Aug. 1, 1967 M. HÉMARD 3,333,425

HYDRAULIC MINE ROOF SUPPORTS

Filed April 12, 1965 2 Sheets-Sheet 1

FIG. 1

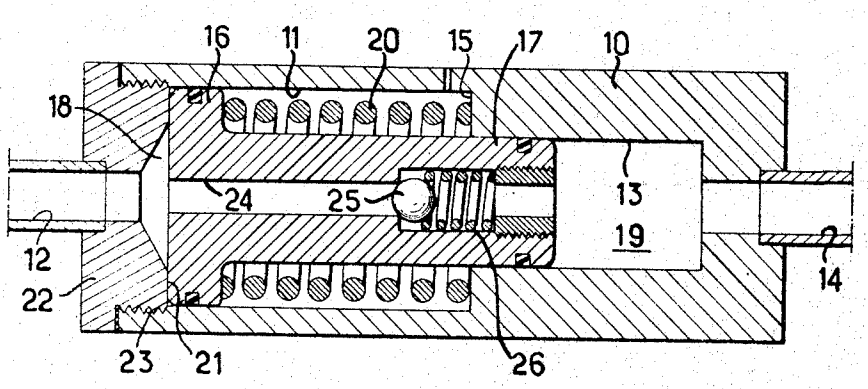


FIG. 2

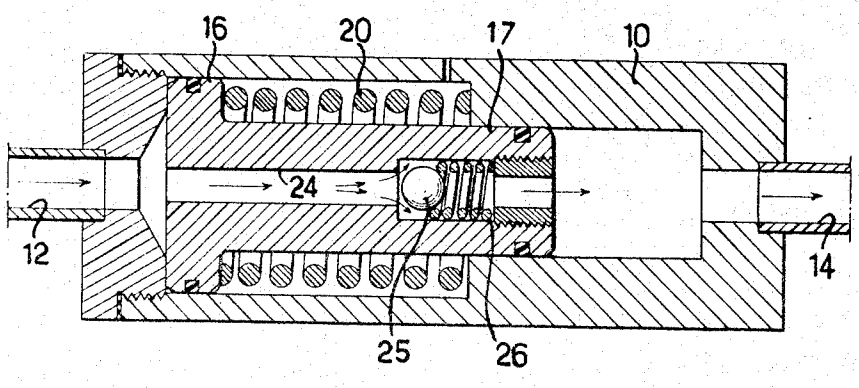
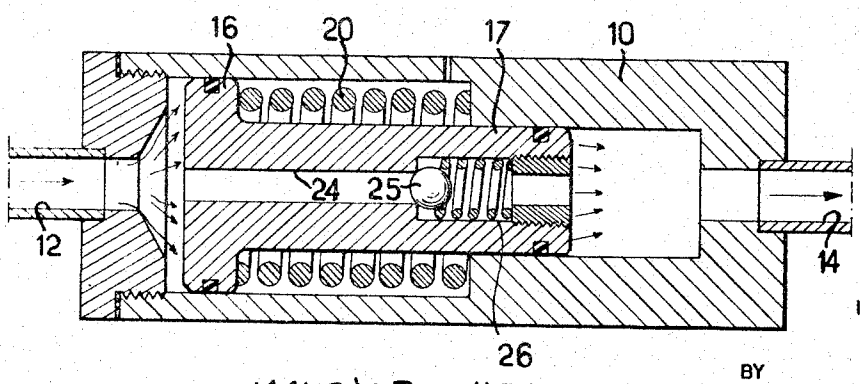


FIG. 3



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Aug. 1, 1967 M. HÉMARD 3,333,425

