United States Patent

[11] 3,557,828

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[21] Appl. No. **770,534**
[22] Filed **Oct. 25, 1968**
[45] Patented **Jan. 26, 1971**
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[32] Priority **Oct. 27, 1967**
[33] **Great Britain**
[31] **48958/67**

[54] **VALVE BLOCK WITH SPRING-LOADED VALVES**
7 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **137/596.1,** 251/251; 137/636.1
[51] **Int. Cl.** **F16k 11/10,** F16k 31/524
[50] **Field of Search** 137/596.1, 596.2, 627.5, 595, 636, 607; 251/251

[56] **References Cited**

UNITED STATES PATENTS

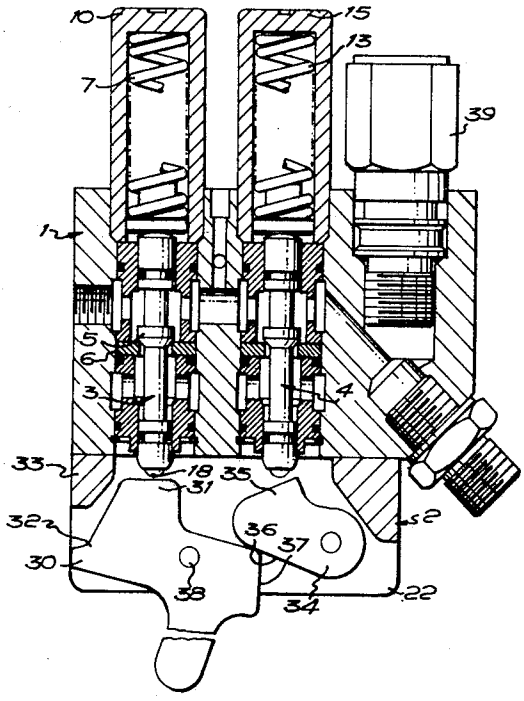
2,337,659	12/1943	Hughey et al.	137/595X
2,647,536	8/1953	Lunde	137/636
2,498,121	2/1950	Haberland	137/596.1X
2,726,680	12/1955	Baines	137/596.1X
3,099,461	7/1963	Stelzer	137/596.1X
3,107,694	10/1963	Hastings et al.	137/596.1X

FOREIGN PATENTS

318,937	1/1932	Canada.
400,344	1941	Canada.
410,174	1/1943	Canada.
428,223	6/1945	Canada.
538,986	4/1957	Canada.

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ABSTRACT: A valve block, particularly suitable for controlling hydraulically powered self-advancing mine roof supports comprises at least one pair of valve consisting of an inlet valve normally urged into closed position by a spring, and an outlet valve, normally urged into open position by a spring, the valves being suitable for association with pairs of conventional spring-urged valves, i.e., both inlet and outlet normally closed and cam means operable on the valves such that the valves may or may not be moved into a set position.



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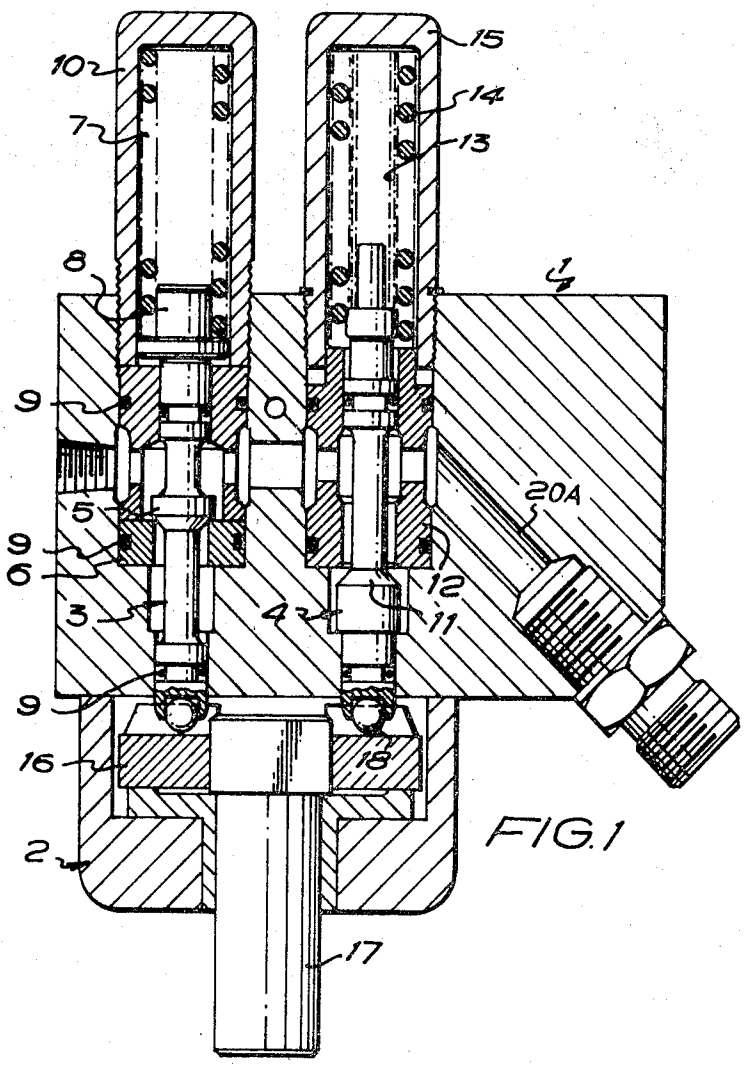


