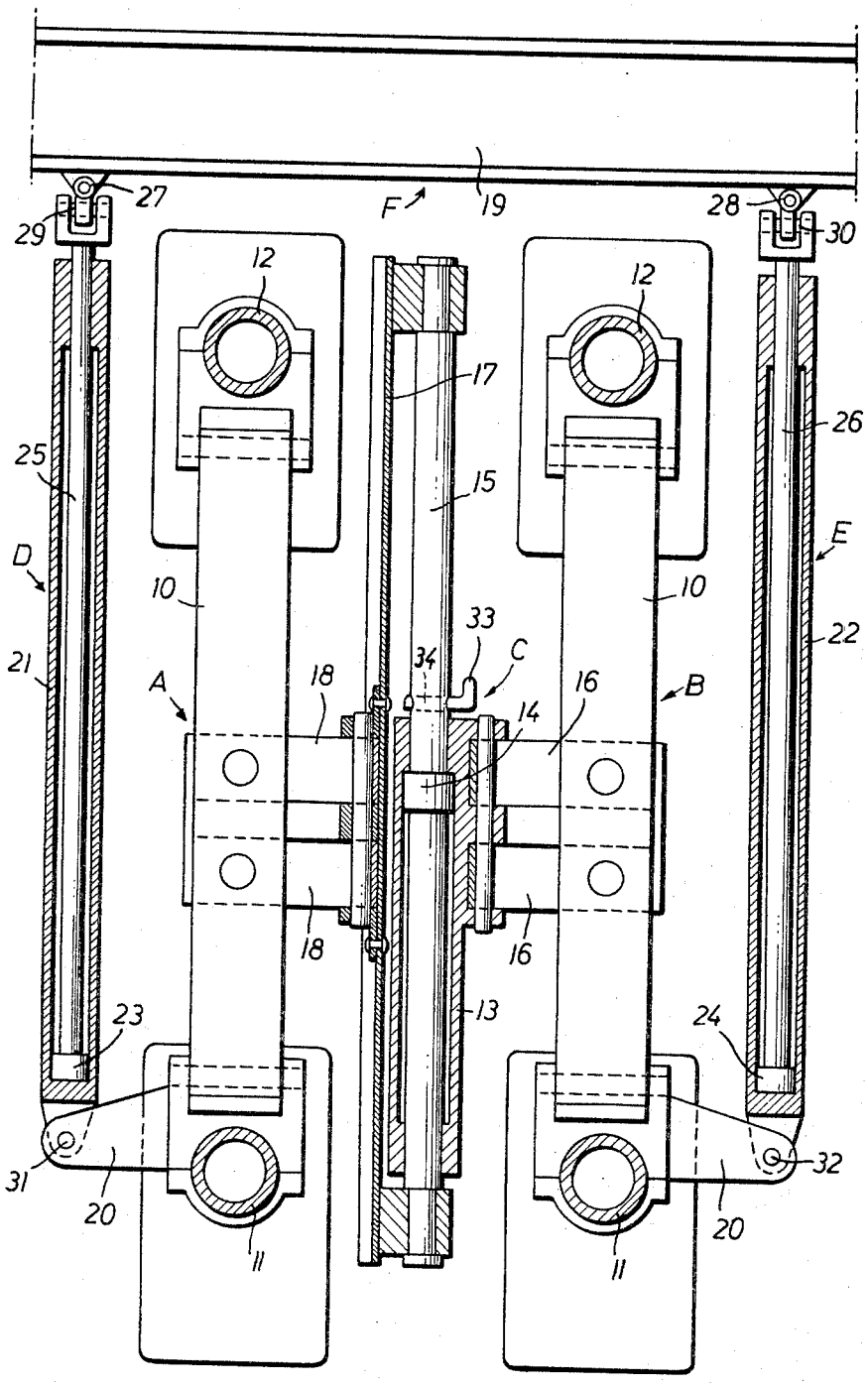
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MINING SUPPORT ARRANGEMENT

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ABSTRACT OF THE DISCLOSURE

Mining support arrangement including a pair of prop means, e.g., prop frames, medially interconnected by a common urging means, e.g., piston-cylinder means, for alternate advance in longitudinal direction of the prop means with respect to each other, guide means, e.g., a mining conveyor, extending crosswise of the longitudinal direction adjacent the prop means, and a pair of separate urging means, e.g., piston-cylinder means, each interconnecting the guide means and a corresponding prop means laterally outwardly outwardly of the prop means and common urging means for simultaneous actuation in the longitudinal direction to advance alternately the guide means and then both prop means together independently of the common urging means as well as for separate actuation to change the angle of the guide means with respect to the longitudinal direction of advance and in turn with respect to the disposition of the prop means.

The present invention relates to a mining support arrangement which may be in the form of a power chock, and more particularly to a pair of prop means operatively interconnected by urging means to one another and to a guide means, such as a mining conveyor, for alternate advance of one such prop means with respect to the other and for joint advance of both prop means toward the guide means and/or advance of the guide means away from the prop means.