HYDRAULIC MINE ROOF SUPPORTS

Filed April 12, 1965 2 Sheets-Sheet 2

FIG. 4

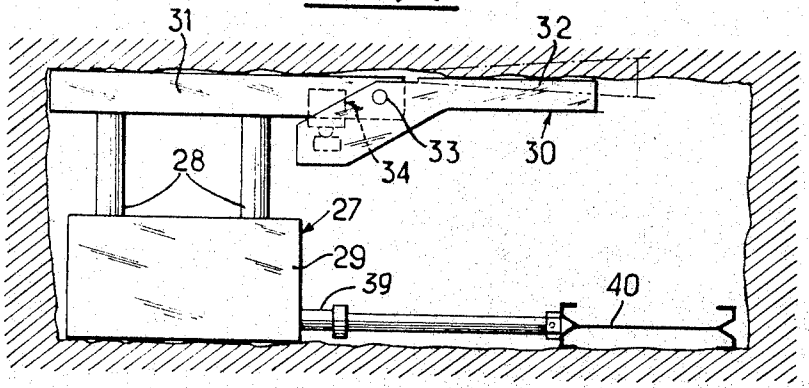


FIG. 5

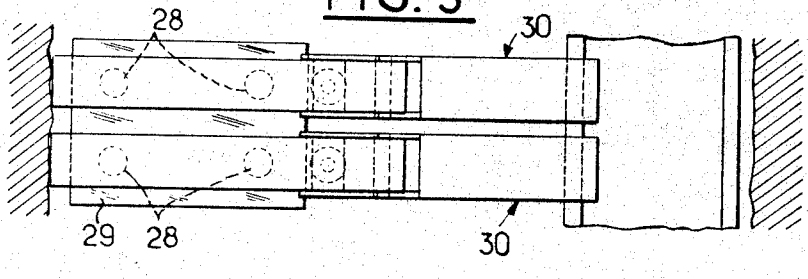


FIG. 6

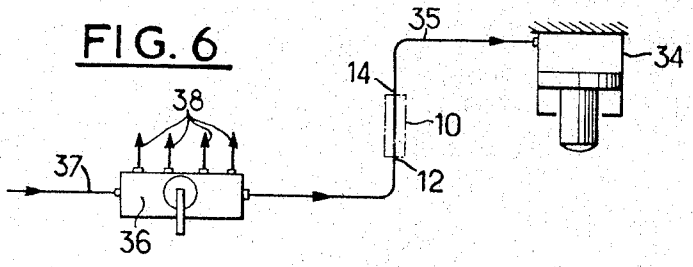
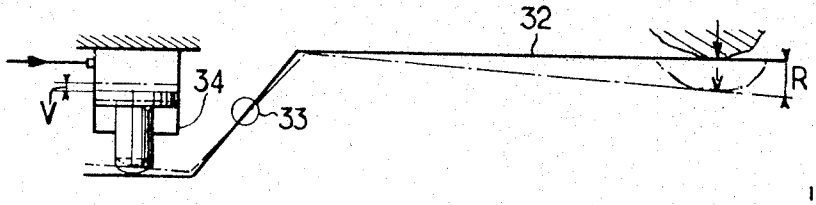


FIG. 7



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HYDRAULIC MINE ROOF SUPPORTS

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4 Claims. (Cl. 61—45)

ABSTRACT OF THE DISCLOSURE

A mine roof support includes a canopy or roof-engaging structure having a pivotally mounted extension piece, a pressure-fluid ram for applying said extension piece to the roof and a pressure intensifier for said pressure-fluid ram. The pressure intensifier comprises, as a compact and robust integral unit, two cylinders one of which has a larger bore diameter than the other and pistons working in said cylinders. A pressure-fluid discharge orifice in the smaller cylinder is connected to the pressure-fluid ram for the supply of pressure-fluid thereto at intensifying pressure. A pressure-fluid inlet opening is provided in the larger cylinder for pressure-fluid to act on the piston therein and move it and the piston in the smaller cylinder towards the exhaust orifice. A spring acts on the pistons to move them in the opposite direction. A communicating passage between the two cylinders is provided with a one-way valve which permits a flow of fluid from the larger cylinder to the smaller cylinder, but not in the reverse direction, until the pressure at the inlet opening equals the pressure at the discharge orifice whereupon the one-way valve closes and the pressure acting on the larger piston causes it to move the smaller piston so as to increase the pressure at the pressure-fluid discharge orifice in relation to the pressure at the inlet opening.

This invention is for improvements in or relating to pressure augmenting or multiplying apparatus.

An object of the invention is to provide a pressure augmenting apparatus having an admission orifice and an exhaust orifice and adapted to increase the exhaust pressure in relation to the admission pressure when the exhaust is loaded.

According to the present invention there is provided a pressure augmenting apparatus comprising two cylinders one of which has a larger bore diameter than the other, pistons working in said cylinders, a pressure-fluid discharge orifice in the smaller cylinder, a pressure-fluid inlet orifice in the larger cylinder for pressure-fluid to act on the piston therein and move it and the piston in the smaller cylinder towards the exhaust orifice, a return spring device acting to move said pistons in the opposite direction, a communicating passage between the two cylinders, and a one-way valve in said passage permitting a flow of fluid from the larger cylinder to the smaller cylinder but not in the reverse direction, the one-way valve permitting flow of fluid from the larger to the smaller cylinder until pressure conditions in the apparatus cause the valve to close whereupon the pressure acting on the larger piston causes it to move the smaller piston so as to increase the pressure at the pressure-fluid discharge orifice in relation to the pressure at the inlet orifice.

According to a further feature of the invention there is provided a pressure augmenting apparatus comprising a cylinder having two aligned borings, a first of these borings having a greater diameter than the second boring, a block slidingly mounted in the cylinder and having a first

piston located in the first boring and a second piston located in the second boring, a first chamber defined in the cylinder by the first piston and connected to an admission orifice, a second chamber defined in the cylinder by the second piston and connected to an exhaust orifice, a return spring applied to said block and tending to displace it so that the first chamber diminishes in volume and the second chamber increases in volume, an abutment for halting said displacement of the block under the action of said spring, and a communicating passage between the two chambers having a one-way valve permitting circulation of fluid from the first chamber to the second chamber and prohibiting any circulation in the reverse direction. When the exhaust is not loaded the block remains applied against the abutment under the action of the return spring and the fluid moves from the admission to the exhaust whilst travelling through the communicating passage by raising the valve of said passage. As soon as the exhaust is completely loaded the pressure is the same at the exhaust and at the admission and the valve closes thus isolating the two chambers. The pressure which continues to be exerted on the first piston induces the separation of the block from the abutment and the pressure which is developed at the exhaust increases, being equal to the admission pressure multiplied in proportion to the relative cross-section of the first piston and the second piston.

The apparatus according to the invention has various applications, particularly in installations which require a partial increase of pressure and where, for reasons of space cost-price or otherwise, a more powerful pump cannot be adopted.

Amongst these applications there is more particularly provided according to the invention, without in any way being limited thereto, the insertion of a pressure augmenting apparatus in the feeding of a hydraulic jack or ram for the control of an extension piece of a canopy of a mine roof support or prop. In this application of the apparatus according to the invention there results prevention of the dangerous lowering of the extension piece even if the mine roof exerts an accidental overloading on the extension piece.

The invention is more specifically described hereinafter, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a longitudinal sectional view of a pressure augmenting apparatus according to the invention in the position of rest,

FIGURE 2 is a like view to that of FIGURE 1 but at the onset of increase of pressure,

FIGURE 3 is a like view to FIGURES 1 and 2 but in the phase of pressure multiplication,

FIGURE 4 shows an elevation of a mine roof support to which is applied a pressure augmenting apparatus according to the invention,

FIGURE 5 is a plan view of the support shown in FIGURE 4,

FIGURE 6 is a schematic view of the hydraulic control of a ram for controlling an extension piece of the canopy of the support shown in FIGURES 4 and 5, and

FIGURE 7 illustrates the operation of the extension piece of the canopy by means of the hydraulic ram.

Referring first of all to FIGURE 1, the pressure augmenting apparatus according to the invention is intended to increase, by a desired value, the pressure at a given point in a hydraulic or compressed air circuit and comprises a cylinder **10** having two aligned borings, i.e. a boring of large diameter **11** adjacent to a fluid admission orifice **12** and a boring of smaller diameter **13** adjacent to a fluid exhaust orifice **14**. The two borings **11** and **13** are separated by a shoulder **15**.

In the borings 11 and 13 there is slidingly positioned a block forming a double differential piston and consisting of a head 16 engaged in the boring 11 and a tail 17 engaged in the boring 13. A first chamber 18 is defined in the cylinder by the head 16 and communicates with the admission orifice 12, whilst a second chamber 19 is defined in the cylinder by the tail 17 and communicates with the exhaust orifice 14.

A helical spring 20 embraces the tail 17 and acts by compression between the shoulder 15 and the head 16. It tends to move the block 16, 17 towards the left of FIGURE 1, against an abutment 21. The latter is formed by a bush 22 screw-threaded at 23 into the extremity of the boring 11.

The block 16, 17 has an axial passage 24 in which is mounted a one-way or non-return valve having a ball 25 and a spring 26. The ball 25 permits, against the action of the spring 26, the circulation of fluid in the passage 24 from the chamber 18 to the chamber 19, but prevents any circulation in the reverse direction.

In operation the fluid (FIGURE 2) circulates in the direction of the arrows and traverses the apparatus by way of 12, 18, 24, 19, 14, the ball 25 being displaced from its seat when the spring 26 is compressed by the upstream pressure of the circuit, i.e. the pressure obtaining at the admission 12.

When the downstream part of the circuit is completely filled, the pressure is the same at all parts of the apparatus, that is to say, at 12 and 14. The spring 26 then applies the ball 25 onto its seat and thus isolates the two parts of the circuit (FIGURE 3). The pressure at 12 continues to be exerted on the head 16 and the pressure in the downstream part of the apparatus, that is to say, the pressure at 14 becomes higher than the pressure at 12 in proportion to the ratio between the cross-sectional area of the head 16 and the cross-sectional area of the tail 17. In this way the apparatus acts as a pressure augmenter.

The apparatus which has just been described is capable of numerous applications. Reference is now made to FIGURES 4 to 7 which deal with one application of this apparatus to roof supports or props for mines.

To support the roof of working galleries or longwall seams of mines (FIGURES 4 and 5) there is utilised a series of supports, one of which is indicated at 27. This support comprises, for example, four vertical hydraulic jacks, props or stanchions 28, mounted in a casing or base 29 and supporting two canopies 30. Each canopy 30 consists of a rigid element 31 resting on the props or stanchions 28 and of an extension piece 32. The elements 31 and 32 are pivotally connected through joint pin 33 which allows the extension piece 32, under the action of a small jack or hydraulic ram 34 mounted in the rigid element 31, to tilt in the vertical plane and to take a variable inclination corresponding to the irregularities of the roof. This extension piece 32 permits more efficient support of the roof for the confidence of passage of personnel in the gallery.

The jack or ram 34 of the extension piece 32 (FIGURE 6) is fed by fluid under pressure (e.g. hydraulic fluid) through a flexible conduit 35, of rubber or other elastic, somewhat expansible material, connected to a hydraulic distributor or manually operable valve device 36. The latter is branched off a conduit 37 fed by a pump having a suitable pressure, for example, 100 kg./cm.^{2}. The distributor 36 is intended to serve in addition to the conduit 35 other conduits 38, particularly for the operation of the props or stanchions 28 and various jacks or rams including the double-acting hydraulic ram 39 which serves, in known manner, to push the conveyor 40 up towards the coal face and then, when retracted and using the conveyor as an anchorage, advance the support 27 towards the coal face as winning of the coal proceeds.

When a substantial load is applied to the extremity of the extension piece 32, for example, following partial separation of the roof, the pressure mounts considerably within the interior of the jack 34 and of the flexible conduit 35 up to the distributor 36. It then produces a slight swelling of the flexible rubber or other conduit 35 which increases its internal volume. The quantity of fluid contained in the conduit 35 being constant, this increase of volume of the conduit 35 results in a diminution of volume of the chamber of the jack 34. This gives rise to displacement V (FIGURE 7) of the piston of the jack 34 which is converted at the extremity of the extension piece 32 to a displacement R which is amplified in relation to the distance V in proportion to the respective lever arms about the pivotal axis 33. The lowering of the extension piece 32 under the effect of an accidental overloading gives rise to risks of grave consequence and jeopardises the security of personnel moving about in the gallery. To remedy this danger there is provided an apparatus 10, such as that above described with reference to FIGURES 1 to 3, within the conduit 35 (FIGURE 6). The apparatus 10 permits the pressure in the jack 34 to be increased so that the swelling of the flexible conduit 35 then produces the contacting of the extension piece 32 with the roof. The admission orifice 12 of the apparatus 10 is located to the side of the distributor 36 whilst the exhaust orifice 14 of the apparatus 10 is located to the side of the jack 34.

If the pressure of the pump at 37 feeding the distributor 36 is of the order of 100 kg./cm.^{2} and if the ratio of the cross-section of the tail 17 to that of the head 16 is of the order of a third, the pressure obtained in the jack 34 is of the order of 300 kg./cm.^{2}.

The apparatus according to the invention applied to the roof support 27 thus increases considerably the efficiency and reliability of the extension piece 32.

It will be well understood that the invention is not limited to the examples described and represented but embraces many variations. For example, the apparatus can be utilised in all installations necessitating a partial increase of pressure, where for reasons of space, cost or otherwise, a more powerful pump cannot be adopted.

I claim:

1. A mine roof support including a roof-engaging structure having a pivotally mounted extension piece, a pressure-fluid ram for applying said extension piece to the roof and a pressure intensifier, for said pressure-fluid ram, comprising, as a compact and robust integral unit, two cylinders one of which has a larger bore diameter than the other, pistons working in said cylinders, a pressure-fluid discharge orifice in the smaller cylinder connected to said pressure-fluid ram for the supply of pressure-fluid thereto, a pressure-fluid inlet opening in the larger cylinder for pressure-fluid to act on the piston therein and move it and the piston in the smaller cylinder towards the exhaust orifice, means acting to move said pistons in the opposite direction, a communicating passage between the two cylinders, and a one-way valve in said passage permitting flow of fluid from the larger cylinder to the smaller cylinder, but not in the reverse direction, until the pressure at said inlet opening equals the pressure at said discharge orifice whereupon the valve closes and the pressure acting on the larger piston causes it to move the smaller piston so as to increase the pressure at the pressure-fluid discharge orifice in relation to the pressure at the inlet opening whereby an intensified fluid-pressure is supplied to said pressure-fluid ram and thereby to the roof through said pivotally mounted extension piece of the roof-engaging structure.

2. A mine roof support as claimed in claim 1 wherein the non-return valve is spring-loaded in a direction to urge it to close the pressure-fluid inlet opening.

3. A mine roof support as claimed in claim 1 wherein said means acting to move said pistons in the opposite

direction comprises a return spring which embraces the smaller piston and is located between the larger piston and a shoulder which separates the two cylinders.

4. A mine roof support as claimed in claim 1 wherein the pressure-fluid discharge orifice in the smaller cylinder is connected to the pressure-fluid ram for the supply of pressure-fluid thereto by an elastic expansible pipe.

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