FIG. 1

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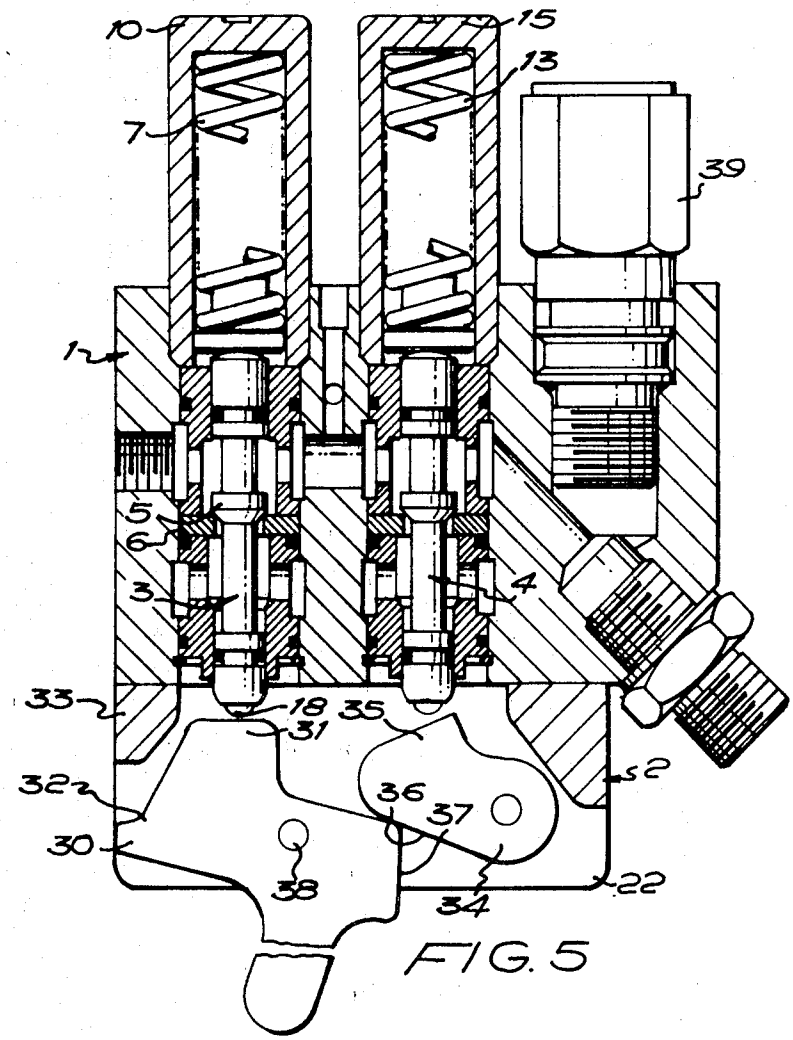