Mining support arrangements, such as those in the form of hydraulic power chocks, are being used more and more in mining operations, especially longwall mining operations, for the extraction of mineral such as coal from a mine face, using a mining machine such as a planer for this purpose. A guide means is extended normally along the mine face and the mining machine may be guided therealong, and as new layers of mineral are extracted, the guide means, which may be a conventional mining conveyor, and the mining machine used in conjunction therewith are advanced in increments toward the new mine face layers to be worked. In order to protect the workmen and the equipment from roof cavein in the mineway in which the operations are conducted, hydraulic power chocks are employed normally behind the guide means, i.e., on the other side thereof from that at which the mine face is disposed. The power chocks may be self-propelled or advanced in any manner so as to protect the roof over the guide means area. Many such power chocks or mining roof supports are utilized in longitudinally spaced apart relation along the mine face.

Each roof support or chock consists as a rule of a plurality of prop frames disposed perpendicularly with respect to the mine face. The constructional design of these chocks will differ considerably, however, depending upon the roof pressures that must be supported.

Thus, if the roof pressure is not expected to be extremely great, the chocks are often constructed with two prop frames disposed in parallel relation to one another and at a certain distance apart, with such frames being

joined together by a common urging means, such as an advancing cylinder. The advancing cylinder really contemplates a piston-cylinder means disposed approximately midway between the two frames such that the cylinder is connected to one prop frame while the piston rod is connected to the other frame. In this way one prop frame may be relieved from the pressure of the roof and advanced by means of the advancing cylinder as the mining operation progresses. When such frame has been reset in supporting engagement between the mine roof and mine floor, the second prop frame can be pulled forward by reverse actuation of the advancing cylinder so that both frames are once more in alignment. As to the second frame, the props thereof are relieved from roof pressure after the already advanced frame has been reset in extended roof supporting engagement. The leverage provided permits the reverse actuation of the advancing cylinder to urge the second frame forward in the direction of advance whereupon both frames may again support the roof at about the same distance from the working face once the second frame is again extended into roof supporting position. A chock containing frames of the type noted is able to be advanced independently of other equipment at the mine face so long as energy is provided for this purpose. It will be realized that each prop frame may contain one or more props in the form of hydraulic mining props or pit props, e.g., hydraulic jacks, which can be operated from a retracted position to an extended position for supporting the roof. The advancing cylinder may be similarly hydraulically operated.

A mining conveyor is normally used with the mining machine and generally such conveyor is in the form of conveyor sections articulatedly interconnected in end-to-end relation, perhaps with allowances for deviation in the horizontal as well as the vertical planes thereof, whereby to accommodate unevenness in the mine floor and also permit undulations as occur when a portion at a time of the conveyor is advanced toward newly exposed layers of the mine face. To advance the conveyor and thus the guide for the mining machine used, separate advancing chocks may be used or the roof support or chock may serve this purpose. Specifically, a particular self-propelled chock of the foregoing type may be provided with an abutment surface or the like at its forwardmost end adjacent the conveyor which exerts pressure on the conveyor to advance the same as the particular prop frame of the chock having such abutment surface is advanced. Actually, one abutment surface may be provided or both frames may be equipped with such abutment surfaces so as to achieve orderly advancement of the conveyor as each frame is advanced. The frames may alternately urge the conveyor forward against the working face or one such frame may perform this task, depending upon whether one or both frames have abutment surfaces, yet the overall force for achieving such advance is provided by the advancing cylinder of the prop frames of the chock.

Chock or roof supporting arrangements of the aforegoing type, such as those containing a pair of side-by-side prop frames interconnected by a common advancing cylinder are disclosed, for example, in U.S. Patents 3,169,377, 3,174,289, 3,192,722, and 3,225,547. Abutment surfaces or connections between such roof supports and sections of the conveyor are shown particularly in said U.S. Patent 3,192,722.

However, where a high proof pressure is expected during mining operations, such as where the roof of a seam consists of heavy sandstone and the depth of the mine is relatively slight, the roof propping system may be subjected occasionally to an overhead pressure which is beyond the capacity of the roof support or chock system being used, i.e., especially is view of the alternate advancement of the frames and the concomitant lessening

by about one-half of the support of the roof during the advance of each such frame. In such events it is preferable to use a different kind of roof propping system in which two or more frames are combined together into a rigid unit. Upon advancing operation of such rigid unit, all of the props are relieved of roof pressure at the same time and the rigid unit chock is urged forward as a whole toward the working face. It is immaterial whether such rigid unit chock has four props or more, the number of props being dependent upon the constructional dimensions of the unit and the supporting force which any particular prop is expected to provide. The greater the pressure expected at the roof, the greater will be as a rule the number of props with which each such chock is equipped whereby to withstand expected roof pressures. The advancing of such a rigid unit chock is usually performed by means of an advancing piston-cylinder, i.e., including a piston carried by a piston rod as well as the cylinder itself, the cylinder part being connected to the chock and the piston part being connected to the conveyor section arranged in front of the mine face, or vice versa. In accordance with such an arrangement, the conveyor may be first advanced by the advancing cylinder while the rigid unit chock is in supporting engagement with the roof to provide the necessary coverage, and thereafter all parts of the rigid unit chock are relieved of roof pressure whereupon the chock may be pulled forwardly toward the conveyor section and the working face by the advancing cylinder upon reverse actuation thereof, using the already advanced conveyor to which the chock is connected as the point of support or leverage to achieve the chock advance. When this has been accomplished, then all of the props are once more extended under pressure between the mine roof and mine floor to attain roof support until the next advance of the chock is intended.

