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MINE ROOF SUPPORT-EQUIPPED MINING APPARATUS

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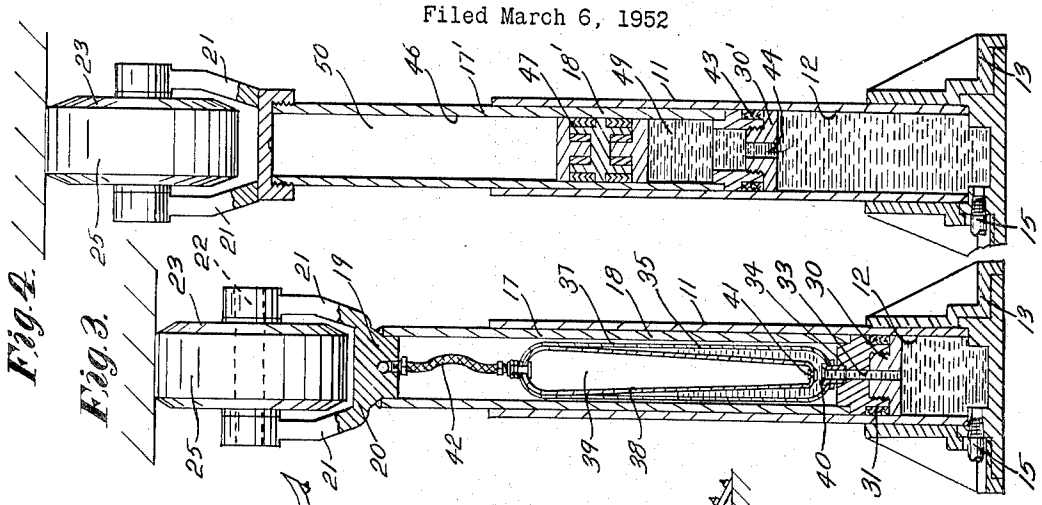


Fig. 4.

Fig. 3.