FIG. 5

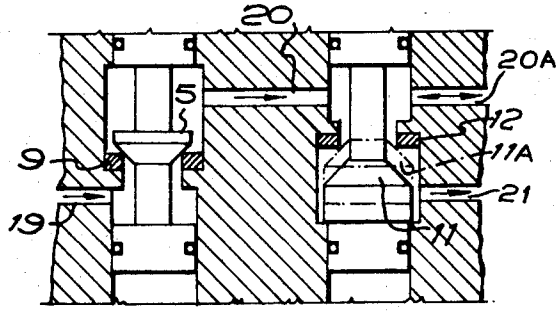


FIG. 2

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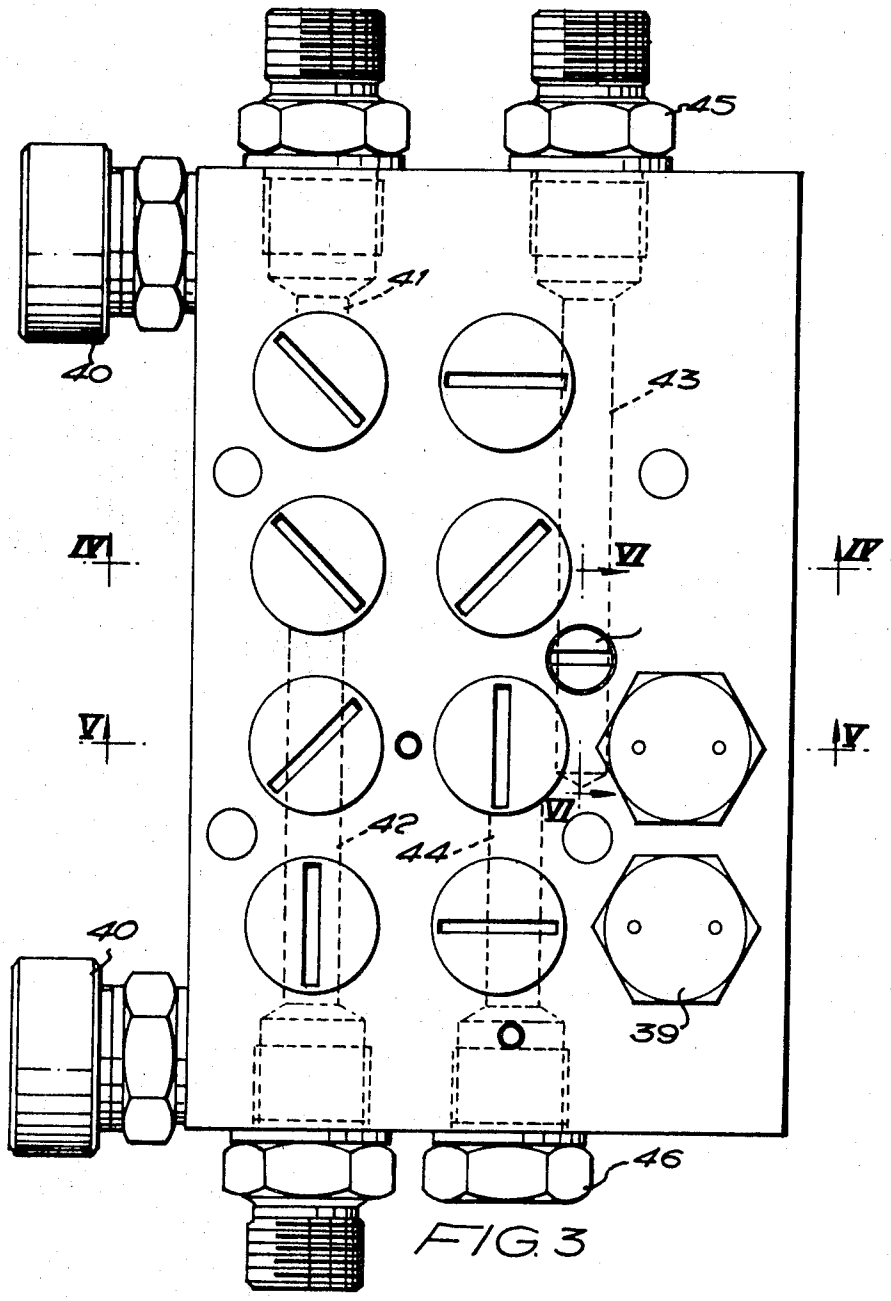