It is an object of the present invention to overcome the foregoing drawbacks and to provide a mining support arrangement which may be in the form of a power chock or other advanceable roof propping system in which individual frames thereof are alternately advanceable and, whenever desired, jointly advanceable together as a unit.

It is another object of the present invention to provide a mining support arrangement which may be used not only where ordinary roof pressure conditions in the mineway and along the mine face are experienced but also where such conditions require additional support beyond that nomally provided by a mining support or advanceable propping system having alternately advancing frame portions.

It is still another object of the present invention to provide such a mining support arrangement which ensures adequate safety against cavein during the mining operation and/or during any alternate or joint advance of the particular mining support arrangement in question.

It is still another object of the present invention to provide a mining support arrangement of the foregoing type which may be used in connection with longwall mining operations, wherein a mining machine is conducted back and forth along a mine face in extractive engagement therewith, utilizing a guide means such as a mining conveyor to maintain the mining machine in the desired path of operation.

It is still another object of the present invention to provide a mining support arrangement of the foregoing type utilizing various urging means alternately or simultaneously to achieve the advance of the mining support arrangement itself and alternately the guide means disposed thereahead in the direction of the mine face being worked, preferably utilizing hydraulic or pneumatic pressure fluid medium urging equipment to carry out the advance as well as the propping of the mine roof by the mining support arrangement or chock.

It is a still further object of the present invention to provide an arrangement of the foregoing type which may utilize as constructional elements thereof certain existing equipment, by appropriate modifications in accordance with the present invention, and particularly to provide a constructional arrangement simple and inexpensive to produce and durable in operation.

Other and further objects of the present invention will become apparent from a study of the within specification and accompanying drawing which illustrates a top plan schematic view with certain parts in section of a mining support arrangement in accordance with one embodiment of the present invention.

It has been found in accordance with the present invention that a mining support arrangement may now be provided which comprises a pair of prop means operatively interconnected by common longitudinal urging means of adjustable effective length operable between a retracted position of minimum over-all effective length and an extended position of maximum over-all effective length for alternate stroke actuation to displace said prop means alternately with respect to each other in the longitudinal direction of said common urging means, elongated guide means extending normally crosswise of said longitudinal direction adjacent said prop means, and a pair of separate longitudinal urging means of adjustable effective length operable between a retracted position of minimum over-all effective length and an extended position of maximum over-all effective length each interconnecting operatively a corresponding prop means with said guide means for separate as well as simultaneous stroke actuation to displace said guide means and the corresponding prop means interconnected thereby alternately toward and away from each other in the longitudinal direction of the corresponding separate urging means, said urging means being capable of actuation independently of one another, whereby upon simultaneous actuation of both said separate urging means to extended position said guide means may be advanced in said longitudinal direction away from said prop means and upon simultaneous actuation of both said separate urging means to retracted position said prop means may be advanced in said direction toward said guide means, while upon separate actuation of one said separate urging means to extended position when the other said separate urging means is in retracted position as well as upon separate actuation of one said separate urging means to extended position and the other to retracted position, said guide means and said prop means may be displaced from the normal crosswise disposition thereof so that the angle of intersection of the elongated axis of said guide means with said longitudinal direction of said common urging means is changed, whereas upon alternate actuation of said common urging means each said prop means may be advanced in said longitudinal direction with respect to the other prop means yet such that said guide means will be advanced simultaneously with a corresponding prop means advance only when said separate urging means are fixed against any further actuation to retracted position as well as only when said separate urging means are also actuated correspondingly to extended position.

Thus, the present invention contemplates a mining support arrangement which may be in the form of a power chock containing a pair of prop means, for example, prop frames operatively interconnected by urging means to one another and to a guide means, such as a mining conveyor, for alternate advance of one such frame with respect to the other and for joint advance of both of the frames toward the guide means, and/or advance of the guide means away from the frames.

The present invention solves the problem of creating an advanceable roof propping system in which the individual prop means or prop frames are alternately advanceable and whenever desired all of the frames may be combined together into a roof propping chock which can be advanced as a complete unit.

In order to achieve the required construction, a typical prior art roof propping chock, such as that shown in said U.S. Patent 3,192,722 or any of the other aforesaid U.S.

patents, in which two frames are advanceable alternately toward the mine face by the use of an advancing cylinder disposed therebetween, is modified by the addition thereto, on the outer lateral sides of the two prop means or frames, of corresponding articulatedly mounted cylinders, i.e., piston-cylinder means, with the piston rods thereof acting upon a guide means, such as a common beam attached to a conveyor disposed thereahead in the direction of the mine face. Advantageously, the two laterally outer or outboard piston-cylinder means are mounted on the prop means at a maximum distance from the working face, preferably in the vicinity of the rear props of the frames in question. Also, it is preferred to make the stroke length of the piston disposed within such outboard cylinders greater than the potential advancing stroke of the common urging piston-cylinder means interconnecting the pair of frames. The length of excursion of the outboard piston-cylinder means may be, for instance, approximately equal to the distance between the forwardmost and rearward props on a given frame, such as in the case where the frame or prop means is composed of tandemly arranged props carried between a floor skid and a roof supporting cap.

Under certain circumstances, it is advisable to provide locking means for the common advancing piston-cylinder means interconnecting the two frames or prop means, i.e., when the entire mining support arrangement is to be advanced as a unit.

