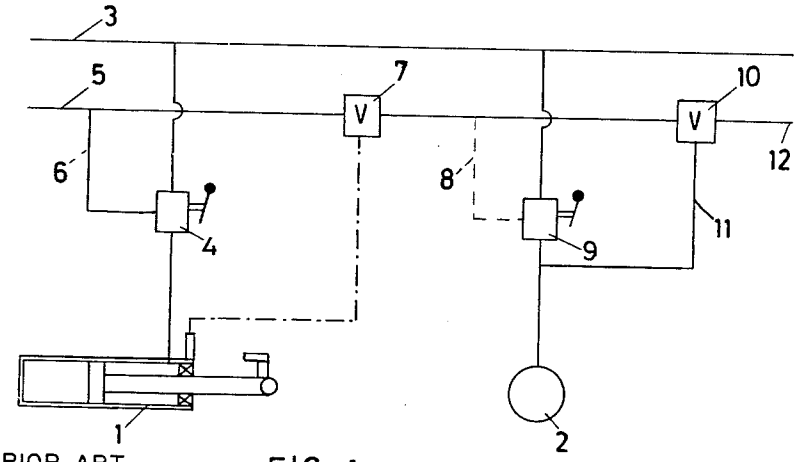
April 5, 1966 J. D. KIBBLE ETAL 3,244,078

ADVANCING MINE ROOF SUPPORT CONTROL SYSTEMS

Filed Oct. 3, 1963 2 Sheets-Sheet 1



PRIOR ART FIG. 1.

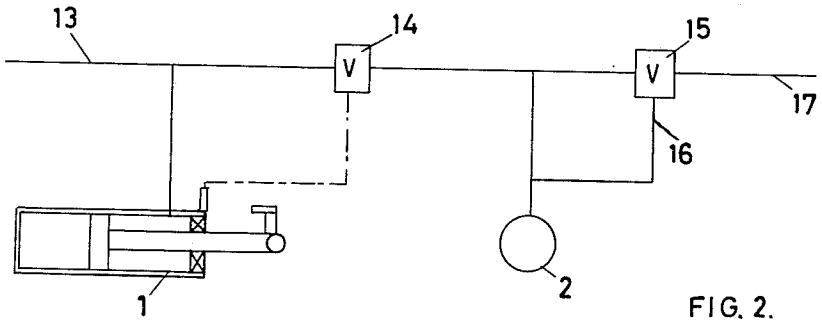


FIG. 2.
PRIOR ART

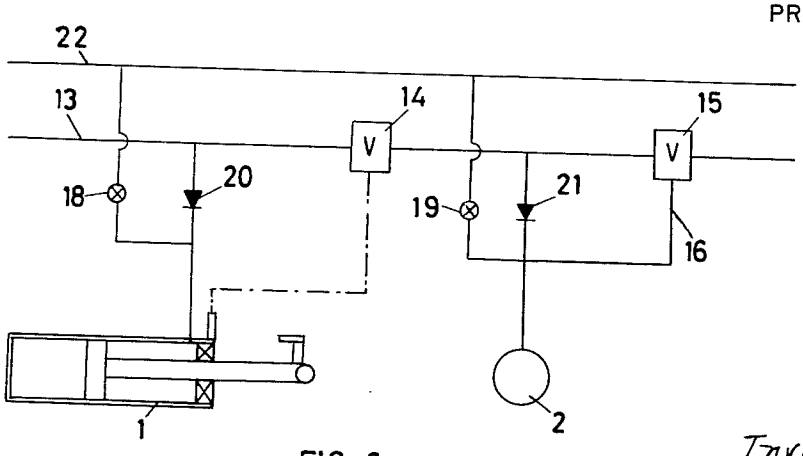


FIG. 3.