FIG. 3

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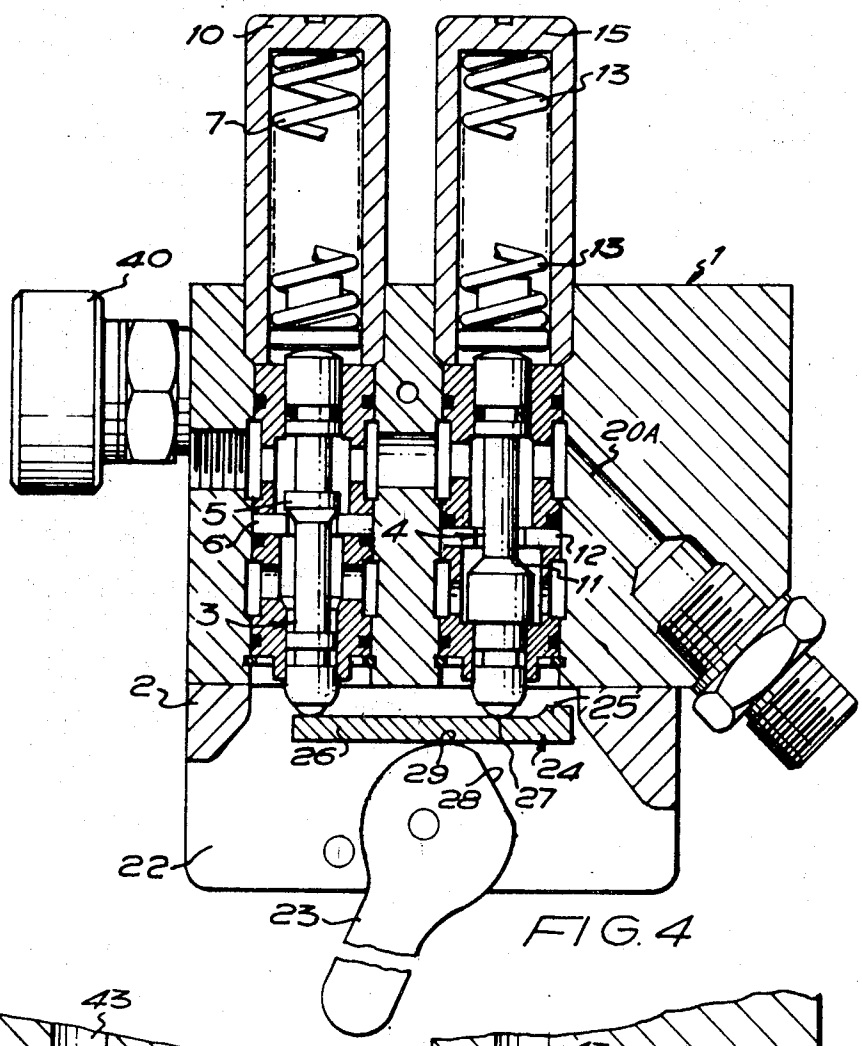


FIG. 4

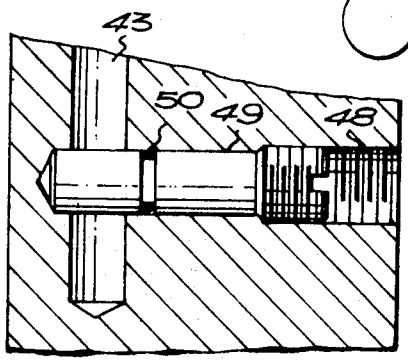


FIG. 6

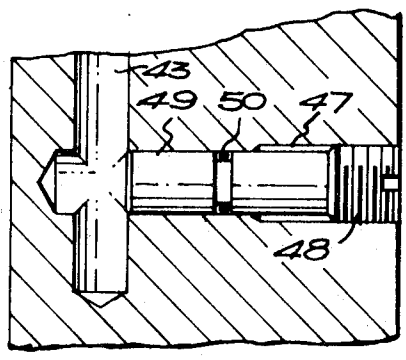


FIG. 7

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VALVE BLOCK WITH SPRING-LOADED VALVES

This invention relates to a valve block particularly adapted for controlling powered advancing underground mine roof supports.

Such supports normally comprise a pair of fluid-operable chocks joined by roof and floor bars and one or more double-acting rams by which the support can be advanced towards a mine face conveyor and the latter can be advanced towards the mineral (e.g. coal) face.

