April 18, 1944. C. E. HAIR ET AL 2,346,679

COAL MINING MACHINE

Filed Dec. 12, 1942 3 Sheets-Sheet 1

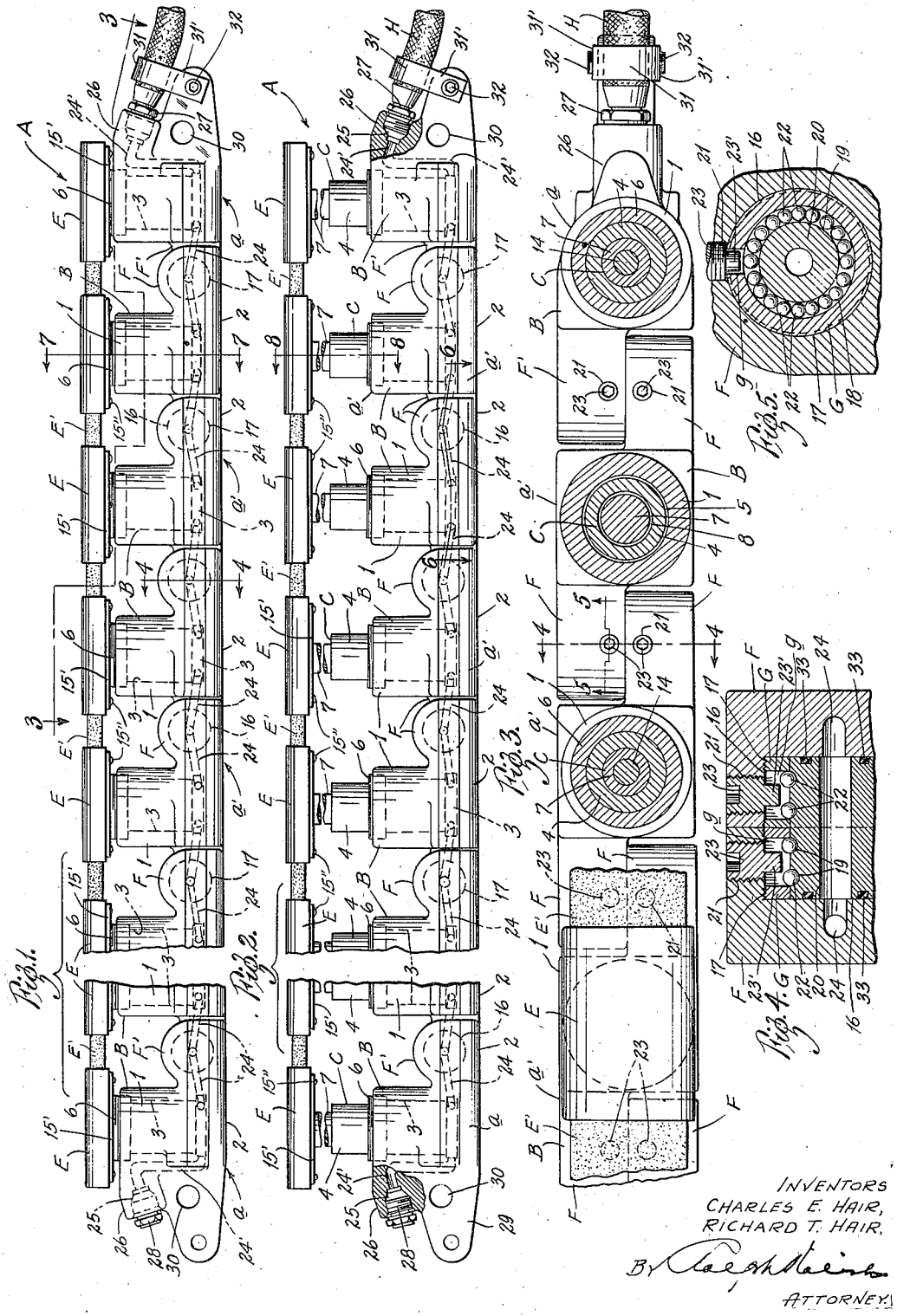


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 5.

Fig. 4.

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Filed Dec. 12, 1942 3 Sheets-Sheet 2

Fig. 6.

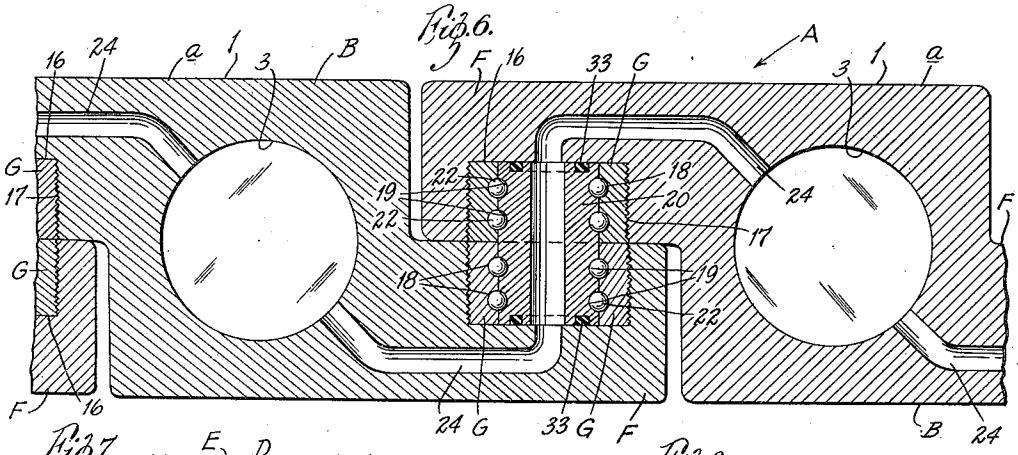


Fig. 7.

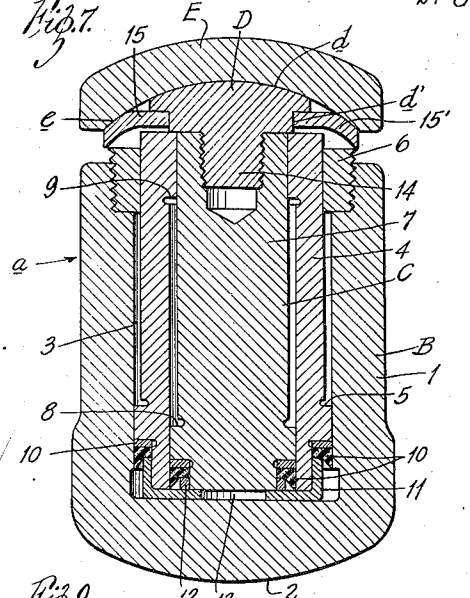


Fig. 8.

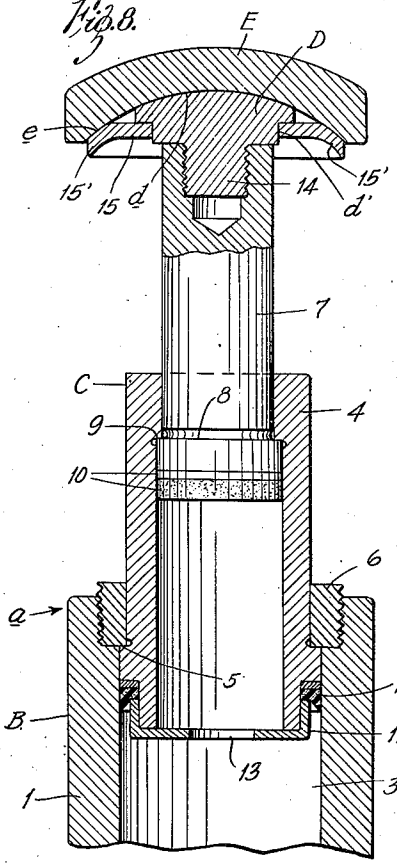


Fig. 9.

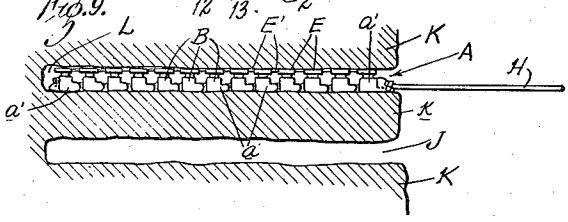
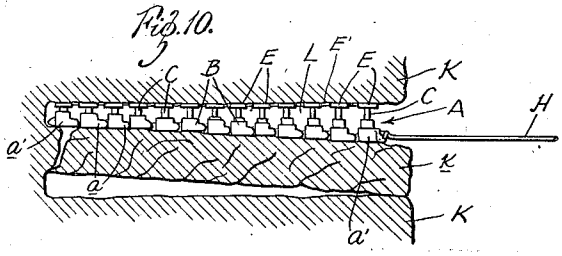


Fig. 10.



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April 18, 1944. C. E. HAIR ET AL 2,346,679

COAL MINING MACHINE

Filed Dec. 12, 1942 3 Sheets-Sheet 3

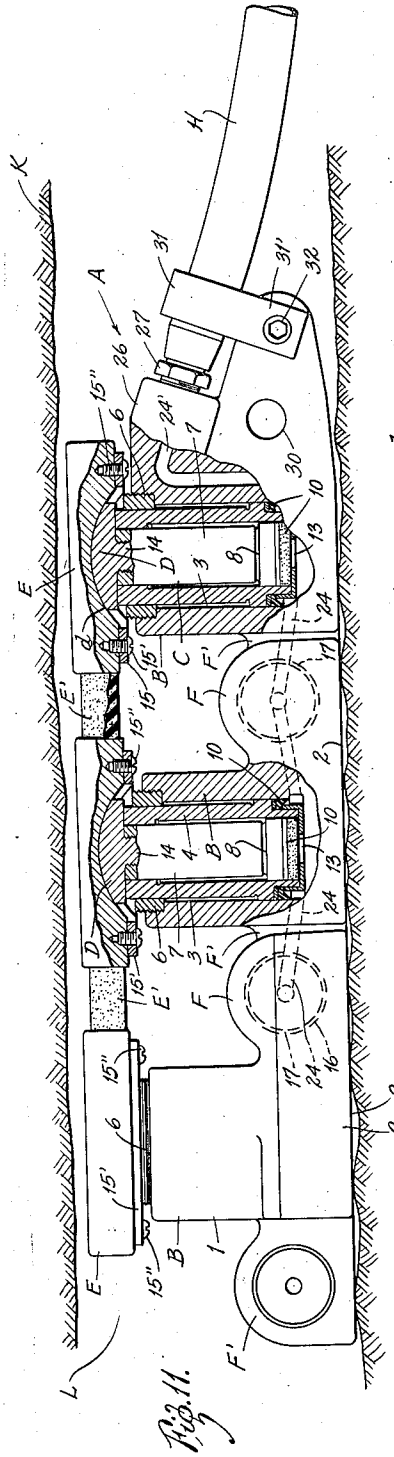


Fig. 11.

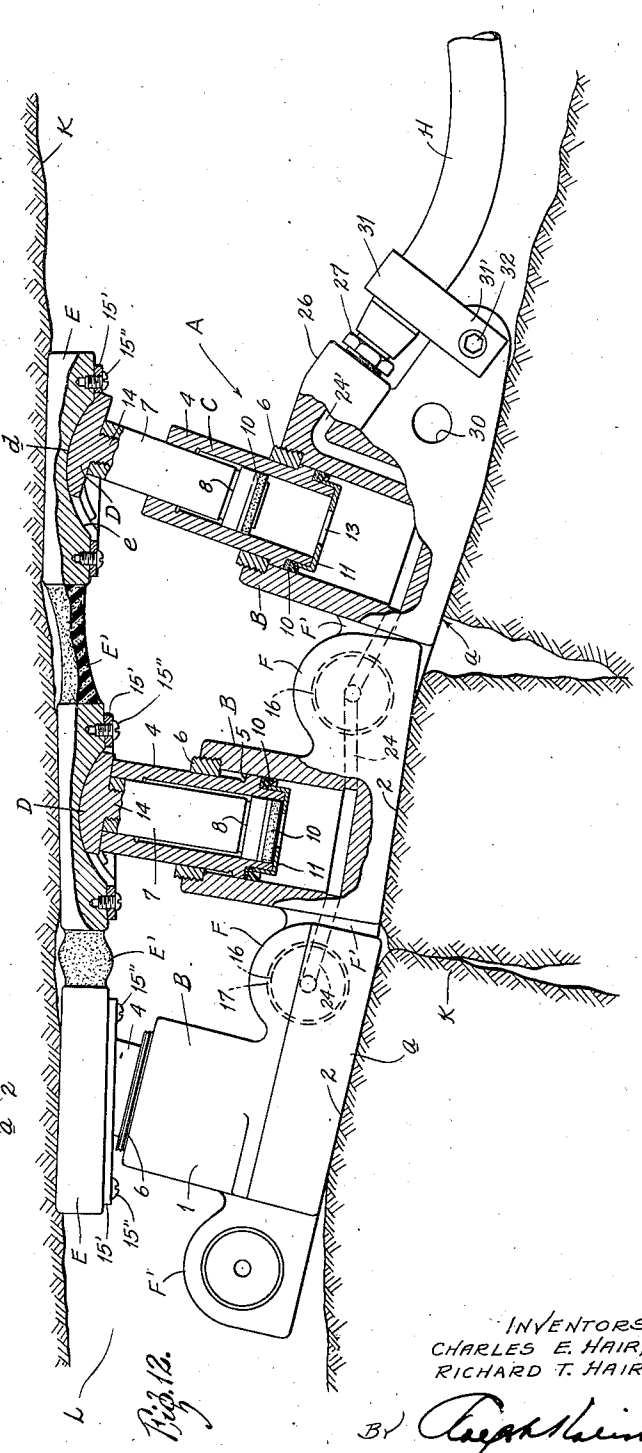


Fig. 12.

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UNITED STATES PATENT OFFICE

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COAL-MINING MACHINE

Charles Edwin Hair and Richard T. Hair,
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Application December 12, 1942, Serial No. 468,794

17 Claims. (Cl. 262—12)

This invention relates generally to mining-machines. More particularly, our invention has to do with, and has for its object the improvement generally of, coal-mining machines of the articulated or jointed type illustrated and described in our present pending patent applications, Serial No. 436,648, filed March 28, 1942, Serial No. 447,052, filed June 15, 1942, and Serial No. 463,364, filed October 26, 1942.

And with the above and other objects in view, our invention resides in the novel features of form, construction, arrangement, and combination of parts presently described and pointed out in the claims.

In the accompanying drawings (three sheets)—

Figure 1 is a broken side elevational view of a coal-mining machine constructed in accordance with and embodying our present invention, its several pistons being in normal or contracted condition;

Figure 2 is a similar view of the machine with its several extensible pistons in fully elongated condition;

Figure 3 is an enlarged fragmental longitudinal sectional view of the machine taken approximately on the line 3—3, Figure 1;

Figure 4 is an enlarged transverse sectional view of the machine taken approximately on the lines 4—4, Figure 1, and 4—4, Figure 3;

Figure 5 is an enlarged detail longitudinal sectional view of the machine taken approximately on the line 5—5, Figure 3;

Figure 6 is an enlarged fragmental sectional view of the machine taken approximately on the line 6—6, Figure 2;

Figure 7 is an enlarged transverse sectional view through one of the jack-units of the machine taken approximately on the line 7—7, Figure 1;

Figure 8 is a similar view taken approximately on the line 8—8, Figure 2;

Figure 9 is a reduced elevational view of the machine as disruptingly or dislodgingly disposed in a coal wall or body;

Figure 10 is a similar view, illustrating some of the units of the machine in successively piston-elongating condition for the breaking down of the coal wall or body;

Figure 11 is an enlarged elevational view of the machine, with adjacent units and their connecting flexible or yielding block partly broken away and in section, as disruptingly or dislodgingly disposed, as in Figure 9, in a coal-wall or body; and

Figure 12 is a similar view showing several of the units of the machine in successively piston-elongating condition and their connecting yielding blocks in either compressed or extended condition, as in the breaking down of the coal-wall or body.

Referring now in more detail and by reference characters to the drawings, which illustrate a preferred embodiment of our invention, the machine, briefly outlined, includes a series of jack-units A, each unit, in turn, comprising opposite individual end-jacks *a*, *a*, and a selected plurality of individual intermediate jacks *a'*, the jack-units A of selected number and the end and intermediate jacks *a*, *a'*, of each unit A being hingedly connected one to the other for articulation in a so-called up-and-down direction, all as presently fully appearing.

Each individual jack *a*, *a'*, as best seen in Figures 3, 7, and 8, consists of a cylinder B and a preferably two-part extensible or telescopic plunger or piston C. In the present instance, the cylinder B is in the form of a block or body 1 preferably of rectangular contour or shape in plan, as seen in Figure 3, and of selected height and dimensions for strength and rigidity, block 1 preferably having a transversely disposed rounded or arcuate under face, as at 2, as best seen in Figure 7, and provided longitudinally with a cylinder-forming cavity or chamber, as at 3, opening to and upon its upper face.

Piston C is sized for slidable co-operation with cylinder B and telescopically comprises a tubular portion 4 annularly enlarged and thereby provided adjacent its lower end with an annular shoulder, as at 5, for engagement with a ring 6 thread-seated in the upper end of the cylinder-cavity 3 for limiting outward or expanding movement of the piston-portion 4 with respect to the cylinder B and a piston-rod portion 7 similarly enlarged and thereby provided with an annular shoulder, as at 8, for engaging with an annular shoulder 9 provided upon, and adjacent the upper end of, the member 4 for similarly limiting outward or expanding movement of the piston 7 with respect to the tubular member 4. It might be here mentioned that the cylinder B and the piston C are so relatively proportioned and sized as to be completely nested when in normal or contracted condition, as best seen in Figures 1 and 7, and to have a stretch of approximately three inches when in abnormal or fully expanded or extended condition, as best seen in Figures 2 and 8.

At their respective lower ends, the piston members 4 and 7 are annularly reduced, as best seen

in Figures 7 and 8, for accommodating suitable cylinder-wall engaging or sealing ring-assemblies 10, 10, preferably held in place by a suitably sized flanged cap 11 and an interposed ring 12, the cap 11 being apertured in its end wall, as at 13, for purposes presently appearing.

Threadedly engaged, as by a stud 14, with, and seated upon the upper or free end of, the piston-rod 7, is a head D constructed of any suitable preferably metallic material, rounded or arcuate upon its upper face, as at *d*, and cut away and shouldered upon its perimeter, as at *d'*, for smoothly and snugly accommodating a correspondingly apertured disk or ring 15 having an obliquely turned down annular marginal portion 15' whose upper face *e* arcuately registers with the face *d* of the head D for conjointly accommodating the correspondingly arcuately shaped under face of a block E preferably of rectangular outline or contour in plan and having a transversely disposed arcuate upper face, all for purposes presently fully appearing, the block E being shiftably or tiltably held in place upon the head D as by means of block and disk engaging fastening members or the like 15'', as shown. And also for purposes presently appearing and as in our copending application, Serial No. 436,648, fully illustrated and described, the blocks E of adjacent jacks of a unit are fixed permanently, though flexibly, together by an interposed rubber or other yielding, elastic, or resilient block E'.

The cylinder-forming block or body 1 of each intermediate jack *a'* is provided in the plane of its lower half and upon its opposite sides with angularly opposed somewhat rectangular extensions F, which project lengthwise of the particular jack or unit, while the cylinder-forming block or body 1 of each end jack *a* as likewise provided in the plane of its lower half, but merely upon one left or right side, as the case may be, as seen in Figures 1 and 2, with a similar oblong-rectangular extension F', which also projects lengthwise of the particular jack or unit, each extension F, F', being formed or provided upon its inner face with a cavity or recess, as at 16, having an annular side wall threaded, as at 17, for seating a ring G correspondingly threaded upon its outer periphery and provided circumferentially upon its inner periphery with a pair of suitably spaced ball-grooves or outer races 18, 18, co-operable with opposed companion ball-grooves or inner races 19 formed circumferentially upon the outer peripheral face of a tubular wrist-pin 20, which latter has a length equal to the combined width of two of the rings G and with which rings G the pin 20 is co-operable in hingedly joining together two intermediate jacks *a'* or an end jack *a* and an intermediate jack *a'* of a unit A, as presently fully appears.

As best seen in Figures 3, 4, and 5, each body or block extension F, F', is formed in a side face thereof with a threaded aperture, as at 21, which at its inner end opens into a groove-communicating recess or cavity *g* in the ring G and through which aperture 21 and cavity *g* suitable spheres or balls 22 may be poured to seat within the races formed by the companion grooves 18—19, the aperture 21 being in turn, closed by a threaded plug 23 having a shank or end-projection 23' of sufficient diametrical dimension for retaining the spheres 22 to their respective races.

Formed in the base of the cylinder-block 1 of each respective intermediate jack *a'* of a unit A and communicating at one end with a respective recess or cavity 16 and at its opposite end with the cylinder-chamber 3, as best seen in Figure 6, are opposed hydraulic or other suitable fluid channels 24, 24.

Similarly formed or provided in each end jack *a* of a unit A, are opposed hydraulic or other suitable fluid channels 24, 24', the channel 24 likewise communicating at its opposite ends with the recess or cavity 16 and cylinder-chamber 3 of the particular jack, and the channel 24' communicating at its inner end with the cylinder-chamber 3 of the jack and at its outer end opening into a small chamber 25 formed in a block enlargement 26 and internally threaded for accommodating a nipple or the like 27 for communicating connection, as by means of a flexible hose or tubular sections H, with an adjacent jack unit A. In this connection, it may here be said that the machine as a whole may include any selected number of units A disposed in suitably spaced end-to-end relation and suitably joined so as to permit the respective units A to shift one relatively to the other in an up-and-down direction, the chamber 25 of the end jack *a* of the rear-end unit A of a particular machine being, of course, equipped with a suitable closure-plug or the like 28 and the seated nipple 27 in the end jack *a* of the front-end unit A being adapted for communicating connection with any suitable source of hydraulic or other fluid supply.

Means for coupling the several units A of a machine for articulation in an up-and-down direction is fully illustrated and described in our co-pending application, Serial No. 463,364, to which reference is made. For brevity, therefore, a description of such means is here omitted; suffice now merely to say that, for joining two units A for articulation, respective end jacks *a* are provided with longitudinally outwardly presented relatively thick or block-shaped ears 29 having transverse openings, as at 30, for accommodating suitable pivot pins, not shown, whereby, as will be evident, one unit A may hingedly shift or articulate vertically or obliquely relatively to its adjacent unit A in a coal dislodging operation, each machine preferably including one unit A for every three feet of under-cut.

And, in turn, in joining two intermediate jacks *a'* of a unit A or in joining an end jack *a* with an intermediate jack *a'* of a unit A, a ring G is thread-seated and housed in each respective cavity or recess 16 of companion extensions F or F', a tubular wrist-pin 20 fitted at one end-portion within one of such rings G, the extensions F or F' of the particular jacks then disposed with their inner faces in opposed relation, and the opposite end portion of the particular wrist-pin 20 then seated in the companion ring G of the particular joint, when the races 18—19 so formed are filled with the spheres or balls 22, as previously described, the wrist-pin 20 being thus also entirely housed within the said companion extensions.

It will be noted that the wrist-pins 20 are lengthwise disposed in right-angular relation to the pistons C and their accommodating cylinders B, and thus adjacent or adjoining jacks of a unit A are hingedly joined or connected for relative articulation in line with the several pistons of the machine or, as it may be said, in an up-and-down direction, the balls or spheres 22 functioning not only as anti-friction members for facilitating hinged movements or articulations of the respective jacks, but in also retaining such jacks in such hinged or articulate rela-

tion, and the resilient blocks E' yieldingly permitting independent fluid-actuated movement of the respective pistons C and relative tilting or angular movement of the heads E and also governing or controlling, as it may be said, the hinged or pivotal separation of adjoining jacks in their relative up-and-down movement.

It will further be noted that, in so hingedly connecting adjoining jacks for relative articulation, the tubular wrist-pins 20 align or register with respective fluid channels of the jacks, and hence the actuating fluid entering the channel 24' of an end jack *a* of a unit A flows into and through the cylinder-chamber 3 of the one jack and then, in succession, through the channels 24, wrist-pins 20, and cylinder-chambers 3 of the intermediate jacks *a'*, then into and through the cylinder-chamber 3 and end channel 24' of the opposite end jack *a* of the unit A, and then similarly flows into and through an adjoining unit A or is drained back to the source of supply, as presently appears, the several pistons C of the particular unit A being telescopically extended in sequence as the actuating fluid thus flows from one jack to the next jack of the particular unit.

Accordingly, in use and operation, an undercut or kerf, as J, is suitably formed or produced in or adjacent the bottom level of the particular wall or body K of coal being mined, and in suitably spaced relation upwardly from the undercut J a desired plurality of suitably spaced and elongated annular holes, as at L, are formed in the coal-body K. One or more machines of our invention are then lengthwise disposed in selected holes L, as indicated in Figures 9 and 11, with the several pistons or plungers C of the respective jacks *a*, *a'*, thereof in normal or contracted condition.

The hose or pipe H of the end unit of the particular machine is suitably connected with a source of hydraulic or other fluid supply, and the fluid in sufficient volume or amount led into the successive cylinders B of the successive jacks *a*, *a'*. Hence, as the pistons C of a unit A are thus successively hydraulically elongated or extended, that portion, as at *k*, of the wall K intermediate the under-cut J and the several holes L is, under the relatively great pressure exerted upon the coal wall or body K by the yieldingly connected blocks D of the elongating pistons C, successively disrupted and dislodged and its removal from the mine thereby conveniently facilitated, as is indicated in Figures 10 and 12.

In such a dislodging operation, the pivot or hinge coupling between, and in the lower half of, the several units A of a machine and also between, and in the lower half of, the several jacks of a unit, all such couplings being yieldingly or resiliently governed or controlled, as it may be said, by the yielding blocks E', readily permit a hingedly shifting movement in graduated increasing amount from the base of each jack or unit to its block E, comparable to the greater movement of the rim of a wheel as compared to its hub, in an up-and-down direction between the respective units A and the respective jacks *a*, *a'*, of each unit A, with the result that, as the coal shifts under the disrupting pressure exerted thereon by the connected blocks D of the successively expanding pistons C of each successive jack *a*, *a'*, any one or more of the jacks *a*, *a'*, and units A may readily hingedly move as described in an up-and-down direction with respect to the remaining jacks or units, as indicated in Figure 10. In all such movements, the outward movement of the pistons C is limited and controlled by the companion shoulder-couplets 5—6 and 8—9 and, also, the blocks E, as well as the units A and jacks *a*, *a'*, may longitudinally of the machine rock or shift with the breaking coal. Hence the machine augments and facilitates shifting movement of the dislodged coal, and at the same time the relative flexibility of the units A and their several jacks *a*, *a'*, eliminates and obviates breaking of the machine in or by shifting movement of the disrupted coal, the respective arcuate faces of the respective blocks I and E of the several jacks *a*, *a'*, and the pivotally shifting movement of the coupling means between the several jacks *a*, *a'*, of a unit A and between the several units A of a machine facilitating engagement of the machine with the coal-body, as well as subsequent movement of the respective units A under the shifting movement of the disrupted coal.

We may add that, of course, on a draining back of the motive fluid, the several pistons C of each respective unit A will automatically return to normal contracted condition, when the machine may be easily removed for successive like operations.

In all such shifting movements of the respective units A of a particular machine, the hose connections H are protected from injury or damage by the underlying ears 29 of the units A and the unit coupling means, as in our said application, Serial No. 463,364, fully described, the end-hose H, we may here add, being also reinforced and protected from damage or breakage during mining operations as by means of an inverted U-shaped brace or guard 31 having its opposite arms 31' disposed on opposite sides of, and by means of a pin or the like 32 pivotally secured to, the ear 29 of the end unit A of the particular machine.

As shown in Figure 6, the rings G are preferably suitably equipped with sealing gaskets 33, and it is to be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the machine may be made and substituted for those herein shown and described without departing from the nature and principle of our invention.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, said jacks having companion extensions provided with opposed recesses, companion rings seated in said recesses, and means comprising a wrist-pin engaging the rings for hingedly connecting the jacks for articulation in an up-and-down direction.

2. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, said jacks having companion extensions having opposed recesses, companion rings thread-seated in said respective recesses, and means comprising a wrist-pin engaging said rings and spheres engaging the wrist-pin and rings for hingedly connecting the jacks for articulation in an up-and-down direction.

3. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, said jacks having companion extensions having opposed recesses, rings thread-seated in said respective recesses and provided upon their inner

periphery with a circumferential groove, a wrist-pin engaging the rings and provided circumferentially upon its outer periphery with companion grooves, and spheres seated in said grooves.

4. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, said jacks having companion extensions having opposed recesses, rings thread-seated in said respective recesses and provided circumferentially upon their inner periphery with a pair of spaced grooves, a wrist-pin pivotally engaging the rings and provided circumferentially upon its outer periphery with companion grooves, each said extension having a sphere-accommodating aperture opening to its said grooves, and spheres projected through said apertures to loosely seat in said grooves.

5. In a mining-machine, a jack comprising a cylinder-chamber providing member, a recessed hinge-forming extension on said member, a ring seated in said recess, and a wrist-pin engaging said ring, the wrist-pin and ring having companion ball-race forming grooves and the extension having an aperture opening into said race for disposing spheres thereinto.

6. In a mining-machine, a jack comprising a cylinder-chamber providing member, a recessed hinge-forming extension on said member, a ring seated in said recess, a wrist-pin engaging said ring, the wrist-pin and ring having a pair of spaced companion ball-race forming grooves and the extension having a single aperture opening into both said races for disposing spheres thereinto, and a plug adapted for removable disposition within said aperture for closure thereof and for retaining the spheres in the respective races.

7. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, means hingedly joining the jacks one with the other for articulation, and means also joining the jacks for yieldingly controlling the relative hinged movement of said jacks.

8. In a mining-machine, a pair of jacks each including a co-operable cylinder and piston, means hingedly joining the jacks one with the other for articulation, and means including resilient blocks also joining the jacks for yieldingly controlling the relative hinged movement of said jacks and permitting fluid-actuated movement of the respective pistons.

9. In a mining machine, a pair of jacks each including a co-operable cylinder and piston, means including a tubular wrist-pin hingedly joining the jacks one with the other for articulation and providing for fluid communication therebetween, and means including resilient blocks also joining the jacks for yieldingly controlling the relative hinged movement of said jacks and permitting fluid-actuated movement of the respective pistons.

10. In a mining-machine, a pair of jacks each including a block, a cylinder in the block, and a reciprocatory piston working in and with respect to the cylinder, means joining the blocks for jack articulation, and a resilient member yieldingly connecting the jack-pistons.

11. In a mining-machine, a pair of jacks each including a block, a cylinder in the block, a reciprocatory piston working in and with respect to the cylinder, and a head-block mounted on the outer end of, and movable with and relatively to, the piston, means joining the blocks for jack articulation, and a resilient member yieldingly connecting the head-blocks of the pistons.

12. In a mining-machine, a pair of pivotally connected jacks each having a cylinder and a piston working in the cylinder, blocks mounted on and having connection with the pistons for sliding movement in an arcuate path, and means flexibly connecting the blocks of the pistons.

13. In a mining-machine, a pair of jacks each including a block, a cylinder in the block, a reciprocatory piston working in and with respect to the cylinder, and a head-member mounted on the piston, the head-member being movable with the piston and the head and piston having co-operable faces for relative sliding movement in an arcuate path, means connecting the blocks for unit articulation, and a resilient block yieldingly connecting the head-members.

14. In a mining-machine, a pair of jacks each including a block, a cylinder in the block, a piston reciprocatory in and relatively to the cylinder, an extension projecting longitudinally from, and in the plane of the lower half of, the block, and a head mounted on and movable with the piston, the head and piston having co-operable faces for relative sliding movement in an arcuate path and the extensions of the blocks being disposed with their inner faces in opposed relation, means including a wrist-pin engaging said extensions for joining the jacks for articulation, and a resilient block yieldingly connecting said heads.

15. In a mining machine, a jack including a cylinder and a co-operable piston, a head on the piston having an arcuate upper face provided with diametrically opposite marginal shoulders, a block co-operably recessed on its under face for seating upon the arcuate upper face of the piston-head, and an apertured plate fitting about the head and attached to the block, the plate having engagement with the head at said shoulders for retaining the block on the head for tilting movement of the block and piston in the longitudinal direction of the machine.

16. In a mining machine, a plurality of jacks each including a block, a cylinder in the block, and a reciprocatory piston working in and with respect to the cylinder, means joining the blocks for jack-articulation, and a series of flexibly connected head-members mounted on and traveling with the pistons.

17. In a mining machine, a plurality of jacks each including a block, a cylinder in the block, and a reciprocatory piston working in and with respect to the cylinder, means joining the blocks for jack-articulation, and a series of flexibly connected head-members mounted on and traveling with the pistons, the respective pistons and blocks being relatively shiftable in an arcuate path longitudinally of the machine.

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