The particular form or construction of the locking means is itself immaterial with regard to the over-all aspects of the present invention. Where an advancing cylinder, i.e., piston-cylinder means, is used to interconnect the two frames, the locking means may be by way of a bolt passing through the piston rod to prevent displacement of the piston and cylinder with respect to one another in a given direction or in both directions, depending upon the axial point along the rod at which the bolt is inserted.

So long as the roof pressure in the mineway adjacent the mine face is not unduly great, the advancement of the mine supporting arrangement, for example in the form of a chock containing a pair of frames, can be undertaken merely by actuating the advancing piston-cylinder means common to the two frames. In this case, in the usual prior art manner, first one frame is relieved from roof supporting engagement and advanced by common advancing means, and thereafter extended into roof supporting engagement. The second frame is then retracted from roof supporting engagement and the advancing piston-cylinder means operated in the reverse direction to urge the second frame forwardly to a position again alongside the first frame advanced. Once this has been done, the second frame may be extended into supporting engagement with the roof. By providing an abutment surface or extension on one or both the frames extending toward the guide means, such as the conveyor, as the mining support arrangement is advanced, the conveyor will be advanced automatically as well, in the known manner. The pushing force of the particular frame being advanced is transmitted to the conveyor through such abutment surface or surfaces. Nevertheless, the outboard piston-cylinder means may be used instead to urge the guide means, e.g., conveyor, in the forward direction during any advance caused by the common piston-cylinder means interconnecting the two frames. To achieve advance of the guide means via the outboard piston-cylinder means will generally require that in the starting position the pistons will be in their rearmost position within the respective cylinders so that an effective common urging means excursion stroke will be possible to urge the conveyor forward. During this time, of course, the other particular frame from that to which such outboard piston-cylinder means is connected will be maintained in roof supporting engagement to contribute the required leverage.

On the other hand, where the roof pressure conditions in the mineway become more dangerous, i.e., where the conditions worsen to such an extent that a light propping system or chock using alternately advancing frames is no longer sufficient to support the roof in a safe manner, the propping system can be utilized in accordance with the present invention in an entirely different manner by merely closing off the common piston-cylinder means interconnecting the two prop means, e.g., frames, so that all of the props of the system in question, i.e., chock, may be relieved of roof supporting engagement simultaneously, the support of the roof generally during this time being borne by adjacent mine supporting arrangements in the mineway. Using the two outboard piston-cylinder means, the mining support arrangement, e.g. chock, may be drawn forward as a unit toward the guide means and in turn the mine face in question. It will be understood that with the retraction of all of the props in the mining support arrangement, the urging forward of such arrangement as a unit and the resetting of the props into extended roof supporting engagement once more, after the advance, can be conducted extremely rapidly so that there is hardly any danger that the roof will sag, crumble or cave in during the non-supported interim.

In order to ensure that when the mining support arrangement is advanced as a unit, no shifting or longitudinal displacement of the two prop means, e.g., prop frames, with respect to the other, will take place under any circumstances, locking means of the foregoing type may be employed for the common piston-cylinder means interconnecting the frames.

If thereafter the mine roof conditions improve so that the advancement of the mining support arrangement as a unit is no longer necessary in the interests of safety, it is easy to revert to the original advancing system of the prop means, e.g., prop frames, in alternate sequence utilizing the common piston-cylinder means interconnecting the pair of prop means for this purpose. During this time, the outboard or lateral outer piston-cylinder means may be switched to idle position or fully retracted position.

Referring to the drawing, a mining support arrangement shown in the form of a prop chock is utilized, the chock including the pair of frames A and B which are disposed in spaced apart side-by-side relation. Each frame is composed of a floor bar or floor skid **10** preferably of resilient strap metal or spring metal to accommodate unevenness in the mine floor, a roof cap (not shown) and a pair of upright props **11** and **12** disposed on the ends of floor skid **10** so as to interconnect such ends with the corresponding ends of the roof cap located thereabove. Props **11** and **12** are preferably in the form of hydraulic props or pit props, e.g. hydraulic jacks, of the conventional type, which may be extended hydraulically into roof supporting engagement and permitted to retract from such engagement when desired.

Between the two frames A and B, a common longitudinal urging means C is provided in the form of an advancing cylinder, i.e., piston-cylinder means, including the cylinder **13** and the piston **14**, carried operatively by the piston rod **15** more or less intermediate the ends thereof. Cylinder **13** has a length which corresponds approximately to half the distance between props **11** and **12** of a given frame. The piston rod **15** projecting via its ends through the cylinder heads of cylinder **13** in the well known manner is attached appropriately to a bar **17** which in turn is connected by the parallel medial arms **18** to the floor skid **10** of frame A. On the other hand, cylinder **13** is similarly connected by the two parallel arms **16** to the floor skid **10** of frame B. Bar **17** is appropriately maintained parallel to the piston rod **15** and in turn the medial connecting arms **16** and **18** are dimensioned so as to maintain frames A and B in the desired substantially parallel position shown so as to permit alternate longitudinal advance in increments by the reciprocating operation of the urging means C. It is apparent from the drawing that the urging means C will first advance individually one of the frames retracted from roof supporting engagement while the second

frame is maintained in such engagement, followed by the advance of the second frame after the first frame advanced is extended into roof supporting engagement and the second frame retracted from such engagement to permit its advance.