According to the invention, a valve block, comprises at least one pair of inlet and exhaust valves, the inlet valve being normally closed under the action of a spring, and the exhaust valve being normally open under the action of a spring, both valves being displaceable against their respective springs by cam means.

When considering the application of the above-defined valve block to a powered mine roof support, the valves defined therein are suitable for controlling the usual double-acting advancing ram, one pair of valves controlling the "push" side of the ram and a second pair of valves controlling the "pull" side of the valve. Pairs of conventional valves i.e. both being normally closed may also be incorporated into the valve block, a first pair to control the forward chock and a second pair to control the rear chock. Thus for a powered support consisting of one forward and one rear chock four pairs of valves are required in the valve block. For a support having one forward and two rear chocks, all in line, a further pair of valves for controlling the third chock is required. Again, a further pair of valves may be required to control some auxiliary equipment e.g. an advanceable forward cantilever extension of the roof support, but whatever number of pairs of valves are required, all may be provided in a single unitary valve block, or alternatively, each pair may be provided in a separate section of valve block, the various sections being secured together to form the valve block proper and hence to provide a valve block capable of being built up, or reduced, to suit a particular hydraulic circuit or particular operating conditions.

Each valve includes, of course, a valve member and a valve seat.

However, an important inventive feature is that the valve members according to the invention i.e. those which control the double-acting ram or rams are such as to assume a neutral-free position, that is, because the exhaust valve is normally open they permit fluid to be freely vented from either end of the ram concerned and thus permit the ram piston rod to be moved in or out without any substantial resistance. A valve block so constructed may be employed in the system disclosed in U.S. Pat. Application Ser. No. 800,663, filed Feb. 19, 1969, titled "CONTROL OF MINE ROOF SUPPORT ASSEMBLY" and assigned to the same assignee as the present application.

The exhaust valve may be displaced against its spring by means of a cam, the axis of rotation of which is fixed, with seating of the valve ensured by having a floating valve seat, also movable against spring action, so that manufacturing tolerances and wear have no adverse effect on seating of this valve.

Alternatively, the exhaust valve may be displaced into seating engagement with a fixed valve seat by means of a cam pivoted slightly towards the exhaust valve, with the exhaust valve spring lighter than the inlet valve spring, the cam acting through a loose thrust plate onto both the inlet and exhaust valve members. When the cam is rotated, its displaced axis of rotation and the different spring ratings mean that the end of the plate contacting the exhaust valve member is displaced before the end of the plate contacting the inlet valve, the latter end of the thrust plate only being displaceable when the exhaust valve end is arrested by seating of the exhaust valve member. Then, the thrust plate, under the force put on it by the cam, pivots about its point of contact with the exhaust valve member to overcome the urge of the inlet valve spring and to unseat the inlet valve, a flat on the cam enabling the valves to remain set in this position, the thrust of the inlet valve spring on the inlet valve member employing the thrust plate as a lever pivoted at its point of contact on the cam to further urge the exhaust valve member into seating engagement.

To maintain the valve block according to the invention at a compact size, a further aspect of the invention comprises a lever arrangement for operating conventional valves incorporated in the valve block. Both these valves are normally in closed position, with a handled operating lever to open the valves, pivoted towards the inlet valve, the lever having a raised portion to contact, upon rotation, the inlet valve member, and a shaped portion to abut a correspondingly shaped portion on the valve block, so that the lever cannot pass a dead center position but on release always returns, by the action of the inlet valve spring, to its neutral position. To unseat the exhaust valve the same handle is rotated but in the opposite direction and a pivoted link is arranged between the lever and the exhaust valve member. The link has a raised portion to contact the exhaust valve member and a flat portion to contact, eventually, a flat portion on the lever but to the other side of the lever pivot than the lever raised portion. When these flats are in contact the exhaust valve is fully open and the lever and link will remain set in this position until the lever is moved back to its neutral position.

The invention will now be further described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a sectional view through a valve block of a pair of inlet and exhaust valves incorporating one embodiment of the invention;

FIG. 2 shows schematically the arrangement of FIG. 1;

FIG. 3 is a plan view of a valve block according to a second embodiment of the invention showing four pairs of inlet and exhaust valves;

FIG. 4 is a vertical cross section on the line IV–IV of FIG. 3;

FIG. 5 is a vertical cross section on the line V–V of FIG. 3;

FIG. 6 is a partial section on the line VI–VI of FIG. 3, and

FIG. 7 is also a section on the line VI–VI of FIG. 3, but showing a different position.

