June 28, 1955 J. F. JOY 2,711,634

MINE ROOF SUPPORTING MEANS

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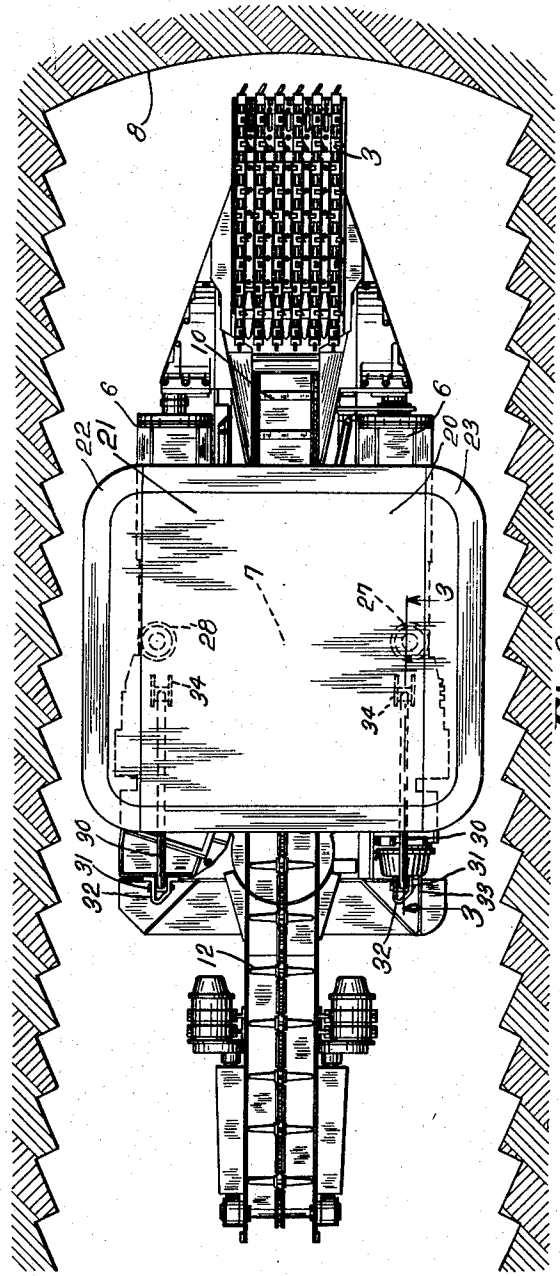


Fig. 1.