The construction and operation described up to this point is more or less within the status of the prior art, as will be appreciated from a study of the aforementioned U.S. patents. However, in accordance with the present invention, the additional outboard or separate lateral urging means D and E are provided in the form of appropriate piston-cylinder means, including the cylinders **21** and **22** correspondingly connected articulatedly at vertical axis pivots **31** and **32**, respectively, to the lateral arms **20** extending from the appropriate rearward ends of frames A and B, and the corresponding pistons **23** and **24** carried at the extreme rearward ends of the piston rods **25** and **26**, respectively, which extend through the forwardmost ends of cylinders **21** and **22**, as the case may be, for appropriate connection with a guide means F located therebefore. The guide means is shown in the form of a conveyor **19** which may be in the form of a double chain scraper conveyor composed of a plurality of articulatedly interconnected conveyor sections in end-to-end relation. Such mining conveyors are well known.

By reason of the combined pivot connections of the piston rods **25** and **26**, including the transverse horizontal axis pivots **29** and **30** as well as the vertical axis pivots **27** and **28**, displacement of piston rods **25** and **26** with respect to cylinders **21** and **22**, when frames A and B are in roof supporting engagement, will cause the displacement in the forward longitudinal direction of the guide means F, i.e. away from the frames A and B.

During this time, it is convenient to insert the bolt or pin **33** into the transverse bore **34** located intermediate the ends of common piston rod **15** to prevent any displacement in either direction of the rod **15** and the cylinder **13** with respect to one another. It will be realized that the piston **14** is so positioned with respect to pin **33** that the cylinder **13** cannot be displaced at all.

The separate lateral urging means D and E are articulatedly connected to the frames A and B in the vicinity of the rear props **11** by means of the offset arms **20** in order to permit the advancement of the guide means F without deviation from its normal longitudinal axis which is, of course, perpendicular to the longitudinal direction of advance of frames A and B. The guide means F in the form of the conveyor **19** is usually maintained parallel with respect to the mine face being worked whereby to permit the mining machine (not shown) to be conducted back and forth therealong in extractive engagement with the mine face. During this time, frames A and B will provide support of the mine roof adjacent the mining operation and prevent cavein, in the usual longwall mining technique.

However, if it is desired to change the direction of the guide means F with respect to the mine face or with respect to the crosswise position thereof, considering the longitudinal direction of advance of frames A and B, the urging means D and E need not be operated simultaneously or under the same force, but instead either may be operated alone or separately or both may be operated at different degrees of force whereby the ultimate stroke amplitude under a given set of conditions will produce an angular displacement of the guide means F with respect to the longitudinal direction of advance of frames A and B. Such change in angular disposition of guide means F with respect to frames A and B may be performed in a very precise manner merely by control of the actuation of the separate lateral urging means D and E.

It should be noted that the present construction may be used to carry out this particular feature of changing the angular disposition of guide means F, on the one hand, and frames A and B, on the other hand, with respect to one another, without the need for utilizing certain prior art arrangements of mining supports as heretofore disclosed, such as in some of the aforementioned U.S. patents.

Once guide means F has been advanced in the desired way utilizing the lateral urging means D and E for this purpose while frames A and B are maintained in roof supporting engagement and common urging means C is fixed from displacement, the chock composed of frames A and B may be advanced as a unit merely by reverse actuation of the separate lateral urging means D and E. Normally, the actuation of the lateral urging means D and E will take place simultaneously and under the same actuating force whereby to draw the chock forward. However, it is still possible to actuate lateral urging means D and E under different degrees of hydraulic or pneumatic force, depending upon the type of pressure fluid medium utilized, so as to adjust the angular disposition between frames A and B, on the one hand, and guide means F, on the other.

As the artisan will appreciate, when the guide means F is advanced via lateral urging means D and E, frames A and B, or at least one of them, will be in roof supporting engagement to provide the desired leverage. On the other hand, when the chock composed of frames A and B in the form of a rigid unit by reason of the position of the piston with respect to the pin in the transverse bore, is to be advanced, all of the props thereof will be released from roof supporting engagement and the weight of the guide means F may be utilized as the leverage permitting the drawing forward of frames A and B in the form of a unit. Immediately thereafter, all of the props in frames A and B are energized to achieve roof supporting engagement.

Insofar as the locking means provided by pin **33** and transverse bore **34** are concerned, this simple means serves to change frames A and B from alternately advanceable members to a rigid unitary chock. It will occur to the artisan that any particular means may be used in place of pin **33** and bore **34** to achieve the same purpose. Thus, the particular elements utilized are immaterial so long as frames A and B are fixed from relative longitudinal displacement with respect to one another in the longitudinal direction of advance when the entire chock is to be drawn forward by means of the lateral urging means D and E. The bore **34** is positioned in rod **15**, in dependence upon the over-all dimensions of the coacting parts, such that in one extreme position of cylinder **13**, i.e., in abutment with the appropriate end face of piston **14**, bore **34** will be located directly in front of the cylinder head adjacent that particular face of piston **14**.