In FIGS. 1 and 2, a valve block 1 has attached thereto, by bolts (not shown) a cam box 2, the valve block containing axially displaceable inlet and exhaust valves indicated generally at 3 and 4, respectively.

The inlet valve 3 consists of a conical valve member 5 normally urged into seating engagement with a valve seat 6 by a spring 7 bearing, through a guide 8, on the upper end of the valve member 5, the valve being provided with suitably arranged seals 9. The spring 7 is housed in a cover 10 which screws into the valve block, the spring pressure being adjustable by this means.

Similarly, the exhaust valve 4 consists of a conical valve member 11 normally urged out of seating engagement with a valve seat 12 by a spring 13, the valve seat 12 being movable against the urge of a spring 14. A cover 15 surrounds both springs and screws into the valve block.

With the valve block controlling the advancing ram of a powered roof support, two pairs of valves according to the invention — one for the "pull" side and one for the "push" side of the ram —are controlled by a cam 16 mounted on a spindle 17 projecting from the cam box 2. The cam acts through hardened steel balls 18. Referring now specifically to FIG. 2, an inlet 19 allows pressure fluid to enter the chamber occupied by valve member 5, and upon the face cam 16 being appropriately rotated, the valve member 5 is urged away from its valve seat 9 against the force of its biassing spring 7. This allows fluid to flow through cross porting 20, and then through porting 20A and to the ram, because at the same time but preferably slightly in advance of the opening of the valve 3, the cam 16 also effects closing of the valve 4, the valve member 11 moving upwardly to position 11A. With valve member 11 in its normally open position fluid can then flow via portings 20A and 21 to exhaust.

The second embodiment of the invention illustrated in FIGS. 3 to 7 will now be described. Parts corresponding to parts of the first embodiment have been given like reference numerals.

As shown in FIG. 4 pivotally mounted between four sets of vertically extending ribs 22 are cams 23. The cam acts through a loose thrust plate 24 onto both inlet and exhaust valve members. When the cam is rotated, its displaced axis of rotation and the different spring ratings mean that the end 25 of the plate contacting the exhaust valve member is displaced before the end 26 of the plate contacting the inlet valve, the latter end of the thrust plate only being displaceable when the exhaust valve end 27 is arrested by seating of the exhaust valve member. Then, the thrust plate 24, under the force put on it by the cam 23, pivots about its point of contact 27 with the exhaust valve member to overcome the urge of the inlet valve spring 7 and to unseat the inlet valve, a flat 28 on the cam enabling the valves to remain set in this position, the thrust of the inlet valve spring 7 on the inlet valve member employing the thrust plate 24 as a lever pivoted at its point of contact 29 on the cam to further urge the exhaust valve member 11 into seating engagement. Thus the normally open exhaust valve 4 is closed before the opening of the inlet valve 3.

As shown in FIG. 5, pivotally mounted between four sets of vertically extending ribs 22 are handled cam levers 30 to open the valves, pivoted towards the inlet valve 4, the lever having a raised portion 31 to contact, upon rotation, the inlet valve member, and a shaped portion 32 to abut a correspondingly shaped portion 33 on the valve block 1, so that the lever cannot pass a dead center position but on release always returns, by the action of the inlet valve spring 7, to its neutral position which is the position illustrated. To unseat the exhaust valve the same handle is rotated but in the opposite direction and a pivoted link 34 is arranged between the lever and the exhaust valve member. The link has a raised portion 35 to contact the exhaust valve member and a flat portion 36 to contact, eventually, a flat portion 37 on the lever but to the other side of the lever pivot 38 than the lever raised portion 31. When these flats are in contact the exhaust valve 4 is fully open and the lever and link will remain set in this position until the lever is moved back to its neutral position.

On returning the lever 30 to the neutral position i.e. that shown in FIG. 1, valve spring 7 will automatically close the valve. To operate the other chock the second lever 34 is operated.

With the valves of FIG. 5 controlling e.g. one of the chocks of a powered roof support by moving all levers 30 together all the chocks controlled thereby will operate simultaneously.

According to a further feature of the invention, illustrated in FIGS. 6 and 7, the valve block may have either a single exhaust connection or a double exhaust connection.