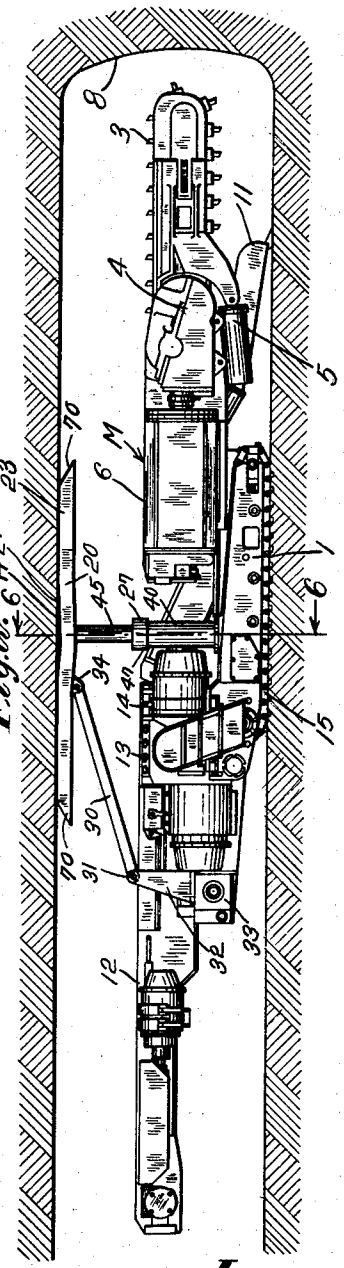


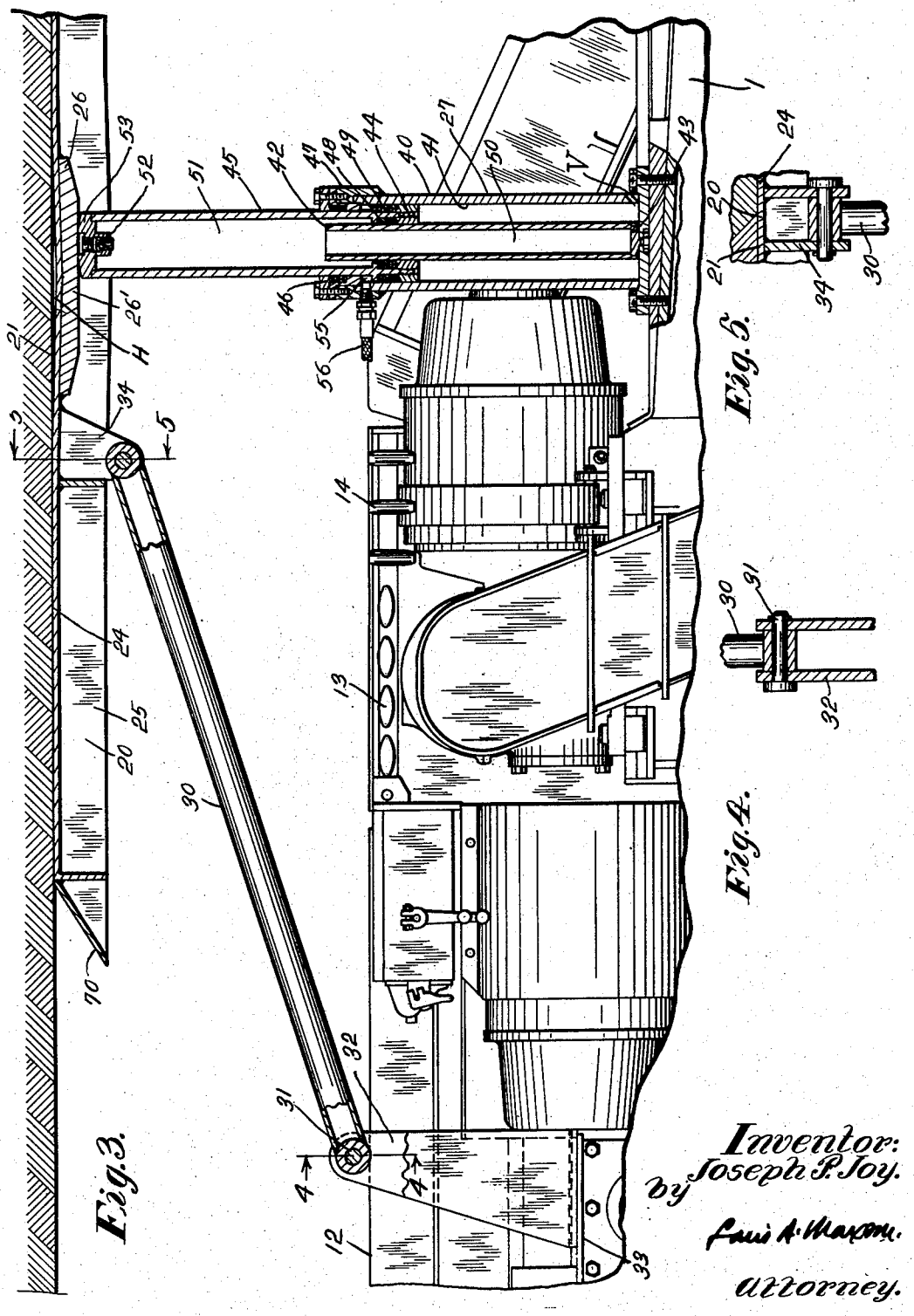
Fig. 2.

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*Fig. 6.*

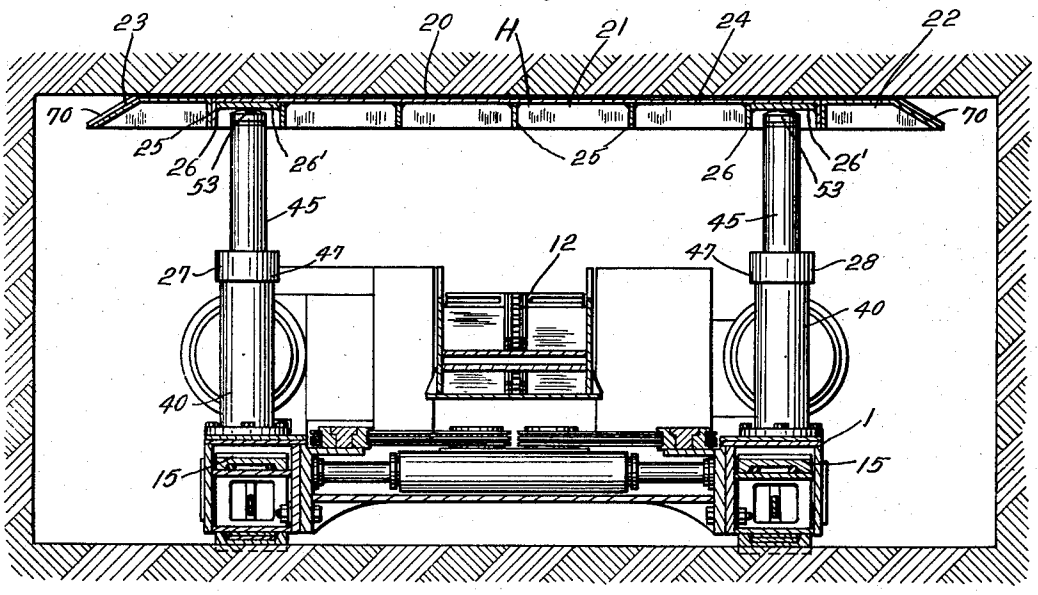



*Fig. 8.*

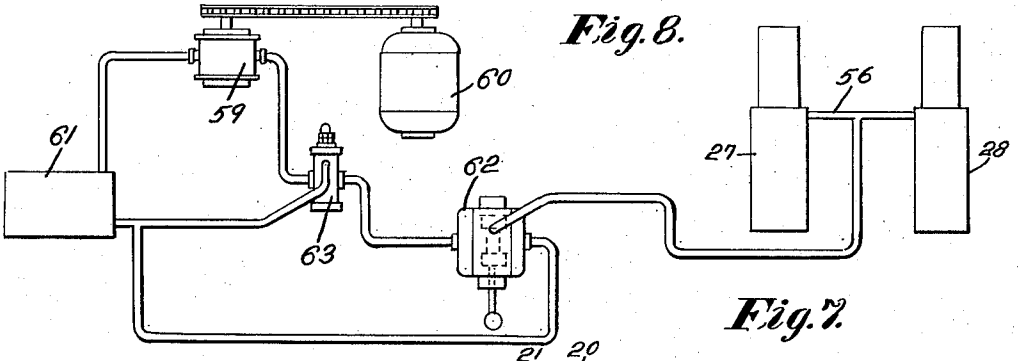
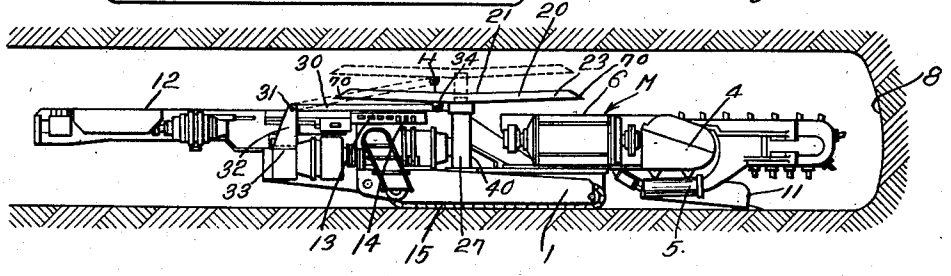



*Fig. 7.*




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2,711,634

# MINE ROOF SUPPORTING MEANS

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10 Claims. (Cl. 61—45)

My invention relates to mining apparatus, and, more particularly to means for the protection of machine runners and of the machines themselves from roof falls.

There has recently been developed a so-called "continuous miner"—an apparatus including a self-propelled base supporting vein attacking instrumentalities operable successively to form a relatively shallow, relatively wide opening adjacent one of the relatively horizontal boundaries of a mineral vein, to attack the vein by a swinging movement in upright planes, and to complete the disintegration of a vertical band by a withdrawing operation, there being a detachment of the mineral from the vein at a high rate, and a delivery of the disintegrated mineral forthwith to a conveying mechanism which is adapted to effect its delivery to a suitable material transport or carrying system. "Continuous miners" are large machines, they are relatively wide, and of very considerable length, and they are adapted, in room or entry work, to form openings whose forward walls—the working face—are adapted to be relatively rapidly advanced.

For the safety of the operators of these machines it is important that some protection against roof falls be provided, as the customary timbering cannot be carried up close to the working face, both because of the necessity of a reasonable amount of space for the maneuvering of the "miner," and because there is frequently little room at the sides of the machines for any work to be carried on. There is, accordingly, a substantial need for some form of roof support which shall advance with the "miner," which shall exert a suitable pressure against the roof to prevent subsidence or falls thereof in the period before permanent timbering can be installed, and which shall provide a shield over the portions of the machine which its operator normally occupies so as both to guard the operator, and prevent injury of the controls of the machine by material falling upon them.

It is accordingly an object of the invention to provide an improved roof shield structure for "continuous miners" or for other mining machinery to which it may be adapted. In a preferred form the shield structure may include a relatively large shield element, desirably formed so as to possess some flexibility so that it may contact a relatively substantial roof area, together with means for supporting, positioning, guiding and advancing the same. Another object of the invention is to provide an improved roof-engaging shield structure per se. A further object is to provide an improved shield structure having improved means for supporting and advancing the same, said supporting means providing for the maintenance of the shield against the roof with desired pressure and the shield advancing means adapted to transmit to the latter forces to effect movement thereof along the roof surface.

In a preferred embodiment a shield, formed to possess a certain flexibility to insure adequate roof contact, is adapted to be raised and held against the roof by hydraulic jack devices, desirably with a certain yielding capacity, and adapted to support the shield at points in a transverse zone approximately midway of the length of the



shield; and suitable thrust exerting devices, as radius rods, are adapted to be connected to the supporting body and to the shield in such a manner as to effect longitudinal advance or retraction of the shield.

Another object still is to provide an improved shield supporting jack structure. A further object is to provide an improved shield feeding means. Still another object is to provide an improved shield supporting and feeding apparatus, in which, in a preferred embodiment, a shield may overlie the apparatus to be shielded, and means is provided for yieldingly maintaining the shield in supporting contact with a mine roof so that it exerts the desired supporting pressure thereon, such last means desirably including what I will term, for convenience, hydro-pneumatic jack means—jack means in which a gas, such, for example, as nitrogen, is confined in an expansible chamber at high pressure and exerts a powerful yielding pressure on the shield, and such jack means desirably has associated with it hydraulic means for overcoming the pressure exerted by the confined gas and depressing the shield just sufficiently so that sliding of the shield shall be possible without the need for exertion of excessive feeding forces, while yet permitting the avoidance of such a withdrawal of the shield as would invite trouble.

Still another object of the invention is to provide an improved jack means, gaseous fluid extended, by a confined charge of gaseous fluid, of a construction such that the working range of extension shall be attended by relatively small changes in applied pressure, and desirably having means, such as hydraulic means, for effecting jack contraction while maintaining the mass of confined gas unchanged.

From the foregoing it will be apparent that among the general objects of the invention are the provision of an improved shielded mining apparatus, an improved shield construction, an improved jack mechanism, and an improved system of control for a roof shield. Other objects of the invention will appear in the course of the specification and from the appended claims.

In the accompanying drawings, in which one illustrative embodiment of the invention is shown for purposes of illustration:

Fig. 1 is a top plan view of a mining apparatus in which the illustrative embodiment of the invention is incorporated.

Fig. 2 is a side elevation of the mining apparatus of Fig. 1.

Fig. 3 is a considerably enlarged, fragmentary, sectional view, with certain parts shown in elevation, the figure showing a portion of a roof shield and of its positioning and supporting means in section, and the view being taken approximately on the vertical plane of the section line **3—3** of Fig. 1.

Figs. 4 and 5, are detail transverse sectional views, taken on the planes of the lines **4—4** and **5—5** respectively, of Fig. 3.

Fig. 6 is an enlarged—but less enlarged than Fig. 3—tranverse sectional view through the apparatus of Figs. 1 and 2, the section being taken on the transverse vertical plane of the line **6—6** of Fig. 2.

Fig. 7 is a side elevational view, similar to Fig. 2, showing, in full and in broken lines, the roof shield in different positions, and

Fig. 8 is a diagrammatic view of the control system for the hydro-pneumatic roof jack means.

Referring to the drawings, it will be observed that a mining apparatus is shown at M, this being for purposes of illustration shown of the "continuous miner" type and including a tractor supported base **1** upon which there is mounted a disintegrating mechanism, more fully disclosed in applications of John D. Russell and John R. Sibley, Serial Nos. 47,421 and 47,422, which, following the filing

of continuation-in-part applications, Serial Nos. 102,995 and 102,996, have become abandoned, all of these applications and the instant application having a common assignee. The disintegrating mechanism includes a disintegrating apparatus proper 3 mounted for vertical swinging movement about a transverse axis 4 under power supplied by swing cylinders of which one is shown at 5; and this disintegrating apparatus, which is driven by motors 6, is reciprocable along radial lines with respect to a vertical axis 7 to effect attacks on the coal across a face such as is indicated at 8 in Fig. 1, these attacks including a sumping forward movement, a vertical swinging movement, and a withdrawing movement. The coal torn loose from the face is carried back over the top of the disintegrating mechanism and deposited on a conveyor 10, and a cleanup arrangement or shovel 11 is provided for gathering coal which may fall on the mine bottom or floor. The mineral torn loose and carried back by the disintegrating mechanism may be delivered to a suitable point of discharge by a delivery conveyor 12. Suitable controls for the various constituent mechanims of the "miner" are provided at 13 and 14. The "miner" includes power driven tractor treads 15, power sumping and withdrawing mechanism for the disintegrating mechanism, power swinging mechanism for the disintegrating mechanism, power tilting mechanism for the shovel 11, power drive for the disintegrating mechanism, power drive for the conveying mechanisms, and power adjusting means for the delivery conveyor 12; and all of this mechanism is fully disclosed in the applications mentioned above.

To protect the operator of the "continuous miner" as he effects the operation of the latter by power and to shield certain more vulnerable parts of the "miner," there is provided a roof engaging shield structure 20. This is built up of three parts, a large central secton 21 and two side sections, 22 and 23. The side sections 22 and 23 are detachable from, but normally fixedly secured to, the center section. A reference to Fig. 6 will show that the shield is made up of generally horizontal plates 24, vertical plate sections 25 and a couple of channel-like reinforcing structures 26 which are engageable by the upper ends of hydro-pneumatic jack devices later described. These structures 26 includes pad portions 26' and the adjacent vertical plate sections 25. The relatively large, relatively flat metal shield 20 is adapted to be resiliently held against the roof by one or more hydro-pneumatic jacks, two herein being shown, one at 27 and the other at 28. The structure of these jacks will shortly be more fully described. The position of the roof shield relative to the tractor-supported base 1 is determined, as respects longitudinal relation thereto, by two radius rods 30. The rear ends of these rods are hingedly connected at 31 to brackets 32 attached to the rear bumper 33 of the "miner," and their front ends are hinged to brackets 34 suitably secured, as by welding, to the under side of the shield just back of where the shield rests upon the jacks. They will be noted to lie in longitudinal vertical planes which intersect the jacks.

The jacks 27 and 28 are mounted one at each side of the machine immediately over and, as shown, slightly to the rear of the centers of the crawlers or tractor treads 15. They serve to thrust the shield up against the under side of the mine roof, and to hold it there yiedingly through the pressure exerted by a gas confined within gas chambers provided within the jacks and later described.

The provision of an expansible gas as the source of the pressure exerted on the under side of the shield is for the purpose of obtaining automatic yielding or extension of the jacks to conform to irregularities in height, while yet an adequate upward force may be continuously exerted by the jacks. Each of the jacks includes a cylinder member 40 having a bore 41 and having a centrally disposed stationary tubular element 42 extending upwardly therein and secured to the bottom thereof, as at 43. An annular piston structure 44 is reciprocable in the annular space within the cylinder bore 41 provided between the cylinder member 40 and the tubular element 42. To the upper side of the piston there is connected a tubular piston rod 45 which extends through an appropriate gland 46 carried by a cylinder head 47. The piston rod 45 has its annular wall spaced both from the annular wall of the cylinder member 40 and from the annular wall of the tubular element 42, and a double packing, consisting of a packing 48 cooperating with the tubular element 42 and a packing 49 coacting with the inner wall of the cylinder 40, is provided for maintaining a very effective seal with these walls. Within the tubular element 42 there is a chamber 50 which communicates with a chamber 51 within the tubular piston rod. These are filled with a gas, desirably but not necessarily nitrogen, under a very considerable pressure, and the gas may be forced into the chambers mentioned through a suitable valved plug 52 carried by the upper head 53 of the piston rod 45. The cross sectional areas of the chambers 50 and 51 and of the tubular element 42 will be appropriately chosen, keeping in mind the importance of not making the combined cross sectional area of the chamber 50 and the wall of the tubular element 42 too small (because with the reduction in this cumulative cross sectional area there is a reduction in the effective area acting to move the piston 44 upwardly), while on the other hand it will be appreciated that the larger these are made, the greater the change in pressure as the piston moves relative to the cylinder. Thus, if the cumulative cross sections of 42 and 50 were made very small compared with the cross sectional area of 51 an enormous pressure of the confined gas would be required to provide an adequate roof supporting pressure, but if they were made nearly equal cumulatively to the cross sectional area of chamber 51, the changes in pressure with changes in jack extension would be quite material. It will be noted that no fluid pressure is adapted to be admitted to the space between the tubular element 42 and the cylinder 40 below the piston 44 and this space may be desirably vented as at V, though were there no vent the degree of collapse of the jack in normal use would involve a pressure change of no great significance. There is an annular pressure area 55, however, formed between the periphery of the piston 44 and the piston rod 45, and to this annular area hydraulic fluid is adapted to be delivered at will through a hydraulic conduit 56. In Fig. 8 there is shown a diagrammatic view of a control system for the jacks 27 and 28, including a pump 59 driven by a motor 60 and drawing fluid from a reservoir 61 and adapted under the control of a valve 62 to supply fluid to the conduit 56 or to permit the return of fluid from this conduit to the tank. A suitable relief valve 63 is provided for the purpose of predetermining the pressure which shall be delivered to the conduit 56 by the pump. The motor 60, the pump 59, the tank 61, may all well be common to other mechanisms of the "miner."

The following figures, which are not to be considered limiting in any sense, may be given to illustrate the operation of the hydro-pneumatic jack mechanism. Let it be assumed that a total pressure of 4700 pounds is desired to be exerted by the shield against the roof and that the total weight of the shield and of the parts which have to be moved upwardly in order to effect upward movement of the shield is 1300 pounds. Then it will be evident that the jacks must be capable of exerting a cumulative pressure of 6000 pounds, or with two jacks 3000 pounds per jack. Now if the effective area of the piston of the jack cylinder be 5 sq. in., then a gas pressure of 600 pounds per square inch will be required in the position of maximum working extension of the jack in order to provide the requisite roof pressure. If the annular area 55 be made on the order of 7½ sq. in., a hydraulic pressure just exceeding 400 pounds per square inch would be sufficient to start the collapse of the hydro-pneumatic jacks; and if the structure of the jack mechanism be such

as to involve a decrease of 25 percent in the nitrogen filled volume on total collapse of the jacks, it would be necessary, disregarding the effect of temperature changes, to be able to exert a pressure of 533⅓ pounds through the conduit **56** on the annular area **55**. It will be noted that with the proportions suggested, the pressure of the nitrogen entrapped within the chambers **50** and **51** will vary between 400 pounds and 533⅓ pounds per square inch, that minor variations in roof height will be attended by but relatively minor variations in roof pressure, and that if fluid were admitted through the connection **56** to depress the plate or shield ¼", and the conduit were then closed, and the roof lowered ⅜", there would immediately be opposed to it something over 4700 pounds in total pressure.

A reference to Figs. 2, 3 and 7 will show an important feature of the shield construction. It will be observed in these figures that the forward and rear portions of the shield are somewhat higher than the portion of the shield midway between the ends of the latter. This may be seen at H. This consrtuction is adopted in order that the shield may have engagement over as great an area as possible when it is forced against the roof. As the shield is constructed desirably of rolled steel plates and shapes welded together, it will possess the usual resilience of such materials; and as a result it can be expected to take the shape indicated by Figs. 2 and 3, which show the shield thrust up against the roof. It will be noted that the shield has, as a result of the upward force, become somewhat modified in shape, so to speak, so as to contact the roof throughout much of the area thereof.

One function of the radius rods **30**, as previously noted, is to locate the shield in position over the jacks, which are provided with the heads **53** which engage the reinforcing elements **26** previously mentioned. Their primary function is, however, that of transmitting the propelling force produced by the crawlers to the shield so as to cause the latter to slide beneath the roof as the crawlers advance the machine. The application of a good coat of heavy grease to the surface of the shield will serve to reduce the friction between the shield and the roof to a relatively small amount; and with a very slight retraction of the plungers or pistons of the hydro-pneumatic jacks this friction may be virtually eliminated. A very important consideration to be borne in mind is that if enough fluid is delivered through the conduit **56** to the upper ends of the cylinders **40** to provide any clearance whatsoever between the shield and the roof, the subsidence of the roof to such a distance as again to exert its pressure on the top of the shield would meet with a resistance actually slightly greater than the force which was exerted by the jacks through the shield on the roof before this retractive action took place.

Little more needs to be said about the operation of this mechanism. The jacks **27** and **28** may be collapsed to the full-line position shown in Fig. 7 during tramming movement, or they may be lowered only part way down, as shown in the broken line position indicated in Fig. 7. The shield is not attached to, but simply rests upon the tops of the heads **53**. As it has down turned ends and side edges, as indicated at **70**, the shield may be forced along in contact with the roof without danger of having its movement blocked by engagement with obstructions. It will exert a yielding pressure, through the expansion of the gaseous charges within the jacks **27** and **28**, upon the roof, and the pressure may be reduced or fully overcome, in order to facilitate the feeding of the apparatus forward, by the supply of fluid under pressure to the areas **55**; and the full yielding pressure may be again made effective at original elevation simply by venting the fluid from the annular areas mentioned.

It will be observed, accordingly, that I have provided a construction including broadly a base, a roof engaging element, an intermediate jack device expansible by a confined body of gaseous fluid under pressure, and means for facilitating the moving of said apparatus by lessening the roof pressure, without releasing the gas under pressure.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a mining apparatus, the combination with a main frame movable over a mine floor, of a shield overlying said frame elongated lengthwise of said frame and substantially horizontal throughout its length, extensible jack means supported by said main frame and at the upper end thereof engaging and supporting said shield, the engagement and support of said shield by said jack means providing for movement of said shield bodily, substantially horizontally, and longitudinally of said main frame relative to the upper end of said jack means, and means including at least one radius rod in the form of an elongated link element pivotally connected at its opposite ends to said main frame and to said shield for causing bodily longitudinal movement of said shield as aforesaid, as it is moved from one generally horizontal position to another by extension of said jack means, relative to the upper end of said jack means.

2. In a mining apparatus, the combination with a main frame, of a shield overlying said frame, resilient yieldable means supported by said main frame and at the upper end thereof supporting said shield for movement relative to said yieldable means in a direction longitudinal of said frame, and radius rod means pivotally connected to said main frame and to said shield including elongated links each pivotally connected to the former near an end of the shield and to the shield near its transverse center line, said pivotal connections each providing for pivoting on a horizontal axis disposed transversely of said main frame and said links confining said shield against substantial movement crosswise of said frame.

3. In a mining apparatus, the combination with a main frame, of an elongated generally horizontal shield overlying said frame, extensible jack devices supported by said main frame and at their upper ends having a sliding engagement with said shield providing for longitudinal movement of said shield relative to said jack devices, and radius rod means pivotally connected to said main frame and to said shield and including at least one elongated link attached at its opposite ends pivotally to said frame and shield for compelling, upon change in level of said shield between upper and lower substantially parallel positions, longitudinal movement of said shield relative to said frame.

4. In a mining apparatus, the combination with a main frame, of a shield for engaging a mine roof, extensible jack devices at opposite sides of and extending upwardly from said main frame for supporting said shield, said jack devices having their axes fixed against tilting movement relative to said main frame and said shield having a sliding support upon said jack devices and movable bodily relatively horizontally upon its support by said jack devices, and radius rods extending between said frame and shield and pivotally connected to each of the same and linking the same together and disposed in longitudinal vertical planes intersecting said jack devices.

5. In a mining apparatus, the combination with a main frame, of a flexible mine roof engaging plate element having between its forward and rearward ends a portion lower than a plane contacted by its end portions and flattenable towards such plane into increased-area contact with a mine roof, and means for supporting said plate element at different heights in overlying relation to said main frame and at said different heights in contact with

a mine roof including extensible jack means supported on said main frame and engaging and arranged to exert upward pressure on said lower portion of said flexible plate element for effecting flattening of an increased-area roof engagement by said flexible plate element.

6. The combination recited in claim 5 wherewith there is provided supplemental means extending between said main frame and said flexible plate element for stabilizing said plate element with respect to said main frame at said different heights.

7. The combination recited in claim 6 in which said supplemental means imposes on said plate element longitudinal movement relative to said main frame as changes in their relative heights are effected and in which said flexible plate is supported on said extensible jack means and is slidable longitudinally of the main frame and relative to said jack means in a direction transverse to said jack means.

8. The combination of claim 7 in which said supplemental means comprises links pivotally connected at their opposite ends to said main frame and to said plate element.

9. In an apparatus of the character described, a base, a roof engaging and supporting element, a jack device extending between said base and element and having in the interior thereof a body of entrapped gas under pressure furnishing the expansive force of said jack device, and means for exerting on said jack device a force in opposition to the expansive force of said entrapped gas for collapsing said jack device and holding it collapsed while maintaining the entrapped gas unvented and in readiness to exert its full pressure in a roof supporting direction upon any collapsing of said jack by roof pressure beyond the limit at which said last mentioned means holds it collapsed.



10. In an apparatus of the character described, a base, a roof engaging and supporting element, a jack device extending between said base and element and having a body of confined gas constantly exerting a jack extending pressure, and means for exerting, in opposition to said jack expanding pressure and while said body of gas remains confined, a pressure tending to collapse the jack device and sufficient at least partially to offset the pressure exerted by said confined gas, to reduce the pressure on the roof exerted by said roof engaging element while engagement of the latter with the roof is maintained and the full jack device extending pressure remains available for roof support in the event roof subsidence initiates collapse of the jack device.


References Cited in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| Re. 2,461 | James | Jan. 15, 1867 |
| 778,168 | Bramwell | Dec. 20, 1904 |
| 881,609 | Nellen et al. | Mar. 10, 1908 |
| 1,450,329 | Morgan | Apr. 3, 1923 |
| 1,480,733 | Morgan | Jan. 15, 1924 |
| 2,313,242 | Johnson | Mar. 9, 1943 |
| 2,320,653 | Ramsay | June 1, 1943 |
| 2,496,694 | Brown | Feb. 7, 1950 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 83,575 | Germany | Apr. 11, 1921 |
| 255,190 | Switzerland | Jan. 7, 1949 |
| 457,122 | Great Britain | Nov. 23, 1936 |
| 485,617 | Great Britain | May 16, 1938 |