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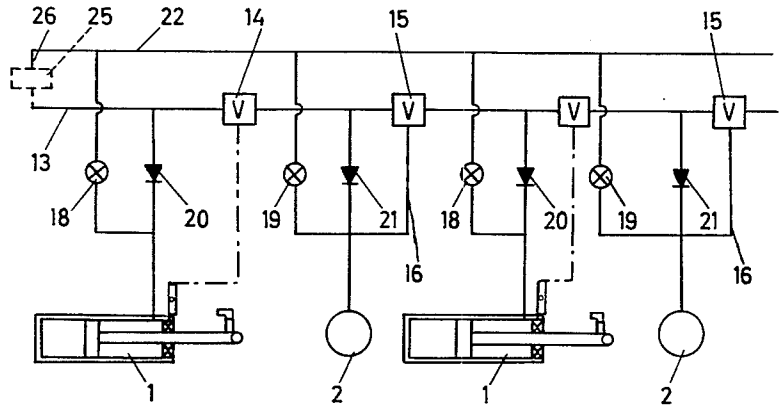

FIG. 4.

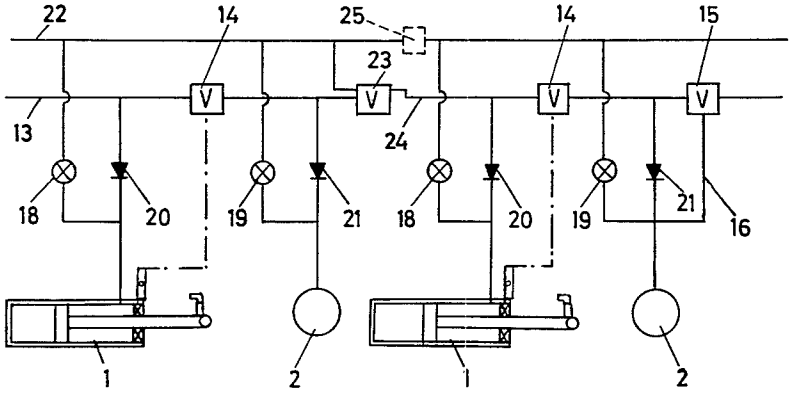

FIG. 5.

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ADVANCING MINE ROOF SUPPORT CONTROL SYSTEMS

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4 Claims. (Cl. 91—6)

This invention relates to advancing mine roof supports and has for its main object the provision of improved control means for such supports.

A means of effecting remote control of fluid-operated (e.g. hydraulic) roof supports for longwall coal faces has already been disclosed in our co-pending U.S.A. application Serial No. 61,210, now Patent Number 3,216,201. The invention disclosed in the said application has two characteristic features, firstly, that means are provided for detecting the completion of the advancing step on each support unit and for detecting the satisfactory setting of its fluid operated legs or props and when these two operations are accomplished the control signal is passed immediately to the next support unit to be advanced. Secondly, that a pilot signal effects control of the motions of the support unit through the medium of one or more pressure operated hydraulic valves in which the pressure in the pilot hydraulic circuit controls the admission of fluid from the main fluid supply conduit to the support to effect the motion concerned. (An electrical analogue of this system is also disclosed.) For reference, the operation of this control system is shown in symbolic form in FIGURE 1 of the accompanying drawings.

In FIGURE 1, the horizontal advancing ram of the support unit is shown at **1**, and its props at **2** (in fact there may be one, two ore more props). There is a main-fluid supply conduit **3** and admission of fluid from this conduit to the pulling side of the ram **1** is controlled by a valve **4**. This valve is caused to open when pressure exists in the pilot hydraulic conduit **5**, by means of the application of pressure through a pilot connection **6**. Means is also provided for alternative manual operation of the valve **4**. The pilot conduit **5** is interrupted by a valve **7** which is located downstream of the pilot connection **6** and which is closed until the ram **1** has completed its stroke. As the ram **1** contracts, pressure relief means, controlled in relation to the pressure conditions within the ram **1**, such as those disclosed in our co-pending U.S.A. application Serial No. 57,462, now Patent Number 3,120,105, or other means, must be provided for releasing fluid from the prop **2**. For simplicity, these means are not shown in FIGURE 1.

The valve **7** is arranged to be opened when the ram **1** is fully contracted. This is done by mechanical means indicated symbolically by a chain line in FIGURE 1. For example, an abutment on the piston rod may be arranged to strike a lever or trigger which operates the valve.