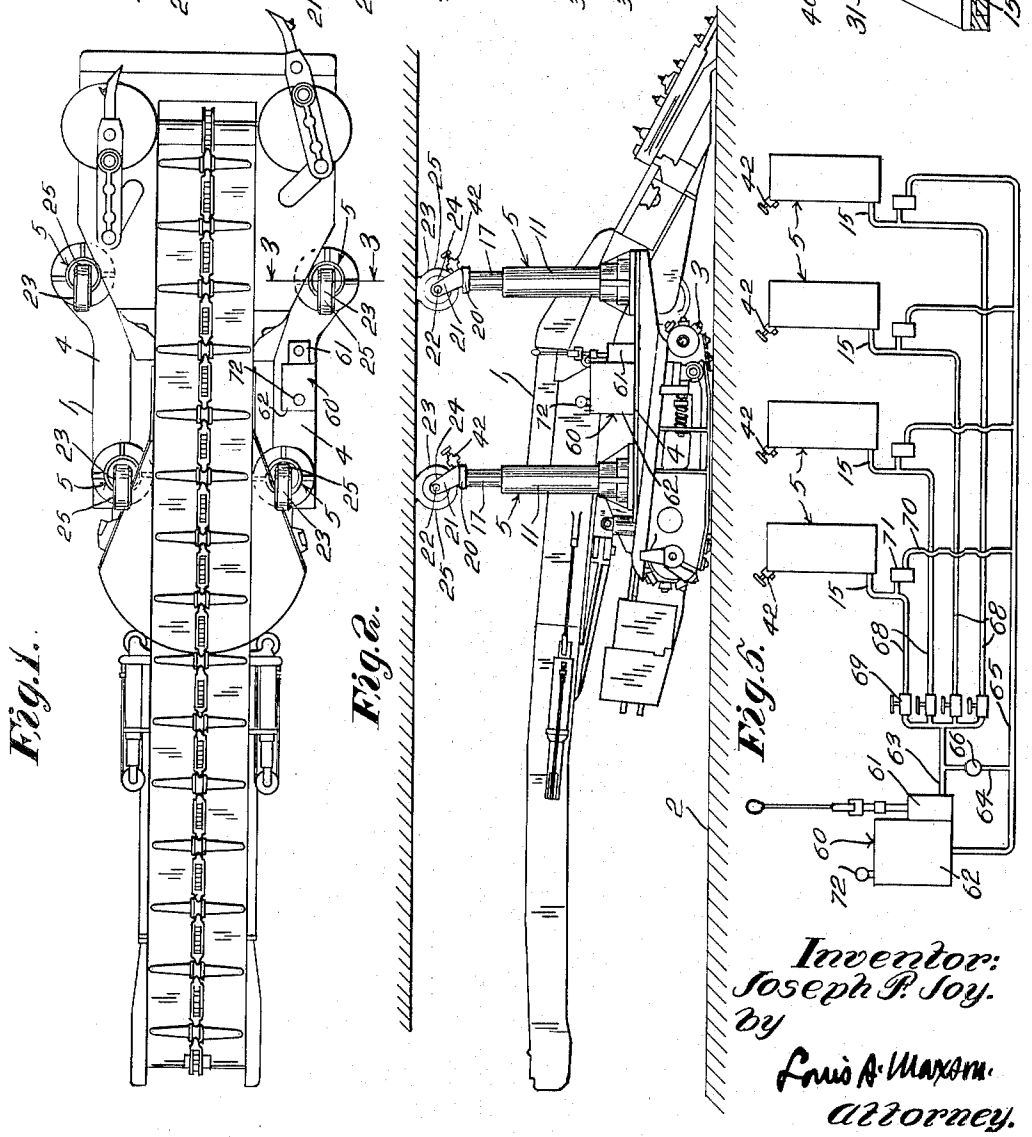


Fig. 1.

Fig. 2.

Fig. 5.

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MINE ROOF SUPPORT-EQUIPPED MINING APPARATUS

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6 Claims. (Cl. 198—10)

This invention relates to mine roof-supporting apparatus associated with mining machinery, and to mining apparatus having associated with it roof-supporting means adapted both to diminish the danger of roof falls and to protect the apparatus and its operator.

Modern mining apparatus, such as universal kerf-cutting machines and continuous miners, is capable of forming comparatively smooth roofs of comparatively uniform height, and, since, particularly in places where timbering or roof bolting has not been carried up to the face, it is desirable to provide protection both for apparatus and operator against roof falls and to provide powerful roof-sustaining pressures, it is very desirable to take advantage of the favorable roof conditions mentioned, by mounting upon mining apparatus roof-engaging and supporting apparatus which may move freely in supporting contact with the roof. Such arrangements are desirable on kerf-cutting machines, continuous miners, loading machines, etc., and especially so upon apparatus which may be moved in selective paths, i. e. which is not confined to operation on tracks.

In a preferred practice of the invention a mining machine, whether a kerf cutter, continuous miner, loading machine, or other mobile apparatus, desirably has its frame, which is suitably mobilely supported and propelled over a mine floor, provided with a plurality of extensible jack devices which are so supported on the frame (that is, so located and spaced) that they cooperate in providing a substantial area of protection for the apparatus and an operator thereof. The jack devices desirably have associated with them individual roof-engaging devices, which are preferably so formed as to have a rolling contact with the mine roof. For this purpose rubber tired wheels of considerable width and diameter are particularly desirable, the rubber tires being preferably of the "solid" type, but sufficiently compressible or deformable to provide substantial areas of roof contact. The roof-engaging devices are desirably so supported by the jack devices with which they are individually associated that their relation to the roof may be automatically shifted to provide for maximum facility of movement in contact with the roof, and a desirable arrangement is to provide caster-like mountings for the roof-engaging devices so that, for example, when the latter are in the form of rubber tired wheels, they may be swiveled about upright axes with respect to which their own axes of rotation are laterally offset; and this lateral pivoting may be accomplished especially readily with certain forms of jack devices, due to the fact that the coaxial, relatively extensible elements thereof may have relative turning take place between them on their common axis. The jack devices may desirably be of the hydraulic type, and may advantageously have associated with them accumulators so that they may not only maintain a powerful roof supporting pressure notwithstanding minor variations in the roof height, but also be capable of yielding without breakage in the event that the roof sags and automatically increase their roof sustaining pressure in the event of such sagging.

An object of the invention is to provide an improved roof-supporting apparatus. Another object is to provide an improved roof-supporting apparatus associated with a mobile mining machine. A further object is to provide an improved mining apparatus including a mobile frame supporting roof-engaging apparatus which is capable of altering its directional relation to a mine roof automatically as the mining apparatus alters its direction of movement. Still another object of the invention is to provide an improved, mobile, roof jack arrangement including wheel elements having yieldable peripheries for engagement with a mine roof and caster-like supports whereby they may automatically readjust themselves to any change in direction of bodily movement of the jack device by which they are carried. Other objects and advantages of the invention will hereinafter appear.

In the accompanying drawings, in which one form of mobile mining apparatus, herein a loading machine, is shown constructed and arranged in accordance with, and embodying the invention,

Fig. 1 is a plan view of the apparatus.

Fig. 2 is a side elevational view of the apparatus shown in Fig. 1.

Fig. 3 is a central vertical section, with parts shown in elevation, on the plane of the line 3—3 of Fig. 1, the view being on an enlarged scale.

Fig. 4 is a similar view, with the parts more fully extended, through a modified construction.

Fig. 5 is a diagrammatic view of a hydraulic system.

Referring to the drawings, and first to Figs. 1, 2 and 3, it will be noted that a mining machine 1, herein a "cat"-supported loading machine, may be moved over a mine floor 2 by the suitable drive and control of "cat" treads 3. The particular apparatus employed for this purpose may assume so many different conventional forms that detailed description and illustration are unnecessary, it being sufficient to state that the "cat" treads 3, which are duplicated at the opposite sides of the machine, may be driven simultaneously in like directions, either forwardly or rearwardly, that one may be driven while the other is stationary, and that either may be driven forwardly while the other is driven rearwardly.

The apparatus 1 is provided with appropriate supporting platforms 4, 4 upon which there are mounted roof-supporting devices, generally designated 5. Four of these are shown, two at the rear of the platforms or frames 4, 4 and two at the front—the front pair being the more widely spaced. These devices 5 form a pattern, so-to-speak, such as to give a support for the roof over a considerable area, and to provide also a substantial area of protection for the apparatus and for an operator thereof. The devices 5 are, as illustrated, hydraulically operated jacks, and each includes an upright cylinder 11 having a bore 12, and mounted in a suitably reinforced and braced combined base and lower cylinder head structure 13, which is suitably secured to and mounted upon one of the frames 4. A connection 15 for hydraulic pressure fluid opens into the bottom of the bore 12 of the cylinder 11.

Referring more particularly to Fig. 3, it will be observed that, within the bore 12 of the cylinder 11, there is reciprocably and rotatably mounted a hollow piston element 17 comprising a tubular element 18 of which the diameter is substantially the same as the diameter of the bore 12. The element 18 has secured to it an upper head 19 on which there is mounted and to which there is secured a caster frame 20 whose laterally extended arms 21, 21 rotatably support a shaft 22 which carries a wheel structure 23, including a hub portion or wheel proper, 24, and a rubber tire 25, of "solid" construction and of a composition which permits some degree of flattening as the tire is forced hard against an overlying roof surface. The

substantial diameter and width of the tire provides a relatively large area of roof contact as the tire is compressed against the roof.

At the lower end of the piston element 17 there is a suitably packed piston 30, shown as provided with a chevron packing 31 and connected as by welding to the lower end of the element 17. The piston is traversed by a bore 33 the upper end of which is enlarged and internally threaded as at 34 to provide a mounting for an accumulator 35 which may, for example, be of the Greer type. This accumulator is shown as including a shell 37, and a separator bag or bladder 38 providing a chamber 39 in which a compressed fluid such as air or nitrogen is confined. The separator bag or bladder may be made of any suitable material, such, for example, as neoprene, which is desirable because of its resistance to damage by oil.

The mouth of the accumulator has mounted in it a suitable perforated metal plug 40, with which a tapered plug 41 molded into the bottom of the bag is adapted to cooperate, when the pressure within the bottom of the bore 12 becomes low enough, to prevent extrusion of the bag through the plug 40. A suitable filling connection 42 is provided for the bag or bladder through which the bag may be prefilled with air, or preferably nitrogen, or have its charge replenished, from an external supply such as a cylinder.

From what has been said, it will be appreciated that the space in the bore 12 below the piston is in free communication with the interior of the shell 37 when the pressure in such space exceeds the pre-established pressure in the chamber or space 39 in the bag or bladder 38.

It will be observed that four such jack devices as have just been described are shown in such a spacing and pattern on the frames 4, 4 that they will provide a most effective roof supporting action and protection for an operator of the apparatus as he works alongside its body.

Before describing briefly the hydraulic fluid supply system for the several jack devices, it may be noted that other jack constructions may be used, and one such other construction may be described.

Referring to Fig. 4, it will be seen that a cylinder element 11, having a cylindrical bore 12, and provided with suitable supporting and holding means 13 and a fluid supply and vent connection 15, may be mounted on such a support as one of the frames 4. It is shown as containing, rotatable and reciprocable within its bore 12, a cylindrical piston structure 17′ whose upper end carries a wheel structure 23, preferably a rubber-tired wheel, and with its axis of rotation offset laterally from the axis of the piston structure 17′.

The piston structure 17′ comprises a tubular member 18′ to whose lower end there is fixed a piston structure 30′, having a suitable chevron packing 43 and traversed by an opening or bore 44. The interior of the member 18′ contains a cylindrical bore 46 in which an appropriately packed piston element 47 is reciprocable. The piston element 47 divides the bore 46 into two spaces, a lower one 49 communicable through the opening 44 with the bore 12 of the cylinder element 11, and an upper space 50 above the piston element 47.

Prior to use of the jack device, the space 50 may be precharged in any suitable manner with air, or preferably nitrogen, to a desired pressure; and, as long as the hydraulic fluid in the bottom of the jack device is not above a predetermined value, the piston element 47 will rest upon the top of the piston structure 30′. When such pressure is exceeded in the bottom of the jack device, the piston element 47 will be forced away from the piston structure 30′ and further compress the gaseous charge above it.

It will be noted, with respect to each of the jack devices specifically illustrated, that the piston element thereof is rotatable within its cylinder, and accordingly the rubber-tired wheels may, by reason of the offset of their axes from the axes of the pistons which support them, turn readily automatically as the apparatus upon which it is supported turns, to follow the course of the apparatus.

Pivoting between the casters and the pistons upon suitable bearings, while comprehended within the scope of the invention, would be less desirable than the arrangement shown, in view of the relatively frictionless support of the jack pistons in the oil beneath them, in the structures illustrated.

Fig. 5 may now be briefly noted. It will be observed that four jack devices, 5, 5, 5, 5, of the type first described are diagrammatically shown. These are shown with valve-controlled connections 42 through which the bags or bladders of the jack devices may be charged or replenished. An oil reservoir and pump device of well-known commercial form is shown at 60 and its pump 61 is operable to draw oil from the tank or reservoir 62 and deliver it to a line 63 which is connected by a relief valve-controlled by-pass 64 to a return line 65 leading back to the tank or reservoir 62. The relief valve 66, associated with the by-pass 64, is set to open at the desired pressure to be maintained in the jack devices 5, 5, 5, 5. The line or conduit 63 is connected with four branch lines 68, 68, 68, 68, and each of the latter is controlled by a stop valve 69 and has a relief valve-controlled return line 70 leading to the main return line 65. The relief valves 71, associated with the lines 70, are set at the pressures at which it is desired that the jacks shall have fluid released from them—ordinarily much higher pressures than the setting of the relief valve 66. A control element 72 indicates a means for permitting fluid in the line 63 to by-pass the pump 61 and return to the reservoir 62—a conventional arrangement in devices such as the apparatus 60.

It will readily be seen that the bags or bladders 38, or the upper spaces 50, as the case may be, may be precharged, as from gas-filled cylinders, to the desired pressures, and that the stop valves 69 may be opened and the jack devices supplied with liquid (desirably oil) under pressure until the wheels are forced against the mine roof with desired pressure. This pressure will be such that the tires are flattened enough to provide substantial areas of contact with the mine roof, thus reducing unit roof pressure and preventing any crushing action. The valves 69 are then closed, and as the apparatus 1 is moved about in the mine the roof is supported, and danger of roof falls on the operator or the apparatus is much reduced. If the roof tends to sag, the jack devices may be slightly telescoped, and the roof-supporting pressure will be automatically increased as the gaseous charges are compressed. Only if the roof sags to such a degree that the setting of the relief valves 71 is exceeded, will oil be forced out of the jack devices 5. The provision of the accumulators will take care of normal variations in roof height, and of unevenness, as expansion or compression of the gas charges will accommodate increases and decreases in such height. The caster mountings of the wheels will permit the latter to reposition themselves about the axes of their respective jack devices as the apparatus 1 changes direction.

It will be evident that there is provided by the invention a safe and efficient arrangement for sustaining the portion of the mine roof which overlies the mining apparatus against all but extreme collapsing forces and that the safety of the machine operator will be much increased.

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

What I claim is is:

1. In a mining apparatus, a frame having means for supporting and propelling it and selectively determining its

path of travel over a mine floor, and means for supporting the roof above the mining apparatus during the performance by said apparatus of its mining operation including at least three extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern to provide a substantial area of protection for the apparatus and an operator thereof, and individual roof-engaging devices carried by said jack devices and each rotatable about an upright axis to cause it to alter, through the forces exerted on it due to the differences in resistance to its movement in various positions, its relation to the roof as the path of said mining apparatus is changed, each of said roof-engaging devices having a contact with the roof providing for ready automatic angular adjustment in horizontal planes in response to changes in direction of frame movement.

2. In a mining apparatus, a frame having means for supporting and propelling it and selectively determining its path of travel over a mine floor, a plurality of extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern including positions spaced longitudinally as well as laterally of said frame, to provide a substantial area of protection for the apparatus and an operator thereof, and individual devices carried one by each of said jack devices and engaging with rolling contact the mine roof as left by the operation which formed it, and each rotatable about an upright axis to cause it automatically to alter its relation to the roof, under the resistance to movement thereof when the lines of rolling contact are not perpendicular to the path of movement, as the path of said mining apparatus is changed.

3. In a mining apparatus, a frame having means for supporting and propelling it and selectively determining its path of travel over a mine floor in selective paths, a plurality of extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern including positions spaced longitudinally as well as laterally of said frame, to provide a substantial area of protection for the apparatus and an operator thereof, and individual wheels carried by said jack devices each rotatable on its own axis and each rotatable about an upright axis offset from its own axis to cause it automatically to alter its relation to the roof as the path of said mining apparatus is changed.

4. In a mining apparatus, a frame having means for supporting and propelling it and selectively determining its path of travel over a mine floor in selective paths, at least three extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern including positions spaced longitudinally as well as laterally of said frame, to provide a substantial area

of protection for the apparatus and an operator thereof, each of said jack devices having associated with it an accumulator and hydraulic means for establishing a predetermined pressure in said jack device and in the accumulator, and individual caster wheels carried by said jack devices each rotatable on its own axis and each rotatable individually about an upright axis offset from its own axis to cause it automatically to alter its relation to the roof as the path of said mining apparatus is changed.

5. In a mining apparatus having means for performing a mining cycle, a frame having means for supporting and propelling it and selectively determining its path of travel over a mine floor in selective paths, a plurality of extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern including positions spaced longitudinally as well as laterally of said frame, to provide a substantial area of protection for the apparatus and an operator thereof, each of said jack devices having a rubber tired wheel supported on its upper end with the axis of the wheel laterally offset from the axis of the jack, each of said wheels rotatable on an axis passing through its center, and means for extending said jacks and for causing them to maintain a pressure against a mine roof throughout a full operating cycle of said apparatus notwithstanding minor variations in roof weight including accumulator means subjected to the pressure within said jacks.

6. In a mining apparatus, a frame having means for supporting and propelling it and selectively determining its path of travel over a mine floor in selective paths, a plurality of extensible roof-supporting jack devices supported by said frame in spaced relation to each other and in a pattern including positions spaced longitudinally as well as laterally of said frame, to provide a substantial area of protection for the apparatus and an operator thereof, each of said jack devices having at its upper end a rubber tired roof-engaging means rotatable on a single axis passing through its center and laterally offset from the jack axis, and means for extending said jacks and for causing them to maintain a pressure against a mine roof including a body of entrapped gaseous fluid under pressure, of such volume that minor variations in roof level occasion relatively small variations in roof supporting pressure.

References Cited in the file of this patent

UNITED STATES PATENTS

881,609	Nellen	Mar. 10, 1908
1,431,564	Brilstra	Oct. 10, 1922
1,588,987	O'Toole	June 15, 1926
2,313,242	Johnson	Mar. 9, 1943
2,420,666	Joy	May 20, 1947