means; and

(b) A hydraulic advancing system made up of a lower hydraulic ram arranged to advance the bottom part of a particular one of the cylinders, an upper hydraulic ram arranged to advance the top part of the particular cylinder, and valve means which is responsive to a departure in the angle of the particular cylinder in a saggital plane from a particular angle and is arranged to control relative liquid displacements of the upper and lower advancing rams to obviate departures of the particular cylinder from the particular angle.

Preferably a mine roof support in accordance with the invention comprises two such frame structures, the rams of the advancing system being coupled at their ends with both frame structures for advancing one frame structure while its support cylinders are depressurised and the cylinders of the other frame structure are pressurised, the roof support arrangement further comprising two such valves, one of which is responsive to the angular position of one of the roof support cylinders in one frame structure, and the other valve is responsive to the angular position of a roof support cylinder in the other frame structure.

In accordance with a further preferred feature of the invention the advance rams are double acting and the two fluid displacement spaces of the upper ram are connected respectively with the two valves.

Two embodiments of the invention are now described with reference to the accompanying drawings.

FIGURE 1 is a diagram of a first embodiment of the invention, the slope of the mine roof being somewhat exaggerated.

FIGURE 2 is a diagram of parts of a mine roof support in accordance with the invention.

FIGURE 3 is a circuit diagram of the structure shown in FIGURE 2.

The roof support frame shown diagrammatically in FIGURE 1 comprises two roof support cylinders **1** and **2** whose top ends are pivotally connected with a frame part bearing against the mine roof *h* and two shoes or feet **5**, **6** (abutment means) bearing against the mine floor. The abutment or cap bearing against the mine roof is made up of two telescoping parts **3** and **4** which allow the tops of the roof support cylinders **1** and **2** to be moved independently of one another in a saggital plane, that is to say a vertical plane containing the line of travel of the support frame.

The bottom ends of the mine roof support cylinders **1** and **2** are connected by an advancing ram R2 whose ends

are connected pivotally to allow the angle of the support cylinders to change.

The top ends of the cylinders are connected by an upper ram R_1 whose ends are connected with the top ends of the cylinders **1** and **2** by being connected with the parts **3** and **4**.

In the embodiment shown of the stratum F being mined coincides with the direction of the mine floor L while the mine roof slopes upwards. As a result the lower advancing ram R2 is parallel to the lie of the stratum and its stroke S_1 is equal to the distance H_1 by which the bottom part of the front mine support cylinder **2** is advanced. On the other hand, since it is not parallel to the lie of the stratum, the stroke H_h of the upper ram R_1 is greater than the effective stroke S_h, the distance by which the top part of the front roof support cylinder **2** is moved forwards toward the working face of the stratum S. If the support arrangement were provided with a device which caused the upper and lower rams R1 and R2 to receive the same quantities of hydraulic fluid their strokes would be the same. The front roof support cylinder would be moved in a saggital plane out of the vertical position shown in FIGURE 1.

In accordance with a feature of the invention therefore the support means is not provided with a device ensuring that both the upper and the lower rams receive the same quantity of hydraulic fluid. Instead the flow of hydraulic liquid to the upper ram R_1 is made dependent upon the operation of a valve V connected with a feeler F′ responsive to the angular position of the front mine roof support cylinder **2** which is to remain perpendicular to the lie of the stratum S. The valve V is mounted on a support S_u carried on the abutment means **6**. When the mine roof support cylinder **2** is in its particular required position perpendicular to the lie of the stratum, the valve V is closed. However, as soon as the hydraulic liquid is fed to the lower ram R_2 so as to advance the bottom part of the roof support cylinder **2** and thus tilt the roof support cylinder somewhat, the feeler F′ detects the tilting and opens the valve V so that hydraulic liquid under pressure flows to the upper ram R_1, extending it sufficiently to maintain the front support cylinder **2** in the angular position normal to the lie of the stratum. The valve V may be fixed on the support S_u by means of an adjusting slide A_d, moved for instance by a screw, to set the particular angle which it is desired that the support cylinder **2** assume.