It will be realized by the artisan that the stroke of the lateral urging means D and E should be greater than that of the common urging means C to permit rapid advance of the chock as a unit when this is desired and also appropriate efficient advance of the guide means F. On the other hand, where danger from roof cavein is not significant, the alternate advance of frames A and B in the prior art manner may be conducted in as many increments as are necessary for achieving a particular over-all displacement in the longitudinal direction. As aforesaid, during this time, the pistons **23** and **24** of the lateral urging means D and E will be retracted position so that the alternate advance of frames A and B will serve to maintain guide means F a given distance thereahead by means of the pushing force exerted onto guide means F through the lateral urging means D and E. The urging force of common urging means C is generally sufficient for this purpose, but if not, frames A and B need merely be extended into roof supporting engagement and the guide means displaced by the use of the lateral urging means D and E.

It will be appreciated that the operation of the mining support arrangement of the present invention may be carried out with any type of advancing means, such as piston-cylinder means, and especially double acting piston-cylinder means, with the piston part being attached to one of the elements to be moved and the cylinder part attached

to the other of the elements to be moved, without particular regard as to whether the piston or cylinder part is attached to any given element to be moved. The common piston-cylinder means may be in the form of a double acting piston-cylinder means in which the piston rod carrying the piston is about twice as long as the cylinder, with the ends of such rod extending through the heads of the cylinder, although a piston-cylinder means may be used as well in which the piston rod carrying the piston at the innermost end thereof extends through only one head of the cylinder. In the same way, the laterally disposed separate piston-cylinder means interconnecting the prop frames with the guide means may be in the form of an elongated cylinder in which is operatively received a piston carried at the innermost end of the piston rod such that the piston rod extends through only one head of the cylinder, although a double acting piston-cylinder means in which the piston rod is about twice the length of the cylinder may be used such that the ends of the piston rod extend through the ends or the heads of the cylinder. Nevertheless, the normal stroke of the separate laterally outer or outboard piston-cylinder means will be greater than that of the common piston-cylinder means interconnecting the two prop means whereby to achieve the over-all benefits of the present invention. The laterally outer separate piston-cylinder means must be designed to permit their joint actuation to advance the prop means as a unit in a very rapid manner and along a path of a desirable distance to permit the advance of the prop means with a minimum of danger to the disposition of the roof robbed of support during this interval.

Thus, when the prop means are in roof supporting engagement, the laterally outer urging means may be actuated to extend the guide means in the longitudinal direction away from the prop means and toward the mine face. If precise advance is not desired but rather angular advance to change the crosswise disposition of the guide means with respect to the prop means, one of the laterally outer urging means will be extended a greater amount than the other. Then the prop means as a unit may be advanced by reverse actuation of the separate outer laterally urging means once the prop means have been removed from roof supporting engagement. This, of course, will be as rapidly as possible and because of the use of both of the separate laterally outer urging means, the desired movement will take place without hindrance due to unevenness in the mine floor and any extracted mineral which may be on the mine floor in the direct path of movement. Since the guide means will normally be a conveyor loaded with mineral such as coal, such guide means readily provides the necessary leverage. Even so, since the conveyor section in question is interconnected with adjacent conveyor sections which may be held in a particular position in terms of adjacently disposed separate mining support arrangements of the instant type, the advance of the prop means as a unit will take place without hindrance, interruption or serious chance of cavein. Nevertheless, if one of the laterally outer urging means is actuated with greater force than the other, the prop means will be advanced at an appropriate changed angle with respect to the guide means. Therefore, the crosswise disposition of the guide means and prop means with respect to one another may be changed either during the advance of the guide means or of the prop means, as the case may be. During advance of the guide means as aforesaid, the prop means will normally be in roof supporting engagement or at least that prop means will be extended into roof supporting engagement which is connected to the laterally outer urging means being used to move the guide means.

On the other hand, where the prop means are advanced in the usual step-by-step manner using the common urging means for this purpose, the advance of the guide means will take place via the laterally outer separate urging means connected with the prop means being advanced (while the other such prop means remains in roof supporting engagement to provide the necessary leverage). The laterally outer urging means at this time merely serves as a pusher bar or link or thrust connection since the piston rod will normally be retracted into the cylinder to the maximum extent. However, at the time a given prop means is advanced by the common urging means, it is still possible, if desired, to actuate at the same time the laterally outer separate urging means connected therewith and in this way achieve a greater linear advance of that portion of the guide means than the linear advance of the prop means being advanced. The other separate laterally outer urging means may remain retracted fully during this time because of the presence of the vertical axis pivot connection **28** or **27**, or depending upon the particular linear dimensions and extent of advance of the guide means, the piston rod of such other separate laterally outer urging means may be drawn somewhat outwardly as for example when the pressure fluid is in idle or neutral condition. When the now advanced prop means is set, reverse actuation of the common urging means will not only bring forward the second prop means but at the same time will urge that portion of the guide means in the desired direction under the linkage provided by the adjacent separate laterally outer urging means. If the piston rod had been partially extended during the previous advance operation, the movement of the adjacent prop means will first cause complete retraction and thereafter advance of the guide means, although as the artisan will appreciate, the particular partially extended piston rod can be set in partially extended position and the guide means will still be advanced in the desired direction under the actuating force of the common urging means.

The inherent versatility of simultaneous and separate actuations to provide an extremely wide variety of sequences of operation utilizing an arrangement of the type contemplated by the present invention will be appreciated by the artisan, and thus each and every sequential operation possible need not be described in detail herein.