Considering again the valve block applied to an underground powered roof support on a single exhaust connection system both the chocks and the advancing rams exhaust into one exhaust main. This system has disadvantages if a fast gravity lowering of the chocks is required since whilst the chocks of one support are lowering the rams of supports further along the face would be operating and would be forcibly exhausting into the same exhaust main. This forced exhausting from the advancing rams tends to cause a back pressure at the chock exhaust thus preventing them from lowering. To overcome this difficulty, the invention in this aspect provides that the chocks are put onto an exhaust main separate from that of the rams.

This system of exhaust is achieved by interconnecting the lower chambers of all the exhaust valves by suitable cross portings 43 and 44 (FIG. 3) the outer ends of each porting being tapped to take an adapter 45 or a plug 46. A vertical bore 48 is then drilled between the two center chock and ram valves to intersect porting 43 as shown in FIGS. 6 and 7. The bore 48 is threaded at its outer end. A plug 49 having an O-ring seal 50 is then screwed into the bore 48.

With the plug 49 in the position shown in FIG. 7 i.e. not closing the porting 43 and a plug 46 screwed into porting 44 then both chocks and rams exhaust through porting 43 and adapter 45, i.e. a single exhaust connection.

But by screwing plug 49 to the bottom of its travel and thus blocking porting 43 (as shown in FIG. 6) and replacing plug 46 with another adapter 45, then the chocks will exhaust through porting 44 and the rams through porting 43, i.e. a double-exhaust connection.

The pressure bore through the valve body for the four inlet valves i.e. those to the left-hand side of FIG. 3 may be drilled completely through the valve block to provide a single working pressure for a plurality of valves. Alternatively the single bore may be replaced by two bores 41, 42 drilled from either side of the valve block but both leaving a solid body between the two bores thus producing a two-pressure system. This is shown in FIG. 3 with 3 valves on the bore 42 and one valve on the bore 41. Alternatively two valves could be arranged on each bore.

The valve block as illustrated in FIG. 3 is additionally provided with check valves 39 and 40.

A pair of plugs at each of the bores 41, 42 contain a nonreturn valve to which access may be gained by removing the cap of the plug, are provided in the valve block 1. These prevent escape of pressure fluid from the interior of the valve block but allow a pressure gauge to be screwed in in order that the pressure in the valve block may be monitored. Two valves are provided, one to allow monitoring of the pressure of each chock. By inserting the spigot of a proprietory form of pressure gauge the normally closed nonreturn valve is opened to allow testing of the internal pressure in the valve block.

I claim:

1. A valve assembly comprising a valve block having first and second parallel bores therein, an inlet valve, an exhaust valve, said first parallel bore housing only said inlet valve and said second parallel bore housing only said exhaust valve, an inlet valve spring acting to urge said inlet valve, normally, into closed position, an exhaust valve spring acting to urge said exhaust valve, normally, into open position, and cam means coupled to said inlet and exhaust valves functioning first to displace mechanically said exhaust valve against said exhaust valve spring into closed position, and subsequently to displace mechanically said inlet valve into open position.

2. A valve block as in Claim 1, wherein the exhaust valve has a fixed valve seat and is displaceable into engagement therewith by means of a cam pivoted slightly towards the exhaust valve from the inlet valve of the pair, with the exhaust valve spring lighter than the inlet valve spring and a loose and rockable thrust plate located between the cam and both the inlet and exhaust valve members.

3. A valve block as in claim 1 containing conventional valves both normally open, a handled operating lever to open the valves separating the latter the liner being pivoted towards the inlet valve and having a raised portion to contact, upon rotation, the inlet valve member, and a shaped portion to abut a correspondingly shaped portion on the valve block.

4. A valve block as in claim 3 comprising a pivoted link having a raised portion to contact the exhaust valve member, and a flat face to contact a flat face on the lever.

5. A valve block provided with two pairs of valves as defined in claim 1 and with two pairs of conventional valves, both the latter normally closed.

6. A valve block as in claim 5, wherein the pressure bore is constituted by two bores drilled from opposite sides of the block to provide a two-pressure system.

7. A valve block as in claim 5 comprising cross portings each associated with at least one exhaust valve, one of the cross portings being intersected by a bore, an adjustable screwed plug located in the bore serving, in one position, to allow connection of the cross ports, and in another position, to prevent such connection.