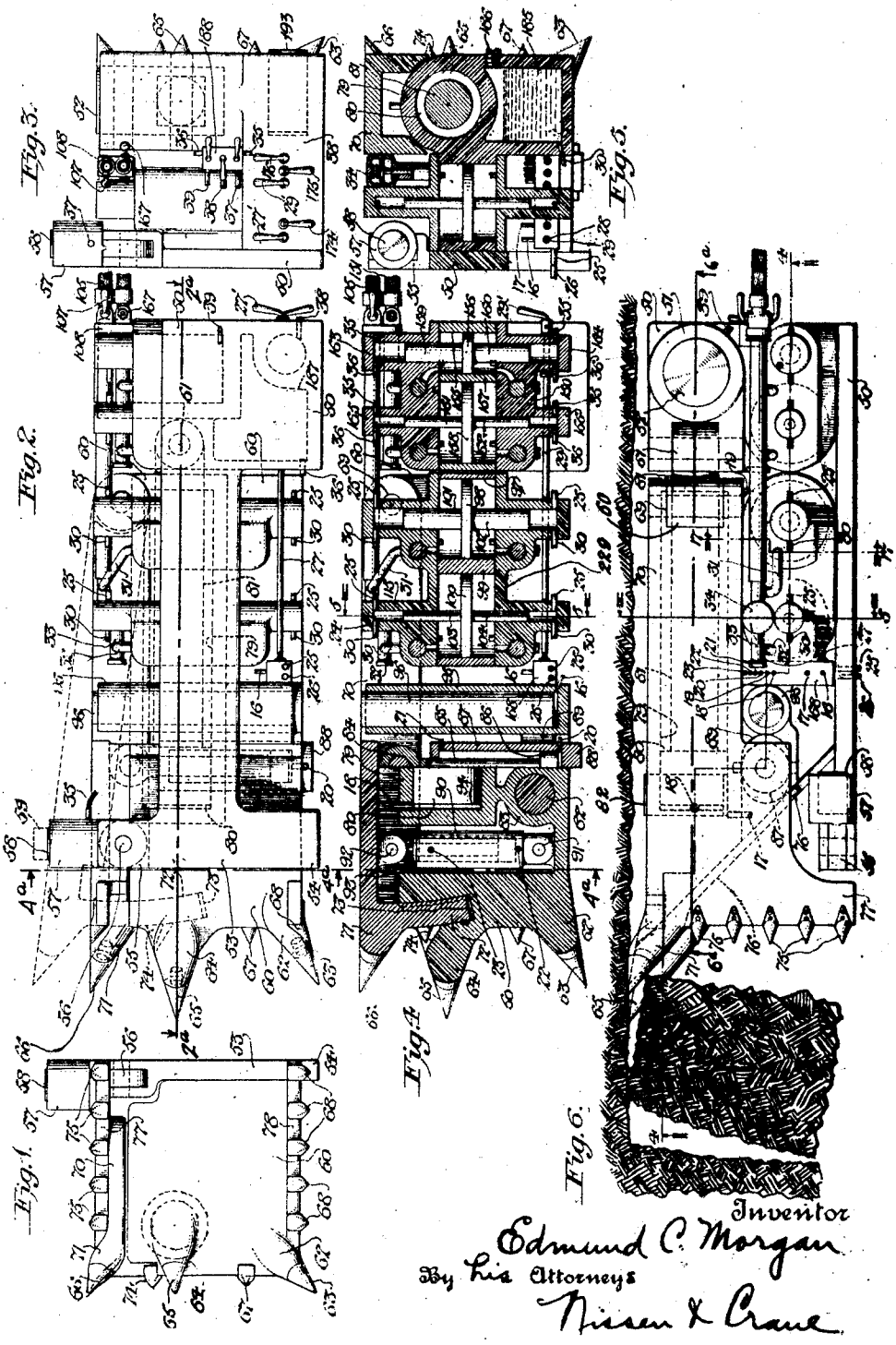
Aug. 2, 1927. 1,637,531

E. C. MORGAN

MINING MACHINE

Filed Nov. 15, 1920 6 Sheets-Sheet 1



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By his Attorneys
Nissen & Crane

Aug. 2, 1927. 1,637,531

E. C. MORGAN

MINING MACHINE

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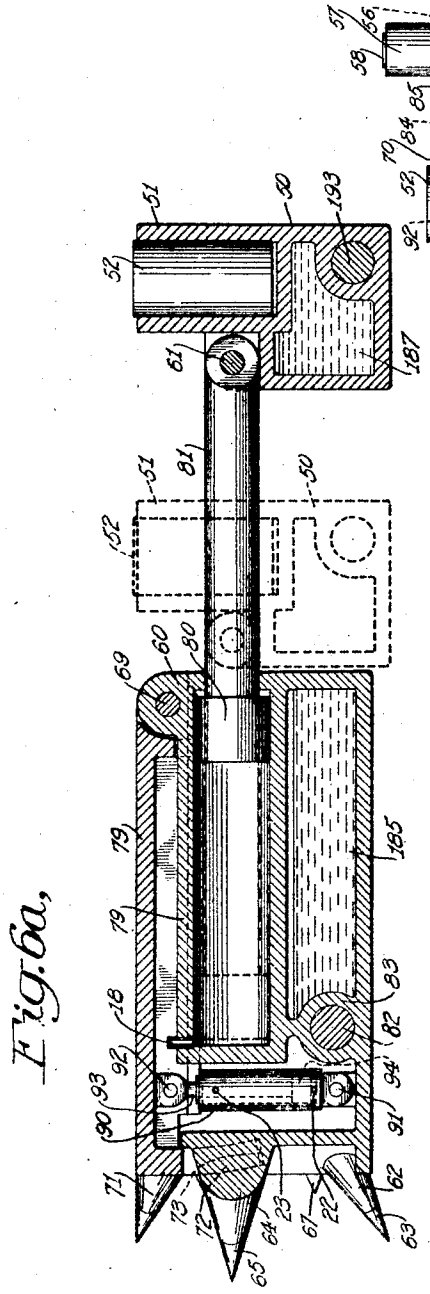

Fig. 6a,

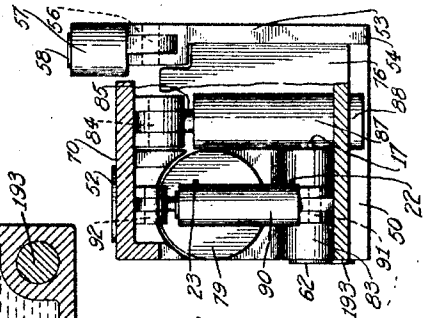

Fig. 4a,

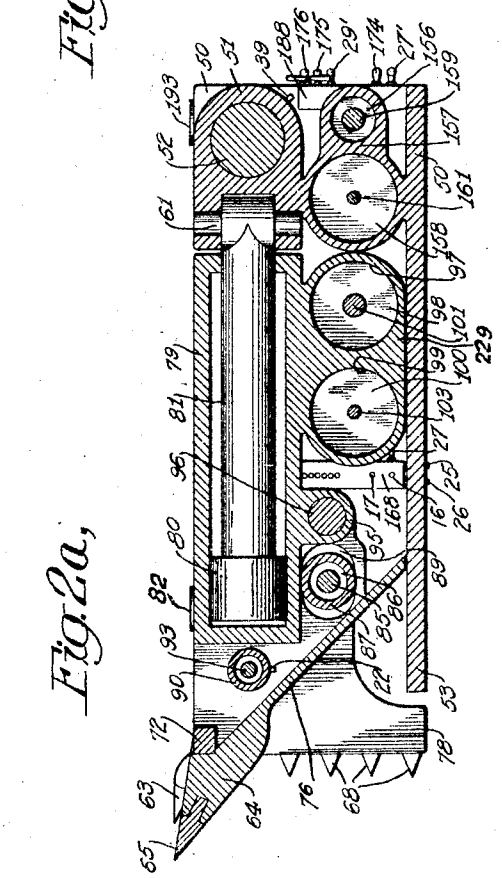

Fig. 2a,

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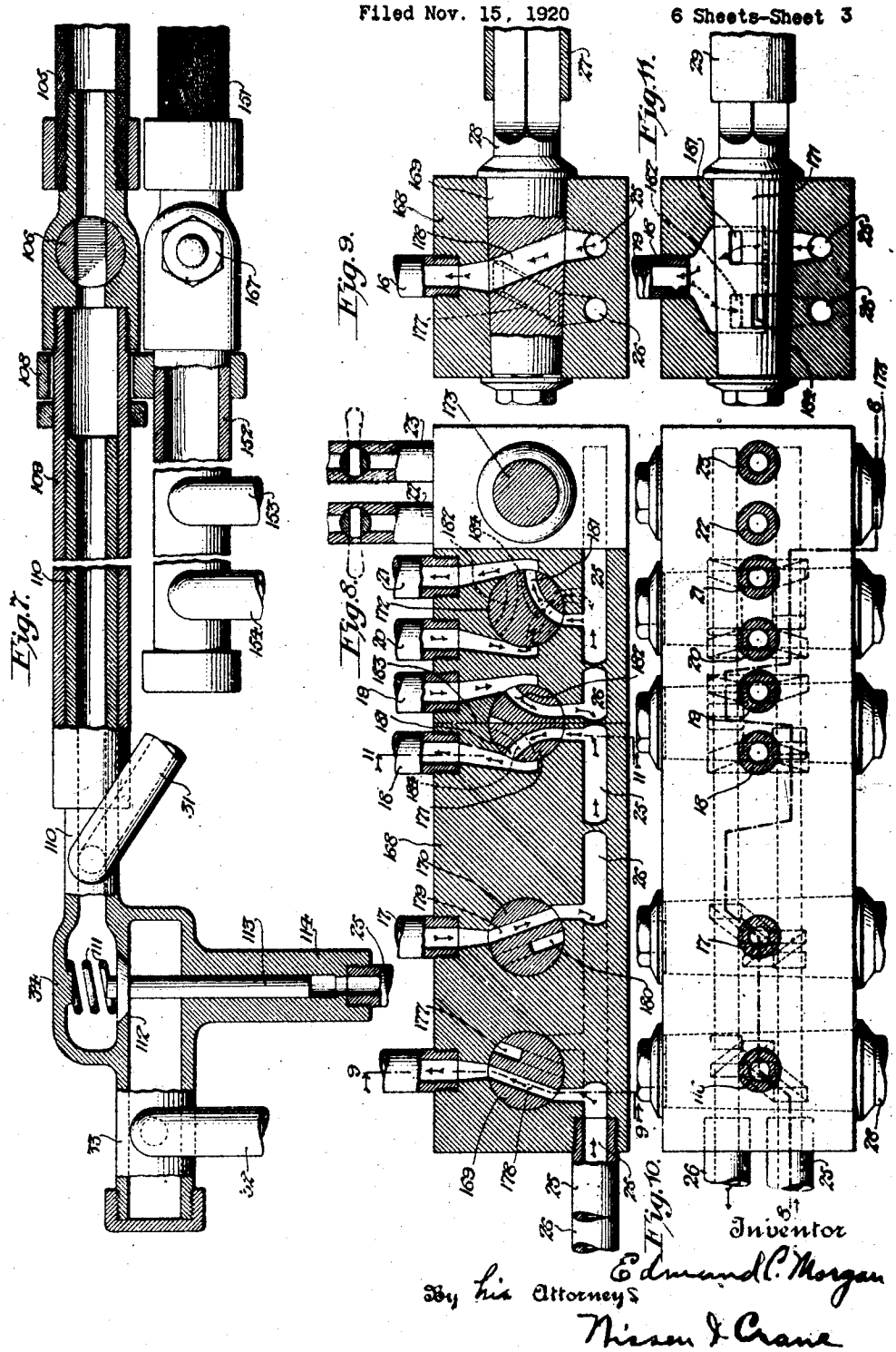

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MINING MACHINE

Filed Nov. 15, 1920 6 Sheets-Sheet 4

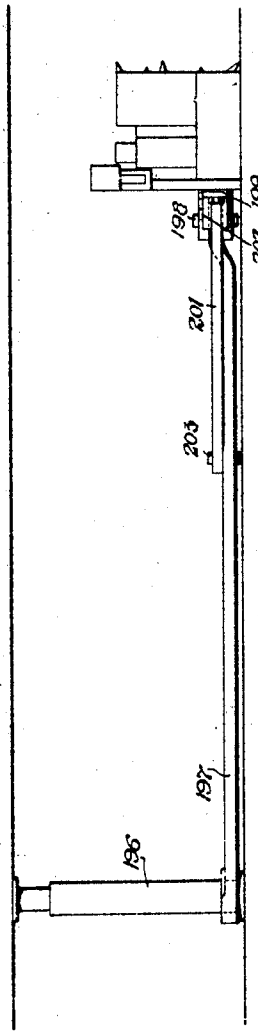

Fig. 12.

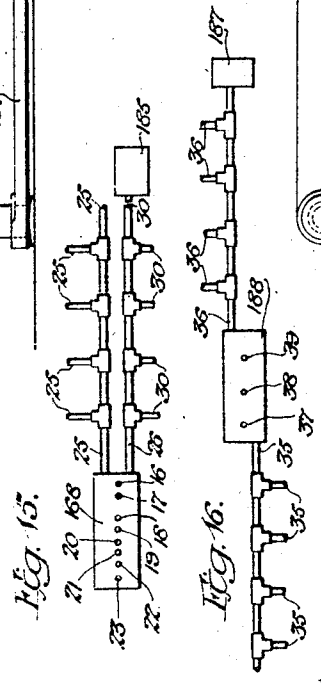

Fig. 15.

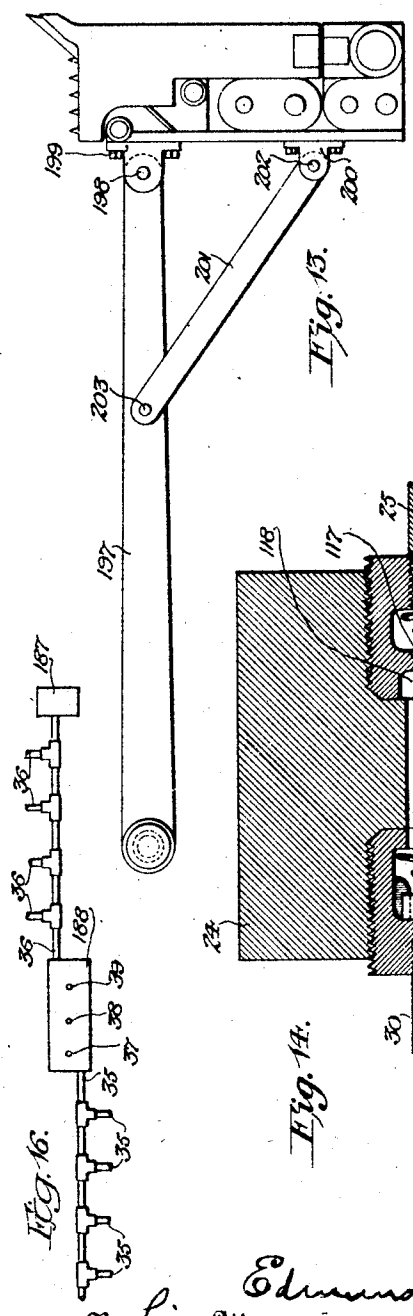

Fig. 13.

Fig. 16.

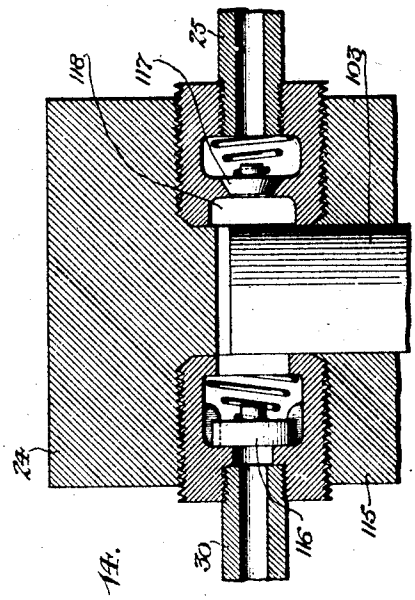

Fig. 14.

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Fig. 17.

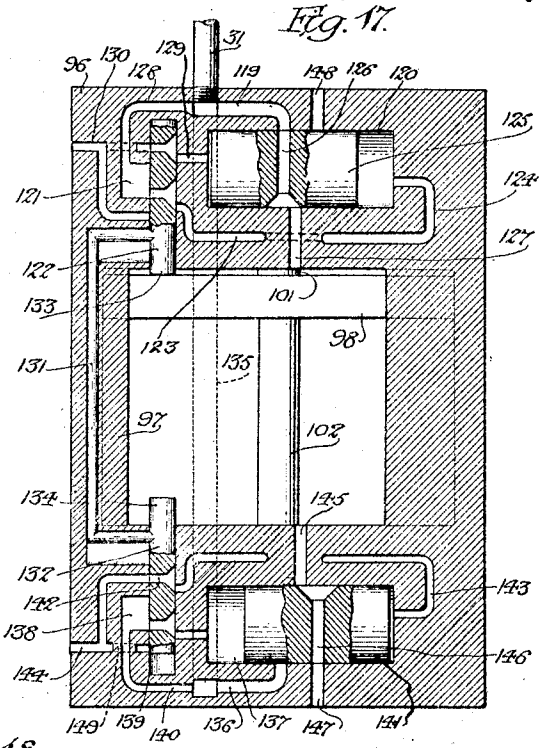


Fig. 18.

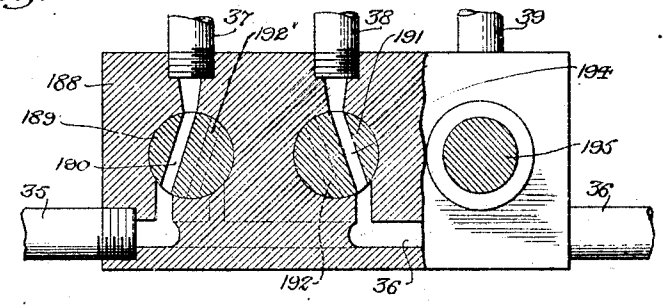
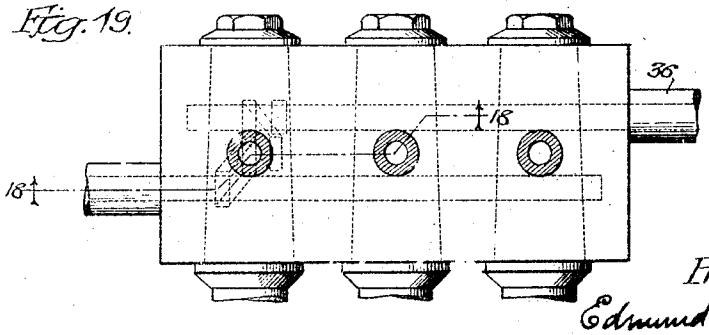


Fig. 19.



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MINING MACHINE

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Fig. 20.

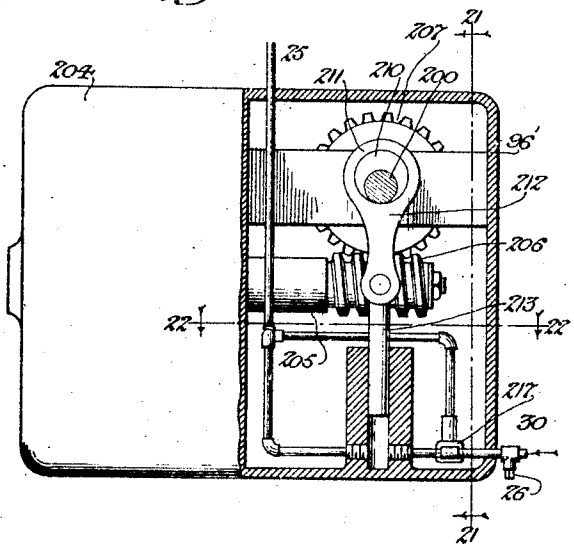


Fig. 21.

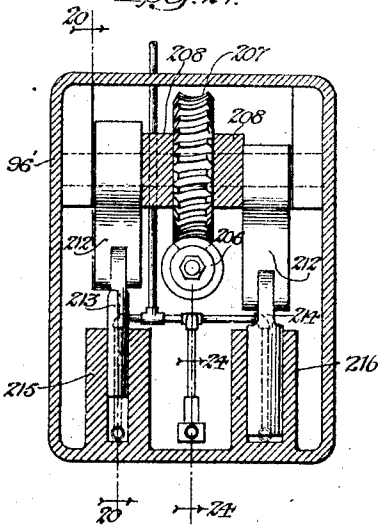


Fig. 22.

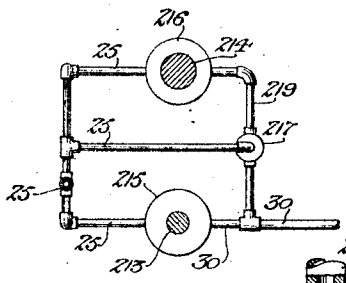


Fig. 23.

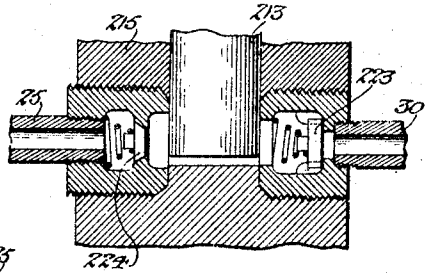
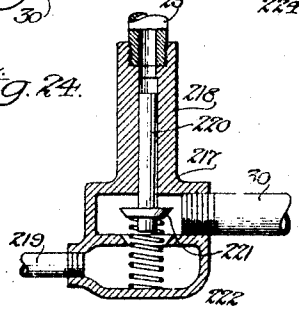


Fig. 24.



Inventor:-
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Patented Aug. 2, 1927. 1,637,531

UNITED STATES PATENT OFFICE.

EDMUND C. MORGAN, OF NEW YORK, N. Y.; OLIVE EUGENIE MORGAN EXECUTRIX OF SAID EDMUND C. MORGAN, DECEASED.

MINING MACHINE.

Application filed November 15, 1920. Serial No. 424,050.

My invention relates to mining machines comprising coal splitting mechanism, and one of the objects of my invention is the provision of an efficient apparatus of this type.

More particularly it is the object of the present invention to provide splitting mechanism and apparatus for operating the said to dislodge coal from a mine wall in a long wall operation.

A further object is the provision of hydraulic mechanism for automatically moving splitting tools into position for operation in a mine wall and then automatically and more slowly applying a more powerful action to effect the dislodgment of material from the mine wall.

Other objects of the invention will appear hereinafter, the novel combinations and features being set forth in the appended claims.

Referring to the accompanying drawings—

Fig. 1 is an end elevation of my improved long wall mining machine;

Fig. 2 is an elevational view of the machine;

Fig. 2ª is a section of Fig. 2 on the line 2ª—2ª looking in the directions of the arrows;

Fig. 3 is a rear end elevational view of the machine shown in Fig. 2;

Fig. 4 is a sectional elevation taken on line 4—4 of Fig. 6 looking in the direction of the arrows;

Fig. 4ª is a sectional elevation on the line 4ª—4ª of Fig. 4 looking in the direction of the arrows;

Fig. 5 is a sectional elevation of Figs. 4 and 6 taken on lines 5—5 looking in the direction of the arrows;

Fig. 6 is a plan view of the machine shown in Fig. 2;

Fig. 6ª is a sectional elevation on the line 6ª—6ª of Fig. 6 looking in the direction of the arrows;

Fig. 7 is a plan view partly in section of the pneumatic connections for the mining machine shown in Figs. 2 and 4;

Fig. 8 is a sectional elevation taken longitudinally through the multiple valve structure shown at the lower central portion of Fig. 6;

Fig. 9 is a sectional view of Fig. 8 taken on line 9—9 looking in the direction of the arrows;

Fig. 10 is a plan view of the structure shown in Fig. 8;

Fig. 11 is a sectional view taken on line 11—11 of Fig. 8 looking in the direction of the arrows;

Fig. 12 is an elevational view of mechanism for guiding the machine shown in Fig. 2 along an arc having a comparatively long radius;

Fig. 13 is a plan view of the structure shown in Fig. 12;

Fig. 14 is an enlarged view showing in detail the hydraulic pump mechanism adapted for use at the upper and lower ends of the hydraulic motors shown in Fig. 4;

Fig. 15 is a diagrammatic illustration of the pipe connections between the multiple valve structure shown in Fig. 8 and the hydraulic pumps illustrated in Fig. 4 at the central portion thereof;

Fig. 16 is a diagrammatic illustration of the connections between the valve structure shown at the central portion of Fig. 3 and the hydraulic pumps shown at the right-hand portion of Fig. 4;

Fig. 17 is a sectional elevation of an enlargement of one of the hydraulic motors shown in Fig. 4 to show the details of the controlling mechanism;

Fig. 18 is a sectional view to show the details of the valve structure shown at the central portion of Fig. 3 for controlling the mechanism operated by the pumps illustrated at the right-hand portion of Fig. 4;

Fig. 19 is a plan view of the structure shown in Fig. 18;

Fig. 20 is an elevation partly in section of an electrically operated pump which may be substituted for the tool hydraulically operated pumps shown at the central portion of Fig. 4;

Fig. 21 is a sectional elevational view of Fig. 20 on line 21—21 looking in the direction of the arrows;

Fig. 22 is a diagrammatic view illustrating the arrangement of the pipe and connections for the electrically operated pump shown in Fig. 20;

Fig. 23 is an enlarged sectional elevation of the details of the hydraulic pump mechanism adapted to be used in the structures shown in Figs. 20 and 21; and

Fig. 24 is a sectional elevation adapted to be used in connection with the electrically operated pump to control the valves in the

water supply pipes to effect the stopping of the motor shown at the right-hand portion of Fig. 21 after the splitting tools have been moved into position for operation as hereinafter described.

The main frame 50 is adapted to rest on the mine floor and move over the same along an upright mine wall. This main frame is provided with a roof jack comprising a cylinder 51 and a plunger 52, as shown in Fig. 6. The frame 50 is provided with a T-shaped forward extension 53 one arm 54 of which is adapted to rest on the floor and the other arm 55 extends upwardly and has pivoted thereto at 56 a roof jack 57 comprising a plunger 58 adapted to be thrust upwardly, as indicated by the dotted lines 59 in Fig. 2. As shown in Fig. 5, the roof jack 57 may be moved rearwardly on the pivot 56 so as to occupy a folded position below the upper plane of the machine.

A supplemental frame 60 is pivotally connected at 61 to that portion of the frame 50 adapted to be located adjacent the mine wall, as shown in Fig. 6. The frame 60 extends forward along the mine wall and laterally to a position in advance of the T-shaped support 53, as shown in Figs. 2 and 6. At the lower forward end of the supplemental frame is a diagonal projection 62 adapted to have secured thereto a conical splitting tool 63. Another splitting tool holder 64 is provided at the upper forward portion of the supplemental frame 60, as shown in Figs. 1 and 2, and such holder 64 is adapted to receive the conical splitting tool 65 in position to engage the coal intermediate the floor and roof thereof in advance of the upper and lower splitting tools 63 and 66, as shown in Figs. 4 and 6. An additional splitting tool or digger may be provided at 67 intermediate the tool holders 62 and 64, as shown in Figs. 1, 2 and 4.

At the forward lower horizontal portion of the supplemental frame 60 is a series of spaced-apart digging tools 68, as shown in Figs. 1 and 2.

Pivotally connected at 69 to the supplemental frame 60 is an auxiliary frame 70 which extends forwardly along the upper portion of the machine and laterally to a position in front of the arm 55, as shown in Fig. 6. This auxiliary frame 70 has a substantially flat top and is provided at its forward end at the mine wall with a tool holder 71 which is adapted to receive the conical splitting tool 66. An arcuate extension 72 extends into an arcuate guiding recess 73, as shown in Fig. 4. Since the auxiliary frame 70 is adapted to swing on the pivot 69 the latter is the center of the arc of the downward extension 72 and the recess 73 in which it fits and along which said extension 72 is adapted to slide in upright directions. The depending guiding extension 72 may be provided on its forward face with a comparatively small splitting or digging tool 74. The forward edge of the auxiliary frame 70 may be provided with a series of spaced-apart splitting or digging tools 75 similar to those shown at 68. The upper series of digging tools 75 is adapted to scrape along the roof of the mine chamber, while the lower series 68 is adapted to scrape along the floor of the mine chamber over areas equal to the width of the mining machine, as shown in Figs. 1 and 6, while the vertical series of spaced-apart large and powerful splitting tools are adapted to be projected along the mine wall to dislodge the coal in comparatively large blocks, as illustrated in Fig. 6. It should also be noted that the front face of the frame 60 is inclined diagonally toward the rear from the upright series of large tool holders, as indicated at 76 in Fig. 6. The extensions for supporting the diggers 75 and 68 are therefore in the form of spaced-apart horizontal plates 77 and 78, as shown in Figs. 1 and 6. It will thus be seen that during the operation of the machine and while the tools 75 and 68 are scraping along the roof and floor of the mine chamber the dislodged pieces of coal will be deflected away from the mine wall by the upright inclined deflector 76, the latter being movable forwardly beyond the forward end of the T-shaped supporting frame 53.

Mounted on the frame 60 so as to be rigidly secured thereto, as by being made integral therewith as shown in Fig. 5, is a cylinder 79 in which is movable a piston 80 having a piston rod 81 extending rearwardly for pivotal connection at 61 to the frame 50, as shown in Fig. 6. When the frame 50 is anchored by means of the hydraulic roof jacks 51 and 57 pressure may be exerted on the piston 80 in the cylinder 79 to move the supplemental frame 60 and auxiliary frame 70 forward along the mine wall to dislodge the coal, as indicated in Fig. 6. When the anchoring jacks 51 and 57 are released the hydraulic motors 79, 80, 81, may be operated to move the frame 50 forward to a new position, while the supplemental and auxiliary frames 60 and 70 remain stationary. Then the frame 50 may again be anchored and the splitting tools moved forward with considerable power to perform another dislodging operation at the mine wall.

In order to properly guide the upright series of splitting tools along the mine wall a plunger 82 may be provided in a horizontal transverse cylinder 83 at the lower portion of the supplemental frame 60, as shown in Fig. 4. Such cylinder 83 may be immediately below the forward end of the large longitudinal cylinder 79 of the main hydraulic motor. The plunger 82 may be moved toward the mine wall a predetermined distance

and held in position to act as a guide when the main hydraulic motor moves the upright series of splitting tools along the mine wall.

Below the auxiliary frame 70, intermediate the ends thereof, as shown at 84, is pivoted a vertical depending piston rod 85 at the lower end of which is a piston 86 fitting in a vertical cylinder 87. The lower end 88 of the latter is adapted to rest on the floor of the mine chamber. As shown in Fig. 6, the cylinder 87 extends through an elliptical opening 89 in the supplemental frame 60 so that the cylinder 87 may have a forward and backward movement relatively to the supplemental frame 60, but the cylinder 87 is not connected to the frame 60 directly.

By referring to Fig. 4 it will be seen that the operation of the hydraulic motor comprising the cylinder 87 adjusts the elevation of the auxiliary frame 70 on its pivot 69 so as to vary the height of the splitting tool 66. However, the lower end 88 of the cylinder 87 is adapted to rest on the floor of the mine chamber for the purpose of accomplishing the additional function of guiding the lower splitting tool 63 along the floor. This function is effected by providing a locking hydraulic motor 90 pivoted at its lower end at 91 to the interior of the frame 60 and at its upper end at 92 to the underside of the auxiliary frame 70, as shown in Fig. 4. A piston rod 93 extends to a piston 94 and control parts 22 and 23 are provided at the ends of the cylinder 90 so that the uppermost tool 66 may be regulated in its distance from the lower tools. When the adjustment has been made the piston 94 may be locked hydraulically against further movement, and when this takes place any upward movement of the piston 86 will not only move the auxiliary frame 70 upward, but also the frame 60 by reason of the motor 90. Therefore, on account of the motor 90 locking the auxiliary frame and the supplemental frame together, the adjustment in elevation of these frames by means of the motor 87 will cause the shoe 88 to guide the lowermost splitting tool 63 along the floor as desired.

In order to properly guide the splitting tools against up and down movement a cylinder 95 may be mounted on the frame 60 so as to receive a vertical plunger 96 in a position to be thrust against the roof of the mine chamber. This guiding mechanism not only prevents the lowermost splitting tool 63 from being moved upward beyond a predetermined distance, but also controls the forward movement of the uppermost splitting tool 66 along approximately horizontal planes because the motor 90 is relied upon to lock the frames 60 and 70 together during the operation of the machine.

After the mining machine has been moved into position adjacent the mine wall and the roof jacks 51 and 57 have been operated to anchor the main frame 50 it is desirable to effect the quick forward movement of the dislodging mechanism along the mine wall and then exert a slower and more powerful force to effect the dislodgment of the coal. I therefore, prefer to provide a double set of pneumatically operated hydraulic motors comprising a housing 229 secured to the frame 50 at the cylinder 79, as shown in Fig. 5. In the cylinder 97 is located a piston 98, and in the cylinder 99 is located a piston 100. Secured to the upper and lower sides of the piston 98 so as to be movable therewith are plungers 101 and 102, and secured to the upper and lower sides of the piston 100 so as to move therewith are plungers 103 and 104. The plungers 101 and 102 are of larger cross-section than the plungers 103 and 104 because it is desired that the larger plungers shall be actuated first to operate the hydraulic pumps to effect a quick forward movement of the upright series of splitting tools, and then when the latter meet with considerable resistance the movement of the piston 98 stops and the movement of the piston 100 continues so that the pumps operated by the plungers 103 and 104 will cause the main hydraulic motor 79 to continue to act to effect dislodgment of the coal.

The pistons 98 and 100 are pneumatically operated and for this purpose pipe connections are provided connected by means of the main supply pipe 105 to a source of supply, such as compressed air. In the supply pipe 105, as shown in Fig. 7, is a main control valve 106 operable by means of the handle 107 shown in Fig. 2. The supply pipe 105 is supported on the main frame 50 by means of the bracket 108. A pipe 109 extends forwardly longitudinally of the machine and telescoping into the pipe 109 is another pipe 110, as shown in Fig. 7, so that connections to the motors 97 and 99 may be maintained when the splitting tools occupy various forward positions. It should be noted that the motors 97 and 99 are secured to one side of the cylinder 79 and therefore these motors are in reality secured rigidly to the supplemental frame 60 and are movable forwardly therewith. Therefore, the supply pipe 105 is connected to the motors 97 and 99 through extensible connections comprising the telescoping tubes 109 and 110.

As shown in Figs. 2, 4, 6 and 7, a branch pipe 31 extends from the tube 110 to the pneumatic motor 97. The forward end of the tube 110 is provided with automatically operated valve mechanism for controlling the supply of pneumatic pressure from the chamber 33 to the pipe 32 to the motor 99. The pneumatically operated valve mechanism comprising a housing 34 having therein a spring 111 exerting its pressure on the valve 112 so as to close communication between

the pipe 110 and the chamber 33 while the motor 97 is operated. The under side of the valve 112 is provided with a plunger 113 which extends into the cylinder 114 and the pressure pipe 25 leads to this cylinder 114 from the hydraulic pumps which are operated by the plungers 101 and 102. Therefore, when the pressure exerted by the plungers 101 and 102 reaches the predetermined amount where the effect is to stop further movement of the piston 98, the pressure through the pipe 25 on the bottom of the plunger 113 will be sufficient to open the valve 112 so as to allow a supply of air pressure to flow through the pipe 32 to the motor 99 and start the piston 101 moving up and down to operate the smaller plungers 103 and 104 and thereby operate the hydraulic pump to secure slow and powerful movement of the upright series of splitting tools by a comparatively slow operation of the main hydraulic motor 79.

In Fig. 14 I have illustrated in detail one of the hydraulic pumps 24, but it should be understood that one of these pumps is located below the piston 100, as well as above the same, and that similar pumps are located above and below the piston 98. These pneumatically operated pumps are entirely automatic in their operation.

By referring to Figs. 4 and 7 it will be seen that when the plunger 103 moves upwardly in the cylinder 115 the check valve 116 will be closed thereby cutting off communication from the supply pipe 30. At the same time the check valve 117 will be open toward the right so that the liquid in the chamber 118 will be forced into the exhaust pipe 25. The lower plunger 104 operates in the same manner to close a check valve at the pipe 30 when the plunger 104 is moved down and at the same time opens a valve at the pipe 25. In the same manner the plungers 101 and 102 operate hydraulic pumps and the check valves in the pipes 30 and 25 occupy the same relation as shown in Fig. 14. Therefore, whenever any of the plungers are moved toward the ends of the cylinders the valves at the pipes 30 will be closed and the valves at the pipes 25 open, and when the plungers move in the reverse direction liquid will be drawn into the cylinders through the pipe 30.

Whenever the valve 106, as shown in Fig. 7, is opened there will be a supply of air pressure directly to the motor 79 through the pipe 31, the communication to the other motor 99 being cut off by reason of the closure of the valve 112. Not until the pumps operated by the piston 98 meet with sufficient resistance to stop the movement of the piston 98 will the pressure in the pipe 25 of Fig. 7 be sufficient to open the valve 112 and let a supply of air pressure through the pipe 32 to the motor 99 to operate the latter.

The details of the mechanism for controlling the operation of the pneumatically operated duplex pumps are shown in Fig. 17 in an enlarged sectional elevation. The air pressure supply pipe 31 is connected to a passageway 119 in the housing 96. One branch of this passageway 119 extends into the cylinder 120 and the left-hand branch extends to the chamber 121 which is adapted to communicate with ports in the vertical tappet valve 122. In the position of this valve shown in Fig. 17 the port 123 establishes communication between the supply pipe 31 through the passageway 124 to the cylinder 120 to the right of the cylindrical slidable valve 125. When the latter has been moved to the left, as shown in Fig. 17, its port 126 establishes communication between the supply pipe 31 to the cylinder 97 through the passageway 127 above the piston 98. When the valve 122 occupies the position shown in Fig. 17 its upper port 128 connects the passageways 129 and 130 so that the left-hand end of the cylinder 120 will be connected to exhaust and permit free movement of the valve 125 to the left.

The valve 122 is connected by means of the rod 131 to the lower tappet valve 132. Therefore, when the piston 98 strikes the tappet 133 to move the valve 122 to its upper position shown in Fig. 17 the tappet valve 132 will be moved upwardly so that its tappet 134 will be extended into the cylinder 97 in position to be struck by the piston 98 when the latter moves down toward the limit of its down stroke. A passageway 135 in the housing 96 connects the supply pipe 31 to the lower passageway 136, the latter being provided with one branch extending to the cylinder 137 and with another branch extending to the chamber 138. When the tappet valves are up communication is established between the supply pipe 31 and the left-hand end of the cylinder 137 through the port 139 and the passageway 140. Therefore, the cylindrical valve 141 will be moved toward the right. This movement is permitted because the port 142 in the valve 132 establishes communication between the right-hand end of the cylinder 137 through the passageway 143 to the exhaust port 144. When the cylindrical valve 141 is moved to its right-hand position, as shown in Fig. 17, the cylinder 97 below the piston 98 is connected through the passageway 145 and port 146 to the exhaust port 147. The piston 98 will therefore be free to move downwardly by reason of the pressure exerted on top of the same from the supply pipe 31 through the passageways 119, 126 and 127.

When the piston 98 approaches the limit of its downward stroke the tappet 134 is struck by the piston to move both of the valves 122 and 132 to their lower positions.

When this occurs the port 128 connects the chamber 121 to the passageway 129 and therefore pressure will be exerted from the supply pipe 31 to the left-hand end of the valve 125. At the same time the right-hand end of the valve 125 will be connected to the exhaust port 130 through the passageway 124 and the port 123 in the valve 122. Upon the valve 125 being moved toward the right the connection between the supply pipe 31 and the cylinder 97 will be cut off and the exhaust port 148 will be connected to the space above the piston 98 through the passageway 127 and port 126. The piston 98 will then be free to be moved upwardly by air pressure exerted on the under side thereof. The flow of air pressure to move the piston 98 upwardly is secured by the downward movement of the valve 132. When such downward movement takes place the supply pipe 31 will be connected through the chamber 138, port 142 and passageway 143 to the right-hand end of the cylinder 137. At the same time the left-hand end of the cylinder 137 will be connected to the exhaust port 144 through the passageway 140, port 139 and passageway 149. The valve 141 will then be free to move toward the left, cutting off communication between the cylinder 97 and the exhaust port 147 and establishing communication between the passageway 136, port 146 and passageway 145 to the under side of the piston 98. The operation of the mechanism shown in Fig. 17 is entirely automatic and it should be understood that each of the four pistons shown in Fig. 4 for operating the pumps is controlled by mechanism similar to that shown in Fig. 17. The rear set of pneumatically operated pumps is for the purpose of operating the various anchoring devices, while the forward set is for the purpose of operating the main hydraulic motor 79 to secure operation of the coal splitting mechanism. The rear set of pneumatically operated pumps comprises a housing 150 mounted on the main frame 50. Therefore, a separate air pressure supply pipe 151 may be used for leading air pressure to the pipe 152 and thence to the branch pipes 153 and 154. Since the pumps are mounted on the main frame 50 no telescoping extension, such as that shown in Fig. 7, is necessary for supplying air pressure to the rear set of pneumatic motors.

Referring to the right-hand portion of Fig. 4 it will be seen that in the comparatively small cylinder 155 is a piston 156, while in the comparatively large cylinder 157 is a piston 158. The piston 156 is provided with an upwardly extending plunger 159 and a downwardly extending plunger 160 of cross-sections larger than the cross-sections of the plungers 161 and 162 which extend above and below the piston 158. The plungers 159, 160, 161 and 162 constitute respectively parts of the hydraulic pumps 163, 164, 165 and 166 each of which is provided with check valves similar to those shown in Fig. 14, the check valves at the pipes 35 of these pumps opening toward the right, and the check valves at the pipes 36 being arranged to close when the plunger is moved toward the ends of the cylinders.

When the valve 167 in the supply pipe 151 is opened air pressure is immediately led through the pipes 153 and 154 to both motors 155 and 157 and both may immediately operate to effect the operation of the hydraulic pumps to exert pressure in the pipes 35 leading to the various anchoring and guiding devices through the control valves at the rear end of the machine.

The pump mechanism having the larger plungers 159 and 160 and the smaller piston 156 will operate to quickly move the various plungers of the hydraulic jacks and guiding devices into positions where they meet with resistance and the back pressure will cause the piston 156 to stop, but the piston 158 is designed to continue the operation of the plungers 161 and 162 to exert sufficient hydraulic pressure to firmly anchor the main frame into the desired position by operation of the roof jacks 51 and 57. The valve mechanism for controlling the hydraulic pressure is secured to the supplemental frame 60 and is movable therewith so that piping connections may be secured so as to be movable for carrying hydraulic pressures between the pumps and the various hydraulically operated devices. It will thus be seen that the motors 97 and 99, together with the hydraulic pumps operated thereby, are mounted on the supplemental frame 60, and since the valve mechanism 168 is also mounted on the frame 60 rigid piping connections suitable for hydraulic pressure, may be used, as illustrated diagonally in Fig. 15.

I prefer to have one point of control of all of the valves on the machine and I therefore provide the operating handles at the rear of the main frame, as shown in Fig. 3. Since the valve mechanism 168 moves forward with the frame 60 while the frame 50 remains stationary, I provide long tubes connected to the operating handles, such tubes comprising sockets angular in cross-section to fit extensions from the valves. For instance, the tube 27 is provided with a socket having a squared cross-section to fit on the operating stem 28 of the valve shown in Fig. 9. The telescoping connection between the valve stem 28 and the tube 27 may be of sufficient length to permit the maximum forward movement of the supplemental frame 60 relatively to the main frame 50 while maintaining operating connection between the handle 27′ and the valve 169 shown in Fig. 9. Each of the other

valves 170, 171, 172 and that connected to the stem 173 are also provided with extensions squared in cross-section to fit into tubular sockets connected respectively to the handles 174, 29', 175 and 176, as shown in Fig. 3.

When the valve 169 is operated to the position shown in Fig. 8 communication may be established from the supply pipe 25 to the pipe 16 and the latter may be connected to the cylinder 95, as shown in Fig. 4. It should be understood that the supply pipe 25 of Fig. 8 is connected in multiple with the pipes 25 of the hydraulic pumps shown at the central portion of Fig. 4. When the valve 169 is moved to the position shown in Fig. 8 and pressure exerted through the pipe 16 on the bottom of the plunger 96 in the cylinder 95, the plunger 96 will be moved upwardly, and when in proper guiding position the valve 169 may be moved to neutral position to cut off the supply of the water to and from the pipe 16. When it is desired to lower the plunger 96 the weight of the latter is relied upon to force the liquid out of the cylinder 95 through the pipe 16 into the pipe 26 shown in Fig. 8. When the valve 169 is moved to the position where the port 177 establishes communication with the pipe 26 the water will flow out of the cylinder 95 through the pipe 16 into the pipe 26. The same valve 169 provided with ports 177 and 178, as shown in Figs. 8 and 9, is therefore sufficient to control the operation of the roof guiding mechanism comprising the cylinder 95 and the plunger 96.

In a similar manner the valve 170 may be operated to control the wall guide comprising the cylinder 83 and plunger 82. When the valve 170 is in the position shown in Fig. 8 its port 179 will permit the water to flow from the pipe 17 into the return pipe 26, and when the valve 170 is turned to neutral position the plunger 82 may be locked in adjusted guiding position. In order to thrust out the plunger 82 to the desired position the valve 170 should be turned so that the port 180 therein will establish communication between the pipe 25 and the pipe 17. The manner in which this is done can readily be seen by referring to Fig. 9 which shows the valve 169 having ports similar to the ports in the valve 170. It should also be noted that the section line 8—8 is partly along the supply passages 25 and partly along the return passages 26.

Where it is necessary to communicate to a cylinder of a hydraulic motor at both ends thereof on opposite sides of the piston, cylinder valves of the type shown at 171 and 172 in Fig. 8 should be used. The ports of such a valve are shown in Fig. 11, the latter being a sectional view on line 11—11 of Fig. 8 looking in the direction of the horizontal arrows. When the valve 171 is in the position shown in Fig. 8 communication is established between the supply passage 25 through the port 181 to the pipe 18 which leads to the cylinder 79 at the left-hand end thereof, as shown in Fig. 4. At the same time that pressure is exerted on the left-hand end of the piston 80 in the cylinder 79 by moving the valve 171 to the position where its port 181 will connect the passage 25 with the pipe 18 the port 182 will be connected between the pipe 19 and the return passage 26. The pipe 19 is connected to the right-hand end of the cylinder 79, as indicated in Fig. 6. Therefore, the water at the right of the piston 80 may be exhausted through the pipe 19 when pressure is exerted through the pipe 18 on the left-hand side of the piston 80 to effect forward movement of the coal splitting devices. The arrows in Fig. 8 indicate the flow of the water from the supply passage 25 into the pipe 18 and back along the pipe 19 into the return passage 26. It should be noted that the section line 10—10 of Fig. 10 is along different vertical planes at the sides of the vertical center line 183. The section of the valve 171 to the left of the center line 183 is through the port 181, whereas the section of the valve 171 to the right of the center line 183 is through the port 182. There is an additional port 184 for connecting the pipe 18 to the exhaust passage 26 when the valve 171 is turned into position for connecting the supply passage 25 to the pipe 19. This is illustrated by the position of the valve 172 because when the port 181 connects the supply passage 25 to the right-hand pipe 21 the port 184 is connected between the left-hand pipe 20 and the return passage 26. In other words, when the valve 171 is turned to the position shown in Fig. 8 at the valve 172 the supply pressure will be exerted through the port 181 to the pipe 19 and thence to the cylinder 79 at the right of the piston 80 to move the latter to the left when the roof jacks 51 and 57 are in released position, and during such movement the water at the left of the piston 80 will flow through the pipe 18 and the port 184 into the passage 26, as represented by the dotted arrows in Fig. 8.

The operation of the valve 172 controls the flow of the fluid pressure medium into and out of the cylinder 87 above and below the piston 86. It is evident that by turning the valve 172 to neutral position the piston 86 may be locked in adjusted position in the cylinder 87 so that the supplemental frame 60 and the auxiliary frame 70 will be adjusted in elevation by reason of the shoe 88 resting on the floor of the mine chamber.

The valve 173 is similar to the valve 171 and 172 and in the same manner controls the flow of fluid pressure into and out of the cylinder 90. By moving the valve 173 to

neutral position the piston 94 may be locked in the cylinder 90 so that the supplemental frame 60 and auxiliary frame 70 will be rigidly connected together. Such a neutral position may be effected by moving the valve in a clockwise direction a small angle from the position shown by the valve 172 in Fig. 8, communication then being closed between the pipes leading to the hydraulic cylinder and also between either of said pipes and either the supply pipe 25 or the return pipe 26. Instead of relying on the valve 173 being moved to neutral position the locking of the piston in the cylinder 90 may be effected by the valves 225 and 226, respectively, operable by the handles 227 and 228.

In a suitable position below the main hydraulic cylinder a water reservoir 185 may be provided, the filling opening being closed by the screw 186. As indicated at 30, (Fig. 5) the water in the reservoir 185 is constantly in communication with the pipes 30 shown in Fig. 4 connected to the hydraulic pumps above and below the pistons 98 and 100. The reservoir being connected by means of the pipe 30 to the various pumps in multiple simply maintains sufficient fluid pressure medium for circulation through the supply pipes 25, the various valves in the valve structure 168 and the pipes and the motors connected thereto, the return passage being into the pipe 26. Of course, the water reservoir 185 should be of sufficient capacity to enable the various motor cylinders to be filled, such motor cylinders including those designated 95, 83, 79, 87 and 90.

By referring to Fig. 15 diagrammatically illustrating the pipe connections it will be seen that the reservoir 185 is connected by means of the pipe 30 with the pipe 26 which leads into the valve structure shown in Fig. 8. Each of the branch pipes designated 30 in Fig. 15 is connected to the pipes 30 shown in Fig. 4. Also, each of the branch pipes 25 shown in Fig. 15 is connected to the corresponding pipe 25 of Fig. 4. There is also an end pipe connection designated 25 which leads to the pipe designated 25 in Fig. 7. Therefore, taking Fig. 15 in connection with Figs. 4, 5, 7 and 8 the complete circulating system for the hydraulic pumping mechanism may be readily traced, including the flow of the fluid pressure medium into and out of the fluid pressure motors 95, 83, 79, 87 and 90.

Fig. 16 illustrates diagrammatically the pipe connections between the reservoir 187 and the return pipe 36, as well as the various connections to the hydraulic motors mounted on the main frame 50 at the right-hand portion of Fig. 4. Fig. 16 also illustrates the various connections designated 35 in Fig. 4 and their relation to the valve structure 188 which is located at the rear of the main frame, as shown in Fig. 3. This valve structure is shown in detail in Figs. 18 and 19.

When the pneumatically operated hydraulic pumps draw the water from the reservoir 187 through the four pipe connections 36 illustrated diagrammatically in Fig. 16, the fluid is directed under pressure through the four pipes designated 35 and thence into the supply passage of the valve structure. For instance, when the valve 189 of Fig. 18 is in the position shown in this view its port 190 will establish communication between the supply pressure pipe 35 and the pipe 37 which leads to the hydraulic jack 57. The plunger 58 may then be moved to the dotted line position indicated at 59 in Fig. 2 to anchor the T-shaped extension 53 of the main frame between the floor and roof of the mine chamber. This roof jack may be released by moving the valve 189 so that the port 192′ will connect the pipe 37 to the return passage 36. In the same manner the valve 191 may be operated to connect its port 192 between the supply pipe 35 and the pipe 38 and thereby effect the operation of the plunger 193 which is in position to act as a guide for the rear portion of the main frame adjacent the mine wall. When the valve 191 is turned to the position shown in Fig. 18 its port 194 is connected between the pipe 38 and the return passage 36 so that the plunger 193 may be moved to the initial position shown in Fig. 3.

By operating the valve 195 the flow of the pressure medium through the pipe 39 may be controlled to control the roof jack 51.

In Fig. 12 I have illustrated a roof jack 196 to the lower end of which is pivoted an elongated directing arm 197, to the outer end of which is pivoted at 198 the forward portion of the main frame of the mining machine shown in Fig. 2. A bracket 199 may be secured to the arm 54 of Fig. 2 and an additional bracket 200 may be secured to the lower rear portion of the main frame 50. A link 201 is pivotally connected at 202 to the bracket 200 at one end, and the other end is pivotally connected at 203 to the arm 197 intermediate the ends thereof. By means of this anchored pivot and radial arm mechanism the mining machine shown in Fig. 2 may be directed along an arcuate path of travel on a comparatively long radius.

In Figs. 20 to 24, inclusive, I have illustrated electrically operated mechanism for securing hydraulic pressure to operate the various hydraulic motors shown on the mining machine illustrated in Figs. 1 to 6, inclusive. The electrically operated mechanism shown in Figs. 20 and 21 may be substituted for the pneumatically operated mechanism shown in Fig. 4. For instance, the housing 229 of Fig. 4, together with the mechanism carried thereby, may be removed from the supplemental frame 60 and re-

placed by the housing 96′ shown in Figs. 20 and 21.

Mounted in the housing is an electric motor at 204 provided with a shaft 205 having a worm 206 at the outer end thereof in position to mesh with the worm wheel 207. The worm wheel 207 is journaled in bearings 208 and the outer ends of the shaft 209 which carries the worm wheel 207 are provided with eccentrics 210 operating eccentric straps 211 connected by links 212 to the upper ends of plungers 213 and 214. The upper ends of the plungers 213 and 214 are pivotally connected to the eccentrically operated links 212 so that the plungers will have vertical movements in their respective cylinders 215 and 216.

In Fig. 23 I have illustrated the valve mechanism which should be used at the lower ends of the cylinders 215 and 216. When the plunger 213 descends the check valve 223 is closed and the check valve 224 is opened. When the plunger 213 reciprocates the hydraulic pump will operate to draw the water from the pipe 30 and force it into the pressure pipe 25 in the same manner that the pipe 24 of Fig. 4 operates to draw water from the pipe 30 and force it into the supply pressure pipe 25.

It will also be seen that Fig. 21 shows the lower right-hand hydraulic motor provided with a plunger having a larger cross-sectional area than the plunger 213. This difference in area corresponds to the difference in area of the plungers 160 and 162 of Fig. 4.

While in connection with the pneumatically operated hydraulic pumps I have provided the mechanism shown at the left-hand portion of Fig. 7 to effect successive operation of the motors 97 and 99, I have also illustrated a modification in connection with the electrically operated pump by providing the automatically operated valve mechanism shown in Fig. 24. As shown in Fig. 22, the pipes extending from the left sides of the cylinders 215 and 216 lead to the pressure supply for the various hydraulic motors to be operated. At 217 I have provided a fluid pressure operated valve device illustrated in detail in Fig. 24. This device comprises a hydraulic cylinder 218 which is connected to the pressure supply pipes 25. When the pump plungers 213 and 214 are first operated by the electric motor 204 there is a free passage from the pipe 30 through the valve device 217 to the pipe 219 which is connected to the cylinder 216. Both pumps are therefore operated initially to supply the pipes 25 with fluid pressure so that the various hydraulic motors may be moved quickly to the desired positions. After such hydraulic motors meet with resistance so that more power is required to operate them the pressure in the pipes 25 will be increased until the plunger 220 shown in Fig. 4 will be moved down to close the valve 221 against the action of the spring 222, whereupon communication between the pipe 30 and the pipe 219 will be cut off and subsequent operation will be effected by the motor 215 with its smaller plunger, the motor 216 becoming inactive to produce any further pressure in the pressure pipes 25. The hydraulic motors will then be operated more slowly but more powerfully as the electric motor 204 continues to operate the hydraulic pump 215 having the smaller plunger 213. When the pressure in the hydraulic motors is relieved the spring 222 will automatically move the valve 221 to initial position. In the same manner when the pressure in the pipe 25 of Fig. 7 is sufficiently relieved the spring 111 will automatically close the valve 112.

Obviously those skilled in the art may make various changes in the details and arrangements of parts without departing from the spirit and scope of my invention as defined by the claims hereto appended and I wish therefore not to be restricted to the precise construction herein disclosed.

What I claim and desire to have secured by Letters Patent of the United States is:

1. In a mining machine, the combination with a main frame, of means for anchoring the rear portion and the forward portion of said frame rigidly between the floor and roof of a mine chamber, mechanism for forcing a cleavage in a coal vein, means for supporting such cleavage mechanism with an entirely free and unobstructed space in advance thereof and for movement along said frame while the latter remains rigidly anchored, and means connected to the rear of said cleavage mechanism for operating the same.

2. In a mining machine, the combination with a main frame, of means for anchoring both the rear portion and the forward portion thereof, a supplemental frame guided on said main frame for rectilinear movement along the same, coal cleavage mechanism mounted on said supplemental frame with the space in advance of said cleavage mechanism entirely free and unobstructed, and means connected between said frames for operating said coal cleavage mechanism by moving said supplemental frame along said main frame while the latter remains anchored at its forward portion as well as at its rear portion and while the space in advance of said cleavage mechanism remains free and unobstructed.

3. In a mining machine, the combination with a main frame having a rear section adapted to be located adjacent a mine wall and a forwardly extending section adapted to be spaced from the mine wall, of anchoring mechanism for said rear section, additional anchoring mechanism for the said forward section, a supplemental frame, coal

cleavage mechanism at the forward end of said supplemental frame, and self-acting power means for moving said supplemental frame in advance of said rear section while being guided along the mine wall between the latter and said forwardly extending section.

4. In a mining machine, the combination of a main frame, of a supplemental frame, cleavage mechanism carried by said supplemental frame, means for anchoring the said main frame, mechanism for moving the supplemental frame relative to said main frame to operate said cleavage mechanism, and means adjustable into position to engage the mine vein to guide said supplemental frame along a predetermined path of travel.

5. In a mining machine, the combination with a main frame, of means for anchoring the same between the floor and the roof of a mine chamber, a supplemental frame mounted on said main frame for movement relatively thereto, coal cleavage mechanism carried by said supplemental frame for bodily movement therewith and adapted to split and tear a layer of coal from the upright wall of a mine vein, means for operating said cleavage mechanism by moving said supplemental frame relatively to said main frame, and adjustable guiding mechanism on said supplemental frame in position to engage the mine vein and move along the same approximately parallel to the path of travel of said cleavage mechanism.

6. In a mining machine, the combination with a main frame, of a supplemental frame mounted thereon for movement relatively thereto along an upright mine wall, coal cleavage mechanism comprising a plurality of spaced apart pointed wedging tools mounted on said supplemental frame for bodily movement therewith, means for moving said supplemental frame relatively to said main frame to operate said cleavage mechanism by causing said tools to split coal from the mine vein over a wide area extending from the floor to the roof of the mine chamber, and a plurality of adjustable guiding devices mounted on said supplemental frame in spaced-apart positions to confine the said coal cleavage mechanism along a predetermined path of travel during operation.

7. In a mining machine, the combination with a main frame, of a supplemental frame, coal cleavage mechanism comprising a plurality of spaced-apart digging and wedging tools adapted to rip and tear a layer of coal from the mine wall in comparatively large pieces and over a wide area, said coal cleavage mechanism being carried by said supplemental frame for bodily movement therewith, means for imparting a translating movement to said supplemental frame to effect the operation of said coal cleavage mechanism, and a wall guiding mechanism mounted on said supplemental frame to move bodily therewith and with said cleavage mechanism, said guiding mechanism comprising a plunger adjustable into position to engage the upright mine wall and slide along the same during the operation of said cleavage mechanism.

8. A mining machine comprising a stationary frame and a movable frame, dislodging mechanism mounted on said movable frame to move therewith, means for moving the latter frame rectilinearly to operate the dislodging mechanism along straight lines of travel, and an upright guiding device adapted to be moved into contact with the roof of the mine chamber to slide along the same during the operation of said dislodging mechanism.

9. A mining machine comprising main and supplemental frames relatively movable, claw-like mechanism comprising a series of spaced-apart digging and wedging fingers mounted on said supplemental frame for movement therewith in position to rip and tear a layer of coal from an upright mine vein over a wide area extending from the floor to the roof of the mine chamber, means for operating said claw-like mechanism by moving said supplemental frame relatively to said main frame, an adjustable mechanism of said supplemental frame in position to engage the floor of the mine chamber and slide along the same during the operation of said dislodging mechanism.

10. A mining machine comprising a main frame adapted to be held stationary, a supplemental frame, coal cleavage mechanism carried by said supplemental frame, a fluid pressure motor for moving said supplemental frame relatively to said main frame to operate said coal cleavage mechanism, and independently operable fluid pressure devices comprising respectively plungers adapted to engage the floor, roof and wall of the mine chamber to guide said coal cleavage mechanism into and along the coal vein.

11. A mining machine comprising a frame, spaced-apart coal cleavage devices carried by said frame, power-operated, means for adjusting the spacing of said devices, and means for operating said coal cleavage devices.

12. A mining machine comprising a frame, coal cleavage devices carried by said frame, power-operated means for adjusting the spacing between said devices, power-operated mechanism for adjusting the elevation of said devices, and means for operating said coal cleavage devices.

13. A mining machine comprising upper and lower spaced-apart cleavage devices, means for adjusting the spacing between said devices, said adjusting means comprising a fluid pressure motor having a cylinder

and a piston therein, and an additional fluid pressure motor for adjusting the elevation of said cleavage devices.

14. A mining machine comprising a main frame, means for anchoring the frame in a mine chamber between the floor and roof thereof, a supplemental frame, a fluid pressure motor having a cylinder on said supplemental frame and a piston rod pivotally connected to said main frame, an auxiliary frame pivotally connected to said supplemental frame and adapted to extend along the roof of the mine chamber, a coal splitting device at the forward end of said auxiliary frame in position to move in the plane of the roof, an additional coal splitting device connected to said supplemental frame in position to move in the plane of the floor of the mine chamber, a fluid pressure motor connected between said supplemental and auxiliary frames to adjust the space between said coal splitting devices and thereby adjust the elevation of the roof splitting device, and an additional fluid pressure device between the floor and said auxiliary frame to adjust the elevation of both of said devices particularly the floor splitting device.

15. A mining machine comprising a main frame, a supplemental frame pivotally connected thereto, a cleavage device carried by said supplemental frame, an auxiliary frame, a cleavage device carried by said auxiliary frame, a fluid pressure motor for adjusting the space between said cleavage devices, and an additional fluid pressure motor connected to said auxiliary frame to swing the frame on its pivotal connection with said supplemental frame.

16. In a mining machine, the combination with supporting framework, of dislodging mechanism comprising means for penetrating the mine vein and by wedging action split large portions of the mineral from the vein, means for moving the dislodging mechanism quickly to its work, and means for operating the dislodging mechanism after reaching its work by moving the same rectilinearly and more powerfully to effect such dislodgement of the mineral from its native bed.

17. In a mining machine, the combination with supporting framework, of dislodging mechanism mounted thereon and comprising penetrating wedging tools adapted to act on the mineral in its native bed and split large portions therefrom, apparatus for moving said dislodging mechanism rapidly into engagement with the mine vein in readiness to dislodge the material therefrom, and means co-acting with said moving apparatus to effect the exertion of said dislodging mechanism to cause said tools to move rectilinearly along the mine wall to dislodge material therefrom by splitting and wedging actions.

18. In a mining machine, the combination with supporting frame-work, of coal cleavage mechanism mounted thereon, fluid pressure mechanism for moving said coal cleavage mechanism quickly into engagement with coal in the vein, and supplemental fluid pressure mechanism operated automatically to effect a slow and more powerful movement of said coal cleavage mechanism into the coal vein to dislodge the coal therefrom.

19. In a mining machine, the combination with a main frame, of means for anchoring said main frame in a mine chamber, a supplemental frame, coal cleavage mechanism carried by said supplemental frame and movable bodily therewith, a hydraulic motor connected between said main and supplemental frames for moving the supplemental frame relatively to the main frame to operate said coal cleavage mechanism, means for controlling the operation of said hydraulic motor to move said coal cleavage mechanism into engagement with the coal vein with a comparatively quick movement, and means for automatically effecting a slower and more powerful operation to said hydraulic motor to cause said coal cleavage mechanism to dislodge coal from the vein.

20. A mining machine comprising supporting frame-work, coal cleavage mechanism mounted thereon, fluid pressure means for operating said coal cleavage mechanism, and means for automatically moving the coal cleavage mechanism into engagement with the coal and thereafter exerting a slower and more powerful force on said coal cleavage mechanism to dislodge the coal from the vein.

21. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, fluid pressure apparatus for operating said dislodging mechanism, and multiple fluid pressure pumping apparatus for controlling the operation of said dislodging mechanism.

22. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, fluid pressure apparatus for operating said dislodging mechanism, and pneumatically operated fluid pressure pumping appliances for controlling the operation of said fluid pressure apparatus.

23. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a hydraulic motor for operating said dislodging mechanism, a plurality of hydraulic pumps connected to said hydraulic motor, and a plurality of pneumatically operated motors operable successively for effecting the operation of said pumps.

24. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a fluid pressure motor for operating said dislodging mechanism, fluid

pressure pumps connected to said fluid pressure motor, a pair of pneumatically operated motors for operating said pumps, and a valve in the pneumatic pressure supply connections for effecting the operation of one of said pneumatically operated motors after the other.

25. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a fluid pressure motor for operating said dislodging mechanism, a duplex pump connected to said fluid pressure motor, a pneumatic motor for operating said duplex pump, an additional duplex pump having plungers of smaller diameter than the plungers of the first-named pump, an additional pneumatic motor for operating said additional duplex pump, separate pneumatic pressure supply connections to said pneumatic motors, a valve in the pneumatic supply connection to said additional pneumatic motor, and connections for effecting the operation of said valve upon the pressure in the connections to said fluid pressure motor reaching a predetermined amount to effect the operation of said additional pneumatic motor after the first-named duplex pump has reached a predetermined pressure by the dislodging mechanism engaging the material to be dislodged.

26. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a fluid pressure motor for operating said dislodging mechanism, a liquid supply tank carried by said frame-work, pumping mechanism for drawing liquid from said tank and forcing it into said fluid pressure motor, a pneumatic motor for operating said pumping mechanism, additional pumping mechanism connected between said tank and said fluid pressure motor and additional pneumatic motor for operating said additional pumping mechanism, and means for preventing the operation of said additional pneumatic motor until after the first-named pumping mechanism has been operated to cause a predetermined fluid pressure to be exerted in said fluid pressure motor to quickly move said dislodging mechanism into engagement with the material to be dislodged.

27. A mining machine comprising a main frame, means for anchoring said frame, a supplemental frame mounted on said main frame for movement relatively thereto, dislodging mechanism comprising spaced-apart pointed digging and splitting tools carried by said supplemental frame to move bodily therewith, a fluid pressure motor for moving said supplemental frame relatively to said main frame to operate said dislodging mechanism by causing said spaced-apart pointed tools to penetrate the mine vein and tear the material therefrom, means for operating and controlling said fluid pressure motor, said means comprising valve mechanism, and a one-point control on said main frame for operating said valve mechanism.

28. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a fluid pressure motor for operating said dislodging mechanism, pumping mechanism connected to said fluid pressure motor, a pneumatically operated motor for operating said pumping mechanism, and an extensible supply pipe connected between the source of supply and said pneumatic motor.

29. A mining machine comprising a main frame, of a supplemental frame, dislodging mechanism carried by said supplemental frame, a fluid pressure motor connected between said main and supplemental frames, pumping mechanism carried by said supplemental frame and movable bodily therewith, means for operating said pumping mechanism, a valve structure carried by said supplemental frame and movable therewith for controlling the operation of said fluid pressure motor, and extensible connections between said valve structure and the rear portion of said main frame for securing a one point control on the main frame for the operation of said dislodging mechanism.

30. A mining machine comprising a main frame adapted to occupy a stationary position, a supplemental frame movable relatively to said main frame, a plurality of coal cleavage devices mounted on said supplemental frame in spaced-apart relation, a plurality of fluid pressure devices for adjusting the spacing and elevation of said coal cleavage devices, a fluid pressure motor for moving said supplemental frame relatively to said main frame to operate said coal cleavage devices, fluid pressure pumps connected to said fluid pressure devices and to said fluid pressure motor, a valve structure carried by said supplemental frame for controlling said fluid pressure devices and said fluid pressure motor independently of each other, and a plurality of extensible connections between said valve structure and a one point control position on said main frame.

31. A mining machine comprising a main frame, means for anchoring said main frame between the floor and roof of the mine chamber, a supplemental frame, a fluid pressure motor mounted on said supplemental frame and pivotally connected to said main frame, an auxiliary frame pivotally connected to said supplemental frame, a coal cleavage device carried by said auxiliary frame, an additional coal cleavage device carried by said supplemental frame, a fluid pressure device for adjusting the space between said coal cleavage devices, a second fluid pressure device extending through an opening in said supplemental frame to engage the floor of the mine chamber and having its upper end

pivotally connected to said auxiliary frame to adjust the elevation of the coal cleavage device mounted on said auxiliary frame, fluid pressure guiding mechanism carried by said supplemental frame, fluid pressure pumping mechanism connected to said various fluid pressure motors and devices, a valve structure for controlling each of said motor devices separately and independently, and a plurality of extensible connections between said valve structure and the rear portion of said main frame.

32. A mining machine comprising a plurality of pointed coal digging and splitting devices arranged in an upright series, means for operating said devices to penetrate the solid of a mine vein and split and tear the coal therefrom, and an upright push plate extending diagonally toward the rear to direct dislodged material away from the mine wall.

33. A mining machine comprising a supporting frame, an upright series of coal digging and splitting devices, and an upright wall at the forward end of said frame in angular position to engage dislodged material and cause the same to slide along the same away from the mine wall.

34. A mining machine comprising a supporting frame, means at the forward end thereof comprising a series of spaced-apart pointed digging tools in position to dig into the mine vein and split material therefrom along upright lines over a wide area extending from the floor to the roof of the mine chamber, mechanism on the forward end of said frame in position to scrape along the roof of the mine chamber and simultaneous along the floor of the mine chamber adjacent the said upright dislodging mechanism, and operating means for said digging mechanism and said dislodging mechanism connected thereto to leave the space in advance thereof free and unobstructed.

35. A mining machine comprising supporting frame-work, means for splitting material from a mine vein along upright lines, splitting mechanism arranged to move along lines parallel to the bed of the vein at the roof of the mine chamber, and additional splitting mechanism arranged to move along lines parallel to the bed of the mine vein and at the floor of the mine chamber.

36. A mining machine comprising supporting frame-work, a roof splitting device, a floor splitting device, a splitting device intermediate the floor and roof and extending in advance of the roof and floor splitting devices in position to engage the coal vein to dislodge material therefrom prior to the engagement of the material by the roof and floor splitting devices, and means for operating said splitting devices and directing the dislodged material away from the mine wall.

37. A mining machine comprising supporting frame-work, an upright series of spaced-apart coal splitting devices mounted on the forward end of said frame-work to move therewith along the mine wall, upper and lower lateral extensions from said frame-work in position to move respectively along the floor and roof of the mine chamber, a series of splitting devices mounted on the upper lateral extension, and an additional series of splitting devices mounted on the lower extension, said series of splitting devices mounted on said extensions being adapted to scrape along the floor and roof of the mine chamber.

38. A mining machine comprising supporting frame-work, anchoring mechanism therefor, fluid pressure apparatus for operating said anchoring mechanism, and means for operating said fluid pressure apparatus to move the anchoring mechanism quickly to engaging position and thereafter operating said anchoring mechanism more slowly but with greater power to anchoring position.

39. A mining machine comprising a supporting frame, a fluid pressure anchoring device therefor, pumping mechanism connected to said fluid pressure anchoring device, and a pair of pneumatically operated motors having pistons and plungers of varying diameters to effect a quick operation of said fluid pressure anchoring device to engaging position and a slower and more powerful operation thereof to anchoring position.

40. The combination with a mining machine comprising supporting frame work, cleavage mechanism mounted thereon, means for operating said cleavage mechanism to dislodge material from a mine vein, of an anchorage adapted to be located a predetermined distance from the said mining machine, and a long arm pivoted to said anchorage for free and unobstructed movement throughout a complete circle and connected to said machine independently of said operating means to direct the machine along any arc of said circle on a comparatively long radius.

41. The combination with a self-contained mining machine comprising supporting framework with anchorage mechanism thereon, dislodging mechanism mounted on said framework, means for feeding said dislodging mechanism against said anchorage mechanism acting as an abutment, of an anchorage adapted to be located in a mine chamber at a predetermined distance from said mining machine, and a radius arm pivotally connected to said last named anchorage and connected to said machine independently of said operating means to direct the machine along arcs as determined by said radius arm.

42. The combination of a complete mining machine comprising supporting framework

and self-contained operating mechanism rendering the machine operable by itself to dislodge material from an upright mine wall, and extraneous mechanism for directing the path of travel of the mining machine along an arcuate path, said extraneous mechanism comprising an anchorage spaced from the mining machine and a directing connection between said anchorage and said mining machine.

43. A mining machine comprising a main frame, fluid pressure anchoring mechanism therefor, a fluid supply tank carried by said main frame, pumping mechanism carried by said main frame and connected between said fluid pressure tank and said fluid pressure anchoring mechanism, a supplemental frame, dislodging mechanism carried by said supplemental frame, fluid pressure mechanism for operating said dislodging mechanism, additional pumping mechanism carried by said supplemental frame, an additional fluid supply tank carried by said supplemental frame and connected to said additional pumping mechanism, and means for controlling the operation of both pumping mechanisms.

44. A mining machine comprising a main frame, fluid pressure anchoring mechanism therefor, pumping mechanism carried on said main frame and connected to said fluid pressure anchoring mechanism, a supplemental frame, dislodging mechanism carried by the latter, a fluid pressure motor for operating said dislodging mechanism, additional pumping mechanism on said supplemental frame and connected to the fluid pressure motor thereon, and means for controlling both pumping mechanisms from one position at the rear of said main frame.

45. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon, a fluid pressure motor for operating said dislodging mechanism, two pumping devices connected to said fluid pressure motor, means for operating said pumping devices, and fluid pressure valve mechanism for controlling the operation of said pumping devices one after the other to secure an initial quick movement of the dislodging mechanism into engagement with the material of the mine vein and a subsequent more powerful and slower movement while dislodging the material.

46. A mining machine comprising a main frame, fluid pressure anchoring mechanism therefor, pumping apparatus connected to said fluid pressure anchoring mechanism, a supplemental frame, a fluid pressure motor connected between said main and supplemental frames for operating said dislodging mechanism, additional pumping apparatus connected to said fluid pressure motor, and means for controlling both of the pumping apparatuses from one position at the main frame.

47. A mining machine comprising supporting framework, cleavage mechanism mounted thereon, means for anchoring said framework, means for operating said cleavage mechanism relatively to said framework while anchored by said anchoring means, additional anchoring mechanism, and a long arm pivotally connected to said additional anchoring mechanism and also connected to said framework to direct the path of travel thereof along an arc on the radius of said arm, the latter and said framework being stationary during the operation of said cleavage mechanism.

48. The combination with a mining machine comprising a supporting frame, means for anchoring said supporting frame in stationary position, a supplemental frame mounted on said supporting frame for movement relatively thereto, dislodging mechanism mounted on said supplemental frame to move bodily therewith, means for moving said supplemental frame together with said dislodging mechanism to operate the latter while said supporting frame remains in anchored position, an additional anchorage located at a predetermined distance from the mining machine, and a long arm connected between said anchorage and said mining machine to direct the latter to new operating positions along an arc having a comparatively long radius.

49. A mining machine comprising upper and lower spaced-apart cleavage devices, power-operated means for adjusting the spacing between said devices, additional power-operated means for adjusting the elevation of said cleavage devices, and mechanism for controlling at will said power-operated devices.

50. A mining machine comprising spaced-apart cleavage devices, self-acting power mechanism for adjusting the spacing between said devices, additional self-acting power mechanism for adjusting the elevation of said devices, and means for controlling at will from a distance the operation of said self-acting power mechanism.

51. A mining machine comprising a main frame, a supplemental frame mounted on said main frame for movement relatively thereto, cleavage devices mounted on said supplemental frame, self-acting power mechanism for adjusting the spacing of said cleavage devices, additional self-acting power mechanism for adjusting the elevation of said cleavage devices by movement of said supplemental frame relatively to said main frame, and means for controlling at will the operation of said self-acting power mechanism.

52. A mining machine comprising a main

frame, a supplemental frame mounted thereon for rectilinear movement relatively thereto, spaced-apart coal cleavage devices mounted on said supplemental frame to move bodily therewith, means for swinging said devices as a whole to adjust the elevation thereof, additional means for adjusting the spacing of said devices, and mechanism for controlling at will both of said adjusting means at a distance from the latter.

53. A mining machine comprising a main frame, a supplemental frame, coal cleavage devices on said supplemental frame, means under control of an operator for automatically adjusting the spacing between said devices, additional means also under control of an operator for automatically adjusting the elevation of said coal cleavage devices, and means for operating said coal cleavage devices.

54. A mining machine comprising supporting framework, means for splitting material from a mine vein along upright lines comprising a plurality of spaced-apart pointed tools to receive concentrated pressure to cause the same to penetrate the mine vein and split the material therefrom, and an upright plow having a coal engaging face extending diagonally toward the rear to direct dislodged material from the mine wall.

55. In a mining machine, the combination with a main frame, of a supplemental frame, dislodging mechanism mounted on said supplemental frame, fluid pressure motor mechanism connected between said main and supplemental frames for operating said dislodging mechanism, and a plurality of pumps, and means for effecting the operation of said pumps successively to cause said fluid pressure motor mechanism to act quickly initially and then impart a more powerful action on said dislodging mechanism.

56. In a mining machine, the combination with a main frame, of a supplemental frame pivoted thereto on a horizontal axis, dislodging mechanism on said supplemental frame and comprising spaced-apart pointed penetrating wedging tools each adapted to penetrate the face of the mine vein and cooperate with the others to dislodge large pieces of the mineral over a wide area from the face of the mine vein, a hydraulic motor between said pivot and said supplemental frame for operating said dislodging mechanism, and pumping mechanism on said supplemental frame and connected to said motor to supply the operating medium thereto.

57. In a mining machine, the combination with supporting framework of fluid-pressure operated anchoring jacks thereon, pumping mechanism on said framework and connected to said anchoring jack mechanism to supply pressure medium thereto, dislodging mechanism, a fluid pressure motor connected to said dislodging mechanism to operate the same, and additional pumping mechanism connected to said motor to supply fluid pressure medium thereto.

58. In a mining machine, the combination with a main frame, of a supplemental frame, a fluid pressure motor on said supplemental frame and comprising a piston rod pivoted to said main frame, dislodging mechanism on said supplemental frame, means for adjusting the elevation of said dislodging mechanism while said piston rod remains pivoted to said main frame, and pumping mechanism on said supplemental frame to move bodily up and down therewith and connected to said motor to supply the pressure medium thereto.

59. In a mining machine, the combination with a main frame having a rear portion adapted to slide along an upright mine wall while a forwardly extended portion of said frame is spaced from such wall, of anchoring mechanism for the rear portion and the forwardly extended portion of said frame, operator-controlled power-operated mechanism on said frame for operating said anchoring mechanism, a supplemental frame connected to said main frame to occupy a position forwardly of the rear portion of said main frame and between the mine wall and the forwardly extended portion of said main frame, means for operating said dislodging mechanism, and operator-controlled power-operated mechanism for controlling said operating means.

60. In a mining machine, the combination with supporting framework, of anchoring mechanism therefor, operator-controlled power-operated mechanism for quickly applying said anchoring mechanism and by continuing operation tightening the same more powerfully, dislodging mechanism mounted on said framework, means for operating said dislodging mechanism, and operator-controlled power-operated mechanism to secure a quick application of said dislodging mechanism to its work and upon dislodging mechanism meeting with resistance operating the same slower but more powerfully.

61. In a mining machine, the combination with a frame, of a piercing wedging tool pivoted to said frame on a horizontal axis in position to act on the roof of a mine chamber, a fluid pressure motor for adjusting the position of said tool relative to said frame, and means for moving said frame to effect bodily movement therewith of said tool to cause the latter to dislodge material from such roof.

62. In a mining machine, the combination with a frame, of coal-splitting mechanism mounted on said frame in position to engage the coal at the roof of a mine chamber and split the coal therefrom, means for

adjusting the elevation of said frame together with said coal-splitting mechanism, and means for exerting pressure on said frame to cause said coal-splitting mechanism to engage the solid material of the mine vein and dislodge portions thereof along the said roof.

63. In a mining machine, the combination with a movable frame, of a plurality of digging tools arranged in an upright series with a tool intermediate the floor and roof in advance of the other tools in position to dislodge an intermediate section of material from an upright mine wall prior to the dislodging of sections above or below, and means for exerting force on said frame to effect the operation of said digging tools to dislodge intermediate sections in advance of sections above and below such intermediate section.

64. In a mining machine, the combination with a supporting frame, of coal splitting mechanism comprising a pointed coal splitting tool pivotally connected to said frame for adjustment in elevation on a horizontal axis, means for operating said coal splitting mechanism, a hydraulic motor connected to said coal splitting tool to adjust the position thereof relative to said frame, and means for controlling the locking of said motor to hold the coal splitting tool rigidly connected to said supporting frame for feeding movement therewith.

65. In a mining machine, the combination with supporting framework, of a plurality of spaced-apart pointed coal cleavage devices each adapted to penetrate the coal in its native bed and split the coal from the mine vein, means for operating said coal cleavage device to cause the same to penetrate the native coal and dislodge the same, and means for adjusting the relative operating positions of said coal cleavage devices.

66. In a mining machine, the combination with a supporting frame, of a coal splitting device having a free end unobstructed space in advance thereof and adjustably mounted on said frame, fluid pressure mechanism for adjusting the position of said coal splitting device relative to said supporting frame, and means for operating said coal splitting device by causing the same to act directly against the mine wall to penetrate the native coal and dislodge the same.

67. In a mining machine, the combination with supporting framework, of coal cleavage mechanism mounted thereon and comprising floor and roof coal splitting devices each adjustable in elevation, separate and independent means for adjusting the respective floor and roof coal splitting devices, and means for operating said coal cleavage mechanism by causing the same to act directly on the coal in its native bed to dislodge the coal.

68. In a mining machine, the combination with supporting framework, of coal cleavage mechanism comprising a pointed pivoted tool, a hydraulic motor for adjusting the elevation of the point of said tool, and means for operating said coal cleavage mechanism to dislodge material between the floor and roof by one continuous movement along the mine wall.

69. In a mining machine, the combination with supporting framework, of a plurality of distributed roof jacks for firmly anchoring said framework in stationary position to form a rigid abutment, coal-splitting mechanism mounted on said framework and comprising a wedging tool adapted to penetrate the coal in its native bed and by wedging action split such coal from the unmined mass in comparatively large lumps, and means for operating said coal-splitting mechanism by very powerfully pressing said tool into the coal by continuous forward movements against such abutment.

70. In a mining machine, the combination with a supporting frame adapted to rest on and move over a mine floor, of a hydraulic roof jack for anchoring said frame between the floor and roof of a mine chamber, and multiple splitting tool mechanism comprising a plurality of spaced-apart penetrating wedges and hydraulic motor mechanism for operating said penetrating wedges to act with a steady forward powerful pressure exerted continuously in predetermined directions during the dislodgment of the mineral from the unmined mass.

71. The long wall method of mining coal which consists in applying continuous forward concentrated pressure along the face of a mine vein in a general horizontal direction on a splitting tool to dislodge the coal between the floor and roof of the mining chamber to a limited extent and then applying similar dislodging actions along such face above and below the space provided by dislodgment of the limited intermediate portion to dislodge the coal from the upright mine wall near the floor and near the roof.

72. The long wall method of mining coal which consists in first dislodging the coal from an upright face of a mine wall in a general horizontal direction along such face between the floor and roof of the mine chamber and then subsequently dislodging the coal from such mine wall along such face immediately below the roof and immediately above the floor while simultaneously trimming the roof and the floor to have approximately horizontal surfaces.

73. In a mining machine, the combination with a main frame, of anchoring means therefor, a supplemental frame connected to said main frame for movement relatively thereto, dislodging apparatus mounted on said supplemental frame and comprising a

plurality of pointed splitting tools each adapted to pierce the solid face of the coal vein in its native state and by wedging action strip a layer of coal from the unmined mass along a path parallel to the coal face, and mechanism for operating said dislodging apparatus by feeding said supplemental frame along said main frame while said anchoring means holds said main frame stationary.

74. In a mining machine, the combination with a main frame, of a supplemental frame, multiple coal splitting mechanism stationary relative to said supplemental frame to move bodily therewith along a rectilinear path in position to penetrate the solid unmined mass to produce upright cleavages spaced back from the upright face of the mine wall, and means for moving said supplemental frame rectilinearly along said main frame to operate said coal splitting mechanism to dislodge the coal in comparatively large lumps.

75. In a mining machine, the combination with a main frame, of a supplemental frame, non-rotatable plowing mechanism for dislodging coal from the upright face of a mine vein, and means for operating said plowing mechanism by moving said supplemental frame relatively to said main frame.

76. In a mining machine, the combination with a movable support, of dislodging tools rigidly connected thereto to move bodily therewith in feeding direction and comprising a floor digging and splitting tool adapted to penetrate the solid face of a mine vein adjacent the floor and by wedging action split large portions of the coal from the mine vein above the floor, said dislodging tools also comprising an additional penetrating and splitting tool spaced above the floor tool and also adapted to penetrate the solid face of the mine vein and by wedging action split large portions of the coal from the unmined mass and thus cooperate with said floor tool to dislodge the coal from the face of the mine vein over a wide area and in large pieces, hydraulic mechanism for anchoring purposes, and means for operating said dislodging tools by forcing them with a continuous movement to penetrate the coal in its native bed and split large pieces from the mine vein over a wide area extending above the floor.

77. In a mining machine, the combination with a supporting frame, of a movable support mounted thereon, dislodging tools rigidly connected to move bodily with said movable support in feeding direction and comprising a penetrating and splitting tool at the base of the mine wall and an additional penetrating and splitting tool spaced above the same, a roof penetrating and splitting tool adjustably mounted on said support, and fluid pressure mechanism for adjusting the elevation of said roof tool.

78. In a mining machine, the combination with supporting framework, of dislodging mechanism mounted thereon comprising a plurality of spaced-apart penetrating tools adapted to penetrate coal in its native bed and tear the same from the unmined mass over an area extending from the floor to the roof, such dislodging mechanism comprising a penetrating tool adapted to move along the coal face at the roof, and hydraulic mechanism for adjusting the elevation of said roof penetrating tool relative to said supporting framework and holding such roof tool locked in adjusted position.

79. In a mining machine, the combination with a movable support, of dislodging tools rigidly connected thereto to move bodily therewith in feeding direction and comprising a floor digging and splitting tool and an additional digging and splitting tool spaced above the same, a roof digging and splitting tool adjustably mounted on said support, and hydraulic mechanism for adjusting the elevation of said roof tool and locking the same in adjusted position rigidly connected to said support to move bodily therewith.

80. In a mining machine, the combination with an abutment, of dislodging mechanism connected to said abutment and comprising claw-like pointed penetrating wedging tools distributed in spaced-apart relation in an upright series, means for operating said dislodging mechanism by imparting a rectilinear movement to all of said tools simultaneously against the resisting action of said abutment, and fluid-pressure motor apparatus connected to said abutment to position the latter together with said dislodging mechanism.

81. A mining machine comprising supporting frame-work, dislodging mechanism mounted thereon and comprising claw-like penetrating tools rigidly connected together, means for operating said dislodging mechanism by moving said tools, roof jack mechanism located back of said frame and adapted to rest on a flat floor and be self-sustaining when in released position and comprising a fluid-pressure cylinder with a plunger extending uprightly therein, and fluid-pressure motor mechanism between said roof jack mechanism and said frame for moving the latter forward together with said dislodging mechanism when said roof jack mechanism is anchored and for moving the latter forward to a new position when not anchored.

82. In a mining machine, the combination with a main frame, of a supplemental frame, dislodging mechanism mounted on said supplemental frame to move bodily therewith and comprising claw-like pointed penetrating wedging tools adapted to penetrate the solid coal in its native bed and by wedging action split and tear the coal in large pieces from the vein over a wide area, a roof jack for said main frame to act as an abutment

for said dislodging mechanism to act against, hydraulic motor mechanism between said frames for spreading them apart to operate said tools and for drawing them together when said abutment and said main frame are to be moved to a new position, additional roof jack mechanism for anchoring the supplemental frame during the re-positioning of said abutment and said main frame, and means for controlling the operation of said hydraulic motor mechanism.

83. In a mining machine, the combination with an anchorage adapted to act as an abutment, of dislodging mechanism comprising spaced-apart claw-like pointed penetrating wedging tools adapted to split and tear coal from the face of a mine vein, a frame for carrying said dislodging mechanism, a connection between said frame and said abutment confining said frame against turning relatively to said abutment when the latter is anchored, and means for operating said tools while said abutment is anchored and while said frame is thus confined relative to said abutment.

84. In a mining machine, the combination with a main frame, of a supplemental frame connected thereto for movement along a mine wall while said main frame is stationary, spaced-apart claw-like dislodging tools mounted on said supplemental frame and movable bodily therewith, the uppermost dislodging tool being pivoted to said supplemental frame for adjustment in elevation, fluid pressure mechanism for adjusting the position of the uppermost tool, and fluid pressure mechanism between said main and supplemental frames for operating said dislodging mechanism while said main frame is stationary.

85. In a mining machine, the combination with supporting framework, of dislodging mechanism comprising claw-like penetrating wedging tools adapted to be held in continuous engagement with the coal in its native bed along a predetermined path of travel to split the coal by wedging action from the mine vein over a wide area and in large pieces, and means for operating said dislodging mechanism including continuous forward feeding movement thereof while contacting with the mine wall as aforesaid.

86. In a mining machine, the combination with a main frame, of a dislodging tool mounted on said frame for bodily movement therewith in a general horizontal direction along the mine wall intermediate the floor and roof of a mine chamber, an additional dislodging tool mounted on said frame for movement along said mine wall at or adjacent the roof of the mine chamber another dislodging tool mounted on said frame for movement along said mine wall at or adjacent the floor of the mine chamber, means for adjusting the elevation of the dislodging tools adjacent the floor and roof respectively, each of said dislodging tools comprising a pointed wedging member adapted to penetrate by rectilinear movement the mineral in its native bed and by wedging action rip and tear the mineral from the unmined mass over wide areas at the working face, and means for effecting the operation of the dislodging tools by imparting rectilinear movements thereto to dislodge the face of the mine vein between the floor and roof of the mine chamber.

87. In a mining machine, the combination with a supporting frame, of a plurality of spaced-apart pointed wedging tools mounted on said frame in position for distribution across the mine vein, means for actuating said tools to cause the same to rip or tear the mineral adjacent the tools and between the same, over an area extending across the mine vein, and means for moving the frame along the mine vein step by step.

88. In a mining machine, the combination with a supporting frame, of dislodging mechanism mounted thereon in position to slice off a layer of coal from an upright face of a mine vein, automatic means for operating said dislodging mechanism while said frame remains stationary, and means for positioning said frame to adjust the dislodging mechanism to its work at the mine wall to secure increments of such sliced layer.

89. In a system of mining coal, a method which consists in distributing a plurality of sharpened wedging tools entirely across the mine vein, distributing other tools adjacent the roof and the floor of the mine chamber, and applying a continuous forward force to all of said tools to cause the sharpened wedging tools to penetrate deeply the solid face of the mine vein and by wedging action split and tear the coal in large pieces adjacent the tools and between the same over an area extending entirely across the mine vein while the tools at the floor and at the roof trim off the projections.

90. A mining machine including a frame, spaced-apart digging tools each mounted on the frame in stationary position relative thereto for operation on an upright mine wall, means for adjusting the digging tools relatively to each other and relatively to the frame, and power-operated mechanism for operating the digging tools to exert a dislodging effect on the material of the mine wall while all of such digging tools remain stationary relative to the frame.

91. In a system of mining, the method of mining coal from the solid face of a mine vein which consists in distributing a plurality of sharpened wedging tools entirely across the mine vein each adapted to penetrate deeply the solid coal and by wedging action split and tear large pieces of coal from the unmined mass with a minimum produc-

tion of fine particles of coal, distributing trimming tools near the roof and the floor of the mine chamber, applying a continuous force to all of said tools to cause the sharpened wedging tools to dislodge the coal in large pieces over an area extending entirely across the mine vein and cause the other tools to trim the floor and the roof adjacent the space from which the large pieces of coal are thus dislodged.

92. In a system of mining coal, a method of mining coal from the solid face of a mine vein which consists in distributing a plurality of piercing wedging tools entirely across the mine vein each adapted to penetrate deeply the coal in its native state and by wedging action split large pieces of coal from the unmined mass, distributing trimming tools at the floor and at the roof of the mine chamber, applying a continuous pushing force to all of said tools to dislodge the coal in large pieces and trim off the floor and the roof adjacent the space from which the coal is dislodged.

93. In a system of mining, the method which consists in applying a piercing force horizontally back of the face of an upright wall intermediate the floor and roof thereof to dislodge an intermediate section and then applying at spaced-apart points above and below such intermediate section piercing forces back of the face of the wall to dislodge additional sections from such mine wall between such floor and roof.

94. A mining machine including a frame, spaced-apart penetrating wedging tools each mounted on said frame in stationary position relative thereto for operation on an upright mine wall, means for adjusting the said tools relatively to each other and relatively to said frame, and power-operated mechanism for operating the said tools while all of them remain stationary relative to said frame.

95. In a mining machine, the combination with a movable frame, of spaced-apart penetrating wedging tools mounted on said frame to move therewith, means for moving said frame to feed said tools, and an adjustable floor-engaging shoe to guide said frame over the floor during the feed of said tools.

96. In a mining machine, the combination with a supporting frame, of a series of spaced-apart penetrating wedging tools mounted on said frame with the intermediate tool advanced ahead of the others to dislodge an intermediate section of material from the mine wall prior to dislodging adjacent sections, and means for operating the tools to cause the same to split large sections of mineral from the mine vein over a wide area.

97. A mining machine comprising a plurality of piercing wedging tools which are disposed in an upright series, means for supporting a tool intermediate the floor and roof in advance of the other tools in position to dislodge an intermediate section of material from the mine wall prior to the dislodging of sections above and below, and means for operating said tools by a unidirectional force to move the tools continuously along the mine wall back from the face thereof to effect splitting of the material both above and below such tools and the dislodging of such material over an area extending from the floor to the roof.

98. In a mining machine, the combination with coal cleavage mechanism comprising a plurality of spaced-apart pointed wedging tools adapted to enter the upright face of a mine vein and split large pieces of coal therefrom over a large area extending from the floor to the roof of the mine chamber, of means for operating said coal cleavage mechanism to dislodge the material from the mine wall as aforesaid, and spaced-apart devices at the floor and roof of the mine chamber in position to trim off the surfaces at the floor and roof where the material has been dislodged.

99. In a mining machine, the combination with an upright series of coal splitting devices adapted to penetrate the face of the mine vein in its native state and by wedging action split large sections of coal from the unmined mass, said upright series of coal splitting devices including one at the roof and one at the floor of the mine chamber, means for operating said coal splitting devices, and auxiliary devices carried respectively by the roof and floor coal splitting devices to trim off the surfaces adjacent the space from which the material has been dislodged.

100. In a mining machine, the combination with coal cleavage mechanism comprising splitting devices to dislodge coal from an upright mine wall in large pieces over a wide area, of means for operating said coal cleavage mechanism to dislodge the material by splitting action from such mine wall, and mechanism at the floor of a mine chamber in position to trim off the surface at the floor where the coal has been dislodged by said coal cleavage mechanism.

101. In a mining machine, the combination with an upright series of coal splitting devices including one extending diagonally toward the roof and one extending diagonally toward the floor of the mine chamber, of means for operating said coal splitting devices, and an auxiliary scraper carried by the floor coal splitting devices to trim the surface adjacent the space from which the material has been dislodged along the floor.

102. In a mining machine, the combination with supporting framework, of a plurality of spaced-apart pointed coal cleavage devices comprising one at the roof and another at the floor, means for adjusting the

elevation of the respective floor and roof cleavage devices, and means for operating said coal cleavage devices to cause the same to penetrate the native coal and dislodge the same.

103. In a mining machine, the combination with a supporting frame, of coal splitting mechanism mounted thereon and comprising a motor adapted to be operated by fluid pressure, and means for operating said motor to cause said coal splitting mechanism to move quickly to its work and thereafter be moved with powerful continuous forward pressure to effect dislodgment of the coal from the mine wall.

104. In a mining machine, the combination with a supporting frame, of a hydraulic roof jack for anchoring said frame between the floor and roof of a mine chamber, a horizontally extending liquid pressure motor mechanism mounted on said frame, spaced-apart conical dislodging tools arranged in an upright series with the space in advance thereof free and unobstructed for operation by said motor mechanism, and means for controlling said motor mechanism for securing powerful forward pushing action on said dislodging tools to cause the same to penetrate the mineral in its native bed with a comparatively slow and continuous forward movement to split such mineral and dislodge the same over an area extending between the floor and roof of said mine chamber.

105. In a mining machine, the combination with a main frame, of a supplemental frame mounted thereon to move relatively thereto, an upright series of coal splitting devices mounted on said supplemental frame and movable bodily therewith, one coal splitting device being at the roof, another at the floor and another intermediate the floor and roof with its forward end in advance of the other coal splitting devices, and means for moving said supplemental frame relatively to said main frame to cause the intermediate coal splitting device to first dislodge the material intermediate the floor to facilitate the dislodging action of the floor and roof splitting devices.

106. In a mining machine, the combination with a supporting frame, of dislodging tools mounted thereon and adapted to penetrate an upright mine wall at spaced-apart points to tear material therefrom across the space between the floor and the roof of the mine chamber, powerful feeding mechanism for forcing said dislodging tools along the mine wall to tear the material therefrom as aforesaid, and an anchored pivot extraneous to the mining machine and connections for directing said dislodging tools along an arcuate mine wall.

107. In a mining machine, the combination with a supporting frame, of coal-splitting mechanism mounted thereon and comprising a motor adapted to be operated by fluid pressure, and means for operating said motor to cause said coal-splitting mechanism to move quickly to its work and thereafter be automatically moved with powerful continuous forward pressure to effect dislodgment of the coal from the mine wall.

108. In a mining machine, the combination with a main frame, of a hydraulic roof jack for very powerfully anchoring said main frame to hold the same stationary, a supplemental frame mounted on said main frame for feeding movement relatively thereto, dislodging mechanism rigidly connected to said supplemental frame to move as a unit therewith and comprising widely spaced piercing implements for penetrating the coal in its native bed and by wedging action rip and tear the coal from the face of the mine vein, the spaces between the said implements while rigidly connected to said supplemental frame being greater than the active penetrating lengths of said implements to permit free expansion of the coal into such spaces and the dislodgment of large pieces of coal, and mechanism for exerting a very powerful feeding movement to said supplemental frame to effect the operation of said dislodging mechanism while said hydraulic roof jack securely holds the main frame in stationary position.

109. In a mining machine, the combination with a main frame, of a hydraulic roof jack for anchoring the same in stationary position, a supplemental frame mounted on said main frame for feeding movement relatively thereto, dislodging mechanism rigidly connected to said supplemental frame for bodily movement as a unit and comprising spread-apart claw-like penetrating fingers adapted to penetrate the coal in its native bed and rip and tear the same from the face of the mine vein, the spaces between said fingers being greater than the active penetrating lengths of said fingers to afford ample spaces for expansion of large pieces of coal from the unmined mass, and means connected between said main and supplemental frames for exerting powerful feeding movement on said supplemental frame and said dislodging mechanism.

110. In a mining machine, the combination with a main frame, of means for holding the same in stationary position, a supplemental frame mounted on said main frame for movement relatively thereto, dislodging mechanism mounted on said supplemental frame and held stationary relative thereto to move bodily therewith, said dislodging mechanism comprising a plurality of claw-like penetrating fingers spread-apart with the space between each finger and the next adjacent one greater than the active penetrating lengths of the fingers to adapt said

fingers to penetrate deeply the solid coal face and by wedging action rip and tear the coal from the unmined mass over a substantial area extending along the spaces between said fingers, and means connected between said main and supplemental frames for exerting a very powerful feeding movement to said supplemental frame to effect the operation of said dislodging mechanism while said main frame is being held stationary.

111. In a mining machine, the combination with a main frame, of a supplemental frame, dislodging mechanism mounted on said supplemental frame and comprising penetrating wedging tools, fluid-pressure motor mechanism between said frames for spreading them apart and drawing them together, an abutment for the main frame, and means for controlling said motor mechanism to spread said frames apart to effect the operation of said dislodging mechanism by rectilinear movement of said tools and to draw said frames together to adjust the position of said main frame and said abutment to a new position.

112. In a mining machine, the combination with a supporting frame, of dislodging tools mounted thereon and adapted to penetrate an upright mine wall at spaced-apart points to tear material therefrom across the space between the floor and the roof of the mine chamber, powerful feeding mechanism for forcing said dislodging tools along the mine wall to tear the material therefrom as aforesaid, and an anchored pivot and connections for directing said dislodging tools along an arcuate mine wall.

113. In a system of mining coal directly from the solid face of a mine vein, the method which consists in distributing pointed wedging tools, one at the corner between the roof and the upright working face and another at the corner between the floor and the upright working face and another intermediate the floor and the roof at the upright working face, associating trimming tools with said pointed wedging tools, and applying forwardly acting forces to all of said tools to cause the pointed wedging tools to penetrate deeply the solid face of the mine vein and by wedging action split and tear the coal in large pieces adjacent the tools and between the same over an area extending entirely across the working face of a mine vein while the tools associated with said pointed wedging tools trim off the projections.

In testimony whereof I have signed my name to this specification on this 13th day of November, A. D. 1920.

EDMUND C. MORGAN.