Therefore, in accordance with the present invention, each urging means preferably includes a first urging part connected to one of the corresponding means to be displaced thereby and a second urging part connected to the other corresponding means to be displaced thereby, said parts being operatively interconnected for limited relative linear displacement with respect to each other to adjust the over-all effective length of the corresponding urging means. In particular, the common urging means is a piston-cylinder means including a cylinder connected to one of said prop means to be displaced thereby and a piston rod carrying a double acting piston operatively received within said cylinder yet with the ends of said rod slidably extending through the corresponding ends of said cylinder and connected correspondingly to the other of said prop means to be displaced thereby, whereas each separate urging means is a piston-cylinder means including a cylinder connected to one of the corresponding means to be displaced thereby and a piston rod carrying a double acting piston on one end thereof operatively received within said cylinder yet with the other end of said rod slidably extending through a corresponding end of said cylinder and connected to the other of the corresponding means to be displaced thereby.

The prop means are preferably arranged in side-by-side relation such that the common urging means is medially disposed therebetween whereas the separate urging means are preferably disposed laterally outwardly with respect to the common urging means and the appropriate prop means with which the particular separate urging means is connected. Advantageously, the common urging means is substantially rigidly connected correspondingly to each of the two prop means while each separate urging means is pivotally connected to the corresponding prop means and to the guide means.

In accordance with a particular embodiment of the invention, the pivotal connection of each separate urging

means to the corresponding prop means is by way of a substantially vertical axis pivot while the pivotal connection of each separate urging means to the guide means is by way of a combined axis pivot connection having both a substantially vertical axis pivot and a substantially transverse horizontal axis pivot, with the transverse axis pivots of both the urging means coinciding and being substantially parallel to the elongated axis of the guide means. Furthermore, in connection with a particular feature of the invention, each prop means is in the form of a substantially rectangular vertical prop frame including a longitudinally extending floor skid, a longitudinally extending roof cap disposed thereabove, and a pair of longitudinally spaced apart extensible and retractable vertical pit props operatively interconnecting said floor skid and roof cap for releasable mine roof support, said common urging means interconnecting said frame in substantially parallel relation, whereas the guide means is in the form of a mining conveyor section.

Advantageously, in accordance with a significant feature of the invention, the separate urging means are connected to the corresponding prop frame in the vicinity of the rearmost portion thereof which is remote from the guide means while the stroke amplitude of the two separate urging means whereby corresponding changes in effective than the corresponding stroke amplitude of the common urging means whereby coresponding changes in effective length of the separate urging means will be greater than that possible with the common urging means. Preferably, as aforesaid, the stroke amplitude of the separate urging means will be approximately equal to the longitudinal dimension of the frames.

To achieve the advance of the pair of prop means or frames as a rigid unit, in accordance with the present invention, the normally operating alternately advanceable prop means or frames are locked releasably from relative longitudinal displacement with respect to one another, for example by providing appropriate releasable locking means on the common urging means, whereby to lock releasably the common urging means from any changes in effective length during actuation of the separate urging means to draw the rigid unit of prop means or frames in the forward direction of advance as efficiently and rapidly as possible for extension once more into roof supporting engagement and thus for minimizing as far as possible danger from cavein during the rigid unit advance of the prop means.

In accordance with the broad aspects of the invention, therefore, a mining support arrangement may be provided for use in connection with normal pressure and excess pressure roof support with a minimum danger of cavein during advance of the system. Such mining support arrangement may comprise in this regard a pair of prop means operatively interconnected by common longitudinal piston-cylinder means for alternate actuation to displace said prop means alternately with respect to each other in the longitudinal direction of said common piston-cylinder means, elongated guide means extending normally crosswise of said longitudinal direction adjacent said prop means, a pair of separate longitudinal piston-cylinder means each interconnecting operatively a corresponding prop means with said guide means for separate as well as simultaneous actuation to displace said guide means and the corresponding prop means interconnected thereby alternately toward and away from each other in the longitudinal direction of the corresponding separate piston-cylinder means, all said piston-cylinder means being capable of actuation independently of one another, and releasable locking means connected operatively to said common piston-cylinder means to lock said common piston-cylinder means against displacement of said prop means with respect to each other when said separate piston-cylinder means are actuated.

Naturally, where various constructional parts have been defined in terms of "means" in the instant specification and/or claims, such means have been illustrated in the accompanying drawing as specific elements, but in accordance with the present invention, such means contemplate any and all elements usable to achieve the combination arrangement of the invention, as the artisan will appreciate, so long as the disposition of the parts in question is maintained, and any and all such constructional elements are contemplated herein just as if prolix enumeration thereof were set forth in detail herein.

It will be appreciated that the instant specification and drawings are set forth by way of illustration and not limitation, and that various modifications and changes may be made without departing from the spirit and scope of the present invention which is to be limited only by the scope of the appended claims.