When the valve **7** opens fluid is admitted by means of a pilot hydraulic connection **8** to the valve **9** controlling re-admission of fluid from the conduit **3** to the prop **2**. Alternative means for manual operation on this valve are also provided. Further progress of fluid along the pilot conduit is prevented by means of the valve **10**. This valve is however opened when the pressure in the prop **2** reaches a sufficient level, by means of this pressure being applied to the valve **10** through the pilot connection **11**. When the valve **10** opens, the pilot pressure is transmitted along the conduit **12** to the adjacent support unit. This support unit will be similar to that shown in FIGURE 1.

Particular mention is made in our U.S.A. application Serial No. 61,210 of the importance of providing alternative manual operation of the control valves **4** and **9**, as if the remote operation only were provided it would be impossible to carry out individual adjustments to support units on the face if this was required by mining conditions.

In the absence of this requirement of individual manual control of the motions at all times, the much simpler circuit in FIGURE 2 of the accompanying drawing could have been adopted. In FIGURE 2 the advancing ram and the prop of the support unit are shown at **1** and **2** as before. However, the pressure supply conduit **13** admits fluid directly, with no valve, to the ram **1**, but the passage of this fluid further is prevented by the valve **14**. The valve **14** is arranged to be opened when the ram **1** has completed its stroke. The ram **1** may be used as its own valve if it is of suitable construction, enabling the valve **14** to be dispensed with. For example, a fluid outlet may be provided in the cylinder wall which is uncovered by the piston at a certain point in its travel. Pressure is then available to re-set the prop **2** but further passage of the fluid along the face is prevented by the valve **15**, which however is opened by means of the pilot connection **16** when the pressure in the prop **2** has reached a pre-determined value. Pressure is then transmitted along the conduit **17** to the adjacent unit. The attractive simplicity of this system is clear from FIGURE 1, as also however is the severe disadvantage of being unable to operate any support unit further along the face until the preceding ones have been operated.

The present invention is intended to avoid this disadvantage and involves a combination of the control system shown in FIGURE 2 with an alternative source of pressure supply which is used when the supports are to be operated under manual control. The simple manual valves then used are much less in cost than the pressure operated valves of the system shown in FIGURE 1. According to the present invention there is provided a control system for a fluid operated advancing mine roof support unit including a unit advancing ram and a roof support prop, wherein the ram and prop are connected to receive operating fluid from a first fluid pressure line, valve means being provided to control the operational sequence of the ram and prop, and wherein the ram and prop are each connected via a fluid cut-off means to a second fluid pressure line whereby the ram and prop can be electrically operated irrespective of the sequence. One example of the control system of the present invention is shown in FIGURE 3 of the drawings, again in symbolic form. FIGURE 4 illustrates two of the units of FIGURE 3 connected in series, and FIGURE 5 illustrates a modification of the arrangement of FIGURE 4. In FIGURE 3 a support unit includes a unit advancing ram **1** and props **2** (only one shown). A fluid pressure supply conduit **13** admits fluid into the pulling side of the ram through a non return valve **20**. Passage of pressure fluid along the conduit **13** to the props **2** is prevented by a fluid flow control valve **14**, the latter being opened when the ram **1** has completed its advancing stroke. This is achieved by providing a mechanical valve operating connection, shown in chain dotted lines, between the ram **1** and the valve **14**. When the valve **14** is opened pressure fluid is applied to the props **2** through the non-return valve **21**. A fluid flow control valve **15** prevents further fluid flow along the conduit. The valve **15** is so arranged that it opens at the pressure at which it is required to set the props **2**. The valve **15** is connected by a pilot line **16** which allows pressure fluid to flow from the conduit connecting the valve **21** to the props **2**. Thus when the props **2** are reset to the roof, as soon as the required setting pressure is attained in

the props **2** the valve **15** is opened. When valve **15** is opened pressure fluid travels to the next support unit. The pilot connection **16** is joined to a further pressure line **22**. The ram **1** is also connected to the pressure line **22** through a manually operable stop valve.

A manually operable stop valve **19** is included in the fluid connection between the props **2** and the line **22**. Operation of the valve **19** allows manual control of the props **2**. The valves **20** and **21** serve to prevent the operation of the valves **18** and **19**. It will be seen that this system is considerably simpler than that shown in FIGURE 1.

FIGURE 4 illustrates two of the units shown in FIGURE 3 connected to receive pressurised fluid from common line **22** and **13**.

It will be understood that any or all of the valves on each support unit may be combined into one block or one compound valve if desired. For clarity, the means of return of fluid from the members of the support unit back to the fluid tank is not shown. In some circumstances it may be advantageous to combine the system now disclosed with that shown in FIGURE 1. Thus, the operation of the pulling ram could be controlled by a pressure operated valve, the actual fluid being drawn from a main pressure supply conduit, while the setting of the props, which requires relatively little fluid, could be accomplished directly from the sequence supply line **13** as shown in FIGURE 3.

A disadvantage of the system now being described is the number of sequence valves through which the sequence operating fluid must pass (i.e. along line **13**) before reaching a support unit. This limits the system to use with small numbers of support units. To enable it to be used with large number of units, a relay effect could be introduced as is shown in FIGURE 5 whereby, after operating a number i.e. group of support units, the sequence supply line **13** is used to actuate a pressure operated valve **23** admitting fluid from the main supply conduit **22** to the sequence supply line **24** of a further group of support units.

The simplified control system of FIGURES 3, 4 or 5 is particularly applicable to the control of a single support unit from a local control station situated at a safe distance from it but within sight, for example, the control station could be the adjacent support unit. Such a control facility is particularly valuable from the safety point of view. In this instance, the adjacent support unit carries a valve **25** (shown in dashed lines in FIGURE 4) admitting fluid from the main pressure conduit via a connection **26** (shown in dashed lines) to the sequence supply conduit **13** which leads to the circuit shown in FIGURE 3 placed on the support unit to be operated. This circuit provides for the carrying out of the full sequence of operations on this support unit, the valve **14** being used to initiate resetting of the props when the unit has completed its forward motion. In the case of the embodiment of FIGURE 4 the opening of valve **25** connects pressure line **22** to pressure line **13** at a point upstream of the support unit whose props are to be reset. As soon as this support unit has completed its advancing movement the valve **14** is automatically operated to allow fluid to flow from line **22** to line **13** to reset the

props **2**. In the FIGURE 5 embodiment if the props **2** of the right hand support unit are to be reset the valve **23** is opened to connect the pressure line **22** to the line **13** upstream of valve **14**. Hence, as soon as the support unit finishes its advancing operation, the valve **14** is opened to enable the pressure fluid in line **13** to reset the props. The valve **15** is not required if the automatic sequence is not to be passed to a further support unit.

In each of the embodiments described in relation to FIGURES 3, 4, and 5, the body of each ram **1** in the sequence will be mechanically connected with its associated support unit. The piston rods of the rams **1** will be connected to a conveyor. A proportion of the rams will be provided with means (not shown) for pressurising the left hand sides of the rams and simultaneously exhausting the right hand side of the ram to push the conveyor. The remaining rams will likewise have means (not shown) for pressurising the left hand side of the ram and simultaneously exhausting the right hand side of the ram.

In practice for each embodiment, the props **2** will be lowered by any suitable control means such as for example the arrangement described in said co-pending application Serial No. 57,462.

We claim:

1. A control system for a fluid operated advancing mine roof support unit including a unit-advancing ram and a roof support prop, wherein the ram and prop are connected to receive operating fluid from a first fluid pressure line, valve means being provided to control the operational sequence of the ram and prop, and wherein the ram and prop are each connected via a fluid cut-off means to a second fluid pressure line whereby the ram and prop can be selectively operated irrespective of the sequence.

2. A control system as claimed in claim **1**, wherein a non-return valve is provided in the fluid connection between the ram and the first pressure line and between the prop and the first pressure line, the arrangement being such as to prevent pressurised fluid downstream of a fluid cut-off means from affecting pressure conditions in the first pressure line.

3. A control system as claimed in claim **1**, wherein the admission of pressurised fluid to the first fluid pressure line is controlled by valve means located at control station remote from the support unit to be operated.

4. A control system as claimed in claim **1**, wherein the sequencing valve means is arranged to control the resetting of the prop when the unit has completed its forward motion.

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