The further embodiment of the invention shown in FIGURE 2 comprises two roof support frames A and B with support cylinders A1, A2 and B1, B2 which are connected with frame parts A3 and B3 engaging the mine floor and supports parts A4 and B4 engaging the mine roof. The two frames are connected together by means of double acting lower ram C and double acting upper ram D. In known arrangements similar to this, for advancing one of the two frames the roof support cylinders in one frame are depressurised and the advancing rams C and D, one end of each of which is connected with the other, pressurised roof support frame, are used to advance the roof support frame. Thus if the frame A would be advanced hydraulic fluid under pressure would be forced into the right hand ends of the two advancing rams C and D so that while the pistons or plungers of the rams remain stationary their cylinders would be moved to the right.

However if the mine roof slopes upwards at an angle to the lie of the stratum being mined, the travel of the top ends of the cylinders A1, B1 will be less than the travel of the bottom parts of the cylinders so that the cylinders would take up the positions shown in broken lines in FIGURE 2. To prevent this the arrangement therefore includes valves **7** arranged to detect departures in the roof support cylinders B1 and A1 from a particular angle. When these valves are opened owing to the cylinders departing from the particular angle which they are intended to assume, hydraulic liquid flows to the right hand end of the upper ram D via duct **8**, in the case of advance of the frame A, or to the left hand end of the upper ram, in the case of advance of the frame B. The lower advancing cylinder C moves with a constant rate of displacement, dependent upon the power pump, and is not affected by the valves **7**.

A less diagrammatic representation of the embodiment of the invention of FIGURE 2 is shown in FIGURE 3.

Hydraulic fluid under pressure flows via duct **24** into the valve **7** which is in the form of a ball valve with a ball **22** which can be pushed away from its seat by a plunger **21** forming the feeler of the valve **7**. When the advancing ram C is fed with hydraulic liquid it moves the bottom part of the roof support cylinder **B1** forwards and consequentially tilts it out of the particular angle which it is supposed to assume. As a result the plunger **21** of the valve **7** pushes the ball **22** away from its seat and hydraulic liquid under pressure flows via duct **25** to the advancing ram D moving its piston so as to cause the top part of the front cylinder to move forwards out of the tilted position.

It will of course be understood that the rear cylinder B2 remains parallel to the front cylinder and tilts with it, but for the sake of simplicity attention has only been drawn to the movement of the front cylinder.

Various modifications can be made in the embodiments of the invention.

Thus, for example, instead of all the liquid for causing displacement of one of the advancing rams having to flow through the valve V or **7**, both the advancing cylinders can be fed from means ensuring that they are fed at precisely the same rate, and the valve V or **7** can act as a bypass valve which either allows some hydraulic fluid to escape from, say, the upper advancing ram when the top of the support frame is ahead of the bottom, or else the valve can effect an increase in the rate of supply of hydraulic fluid to the advancing ram whose stroke is lagging behind.

Also instead of being responsive to an angle, the valve can be responsive to a speed or travel along the roof or floor.

Furthermore in the embodiment of the invention shown in FIGURES 2 and 3 means can be provided for adjusting the positions of the valve **7** so as to cause the roof support cylinders to assume angles different to those indicated in the figures.

What we claim is:

1. A mine roof support comprising:

(a) a frame structure made up of generally horizontal separate abutment means for engaging a mine roof, generally horizontal separate abutment means for engaging the mine floor, and front and rear hydraulic mine roof support cylinders pivotally connected at their tops and bottoms with the abutment means; and

(b) a hydraulic advancing system made up of a lower hydraulic ram pivotally attached to the front and rear cylinders at the lower ends thereof and arranged to advance the bottom part of a particular one of the cylinders, an upper hydraulic ram pivotally attached to the structure between the cylinders and arranged to advance the top part of the particular cylinder, and valve means which is responsive to a departure in the angle of the particular cylinder in a saggital plane from a particular angle and is arranged to control relative liquid displacements of the upper and lower advancing rams to obviate departures of the particular cylinder from the particular angle.

2. A mine roof support arrangement according to claim **1** comprising two such frame structures, the rams of the advancing system being coupled at their ends with both frame structures for advancing one frame structure while its support cylinders are depressurised and the cylinders of the other frame structure are pressurised, the roof support arrangement further comprising two such valves, one of which is responsive to the angular position of one

of the roof support cylinders in one frame structure, and the other valve is responsive to the angular position of a roof support cylinder in the other frame structure.

3. A mine roof support arrangement according to claim 2 in which the advance rams are double acting and the two fluid displacement spaces of the upper ram are connected respectively with the two valves.

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JACOB SHAPIRO, *Primary Examiner.*

U.S. Cl. X.R.

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