What is claimed is:

1. Mining support arrangement which comprises a pair of prop means operatively interconnected by common longitudinal urging means of adjustable effective length operable between a retracted position of minimum over-all effective length and an extended position of maximum over-all effective length for alternate stroke actuation to displace said prop means alternately with respect to each other in the longitudinal direction of said common urging means, elongated guide means extending normally crosswise of said longitudinal direction adjacent said prop means, and a pair of separate longitudinal urging means of adjustable effective length operable between a retracted position of minimum over-all effective length and an extended position of maximum over-all effective length, each respectively pivotally connected at one end portion thereof to said guide means and at the other end portion thereof to a corresponding prop means and thereby each interconnecting operatively a corresponding prop means with said guide means for separate as well as simultaneous stroke actuation to displace said guide means and the corresponding prop means interconnected thereby alternately toward and away from each other in the longitudinal direction of the corresponding separate urging means, said urging means being capable of actuation independently of one another, whereby upon simultaneous actuation of both said separate urging means to extended position said guide means may be advanced in said longitudinal direction away from said prop means and upon simultaneous actuation of both said separate urging means to retracted position said prop means may be advanced in said direction toward said guide means, while upon separate actuation of one said separate urging means to extended position when the other said separate urging means is in retracted position as well as upon separate actuation of one said separate urging means to extended position and the other to retracted position, said guide means and said prop means may be displaced from the normal crosswise disposition thereof so that the angle of intersection of the elongated axis of said guide means with said longitudinal direction of said common urging means is changed, whereas upon alternate actuation of said common urging means each said prop means may be advanced in said longitudinal direction with respect to the other prop means yet such that said guide means will be advanced simultaneously with a corresponding prop means advance only when said separate urging means are fixed against any further actuation to retracted position as well as only when said separate urging means are also actuated correspondingly to extended position.

2. Arrangement according to claim **1** wherein each said urging means includes a first urging part connected to one of the corresponding means to be displaced thereby and a second urging part connected to the other corresponding means to be displaced thereby, said parts being operatively interconnected for limited relative linear displacement with respect to each other to adjust the over-all effective length of the corresponding urging means.

3. Arrangement according to claim **2** wherein said common urging means is a piston-cylinder means including

a cylinder connected to one of said prop means to be displaced thereby and a piston rod carrying a double acting piston operatively received within said cylinder yet with the ends of said rod slidably extending through the corresponding ends of said cylinder and connected correspondingly to the other of said prop means to be displaced thereby, and wherein each said separate urging means is a piston-cylinder means including a cylinder connected to one of the corresponding means to be displaced thereby and a piston rod carrying a double acting piston on one end thereof operatively received within said cylinder yet with the other end of said rod slidably extending through a corresponding end of said cylinder and connected to the other of the corresponding means to be displaced thereby.

4. Arrangement according to claim **2** wherein said prop means are in side-by-side relation and said common urging means is medially disposed between said prop means, and wherein said separate urging means are laterally outwardly disposed with respect to said common urging means and with respect to the corresponding prop means to which the particular separate urging means is connected.

5. Arrangement according to claim **4** wherein said common urging means is substantially rigidly connected correspondingly to each of said prop means.

6. Arrangement according to claim **5** wherein the pivotal connection of each said separate urging means to the corresponding prop means is a substantially vertical axis pivot, and wherein the pivotal connection of each said separate urging means to said guide means is a combined axis pivot connection having both a substantially vertical axis pivot and a substantially transverse horizontal axis pivot, the transverse axis pivots of both said separate urging means coinciding and being substantially parallel to the elongated axis of said guide means.

7. Arrangement according to claim **6** wherein each said prop means is in the form of a substantially rectangular vertical prop frame including a longitudinally extending floor skid, a longitudinally extending roof cap disposed thereabove, and a pair of longitudinally spaced apart extensible and retractable vertical pit props operatively interconnecting said floor skid and roof cap for releasable mine roof support, said common urging means interconnecting said frames in substantially parallel relation, and wherein said guide means is in the form of a mining conveyor section.

8. Arrangement according to claim **7** wherein said separate urging means are connected to the corresponding prop frame in the vicinity of the rearmost portion thereof remote from said guide means, and wherein the stroke amplitude of said separate urging means is substantially equal yet greater than the corresponding stroke amplitude of said common urging means, whereby the corresponding changes in effective length of said separate urging means is greater than that possible with said common urging means.

9. Arrangement according to claim **8** wherein the stroke amplitude of said separate urging means is approximately equal to the longitudinal dimension of said frames.

10. Arrangement according to claim **2** wherein releasable locking means are provided on said common urging means to lock releasably said common urging means from changes in effective length during actuation of said separate urging means.

11. Mining support arrangement which comprises a pair of prop means operatively interconnected by common longitudinal piston-cylinder means for alternate actuation to displace said prop means alternately with respect to each other in the longitudinal direction of said common piston-cylinder means, elongated guide means extending normally crosswise of said longitudinal direction adjacent said prop means, a pair of separate longitudinal piston-cylinder means each respectively pivotally connected at one end portion thereof to said guide means and at the other end portion thereof to a corresponding prop means and thereby each interconnecting operatively a corresponding prop means with said guide means for separate as well as simultaneous actuation to displace said guide means and the corresponding prop means interconnected thereby alternately toward and away from each other in the longitudinal direction of the corresponding separate piston-cylinder means, all said piston-cylinder means being capable of actuation independently of one another, and releasable locking means connected operatively to said common piston-cylinder means to lock said common piston-cylinder means against displacement of said prop means with respect to each other when said separate piston-cylinder means are actuated.

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U.S. Cl. X.R.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,434,292 March 25, 1969

Willy Heyer

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 11, line 25, after "means" insert -- is substantially equal yet both are greater --; same line 25, cancel "whereby corresponding changes in effective".

Signed and sealed this 31st day of March 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents