

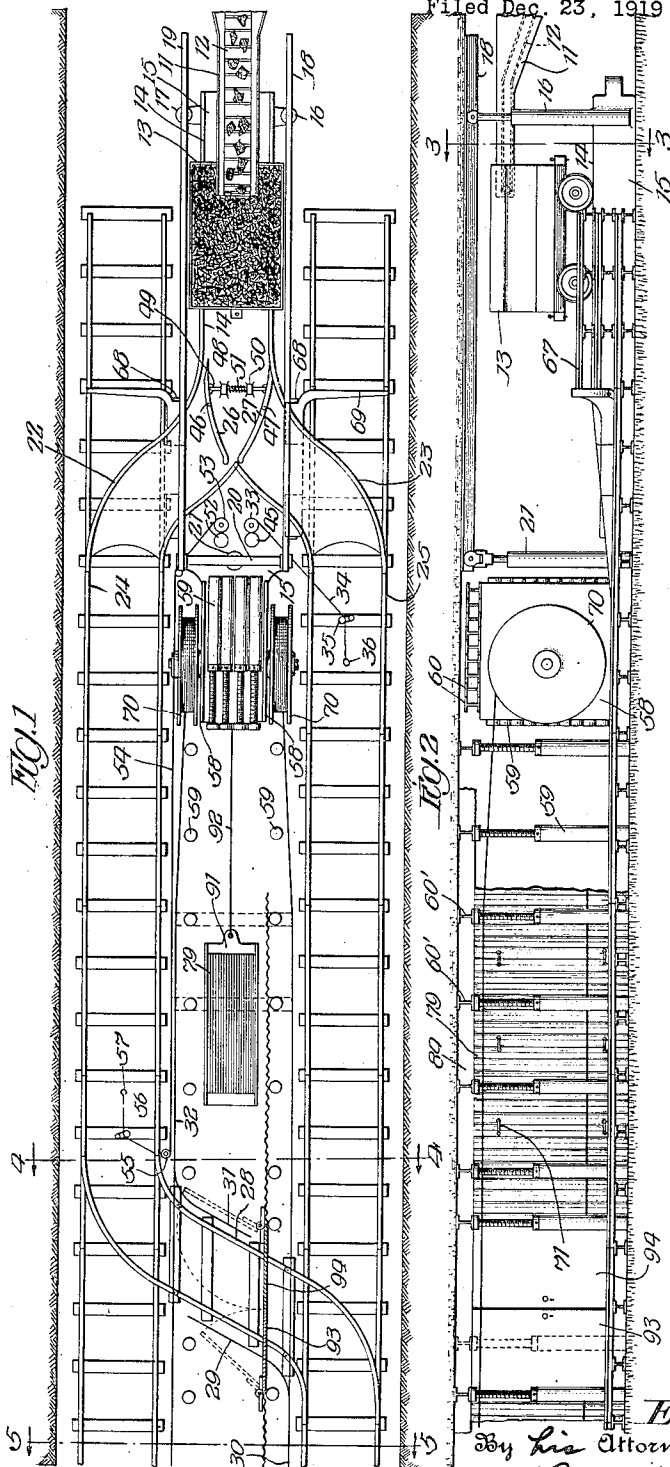
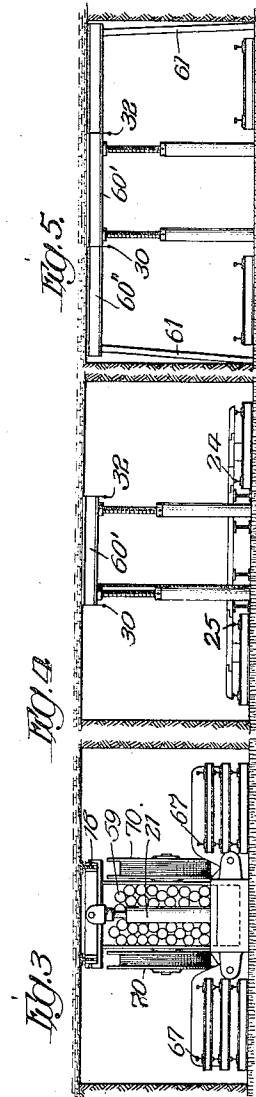
Jan. 29, 1924.

1,481,875

E. C. MORGAN
MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 1



Inventor
Edmund C. Morgan.
By his Attorneys
Brown & Nissen

Jan. 29, 1924.

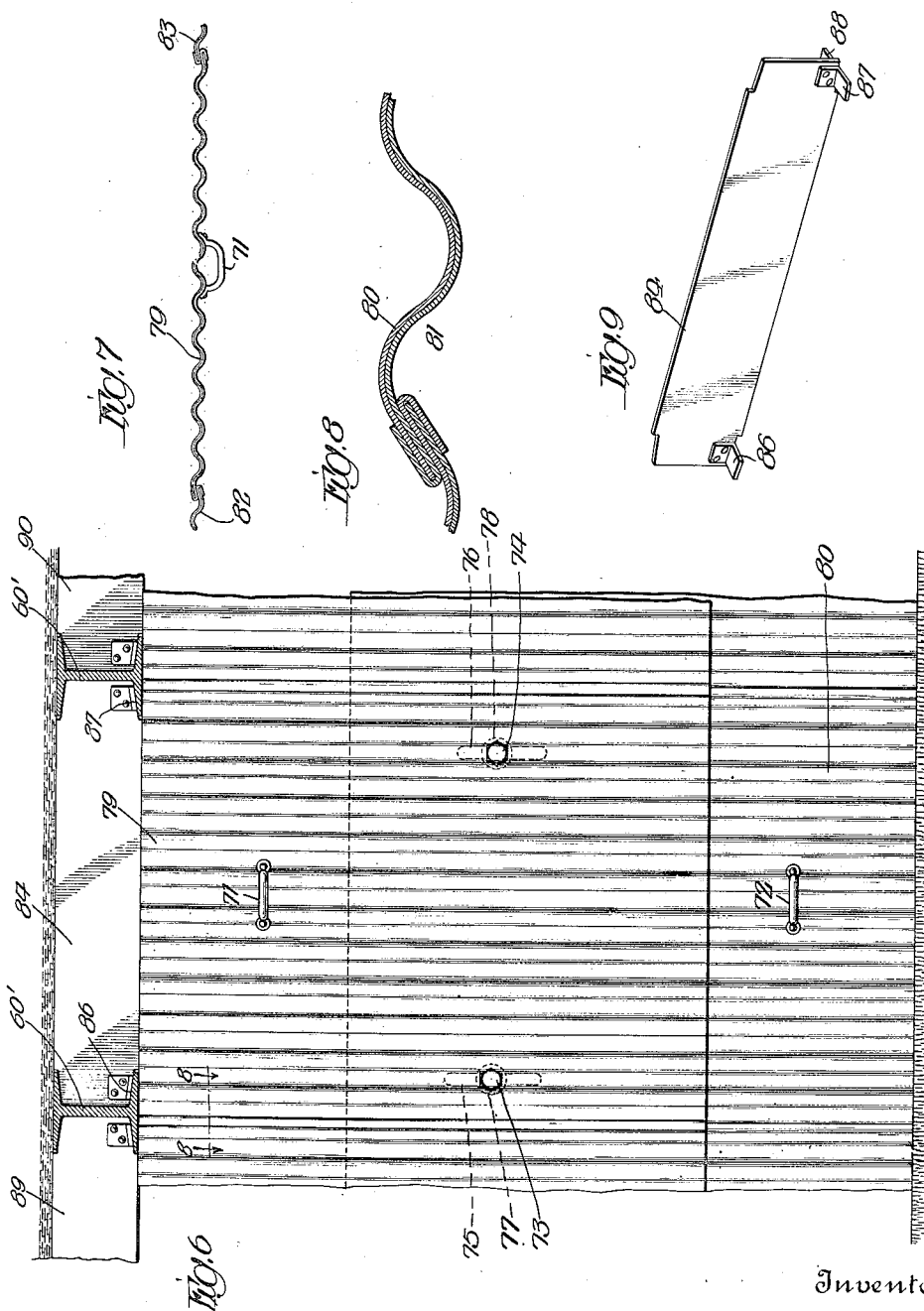
1,481,875

E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 2



Inventor

By his Attorneys
Edmund C. Morgan.
Brown & Nissen

Brown & Nissen

Jan. 29, 1924.

1,481,875

E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 3

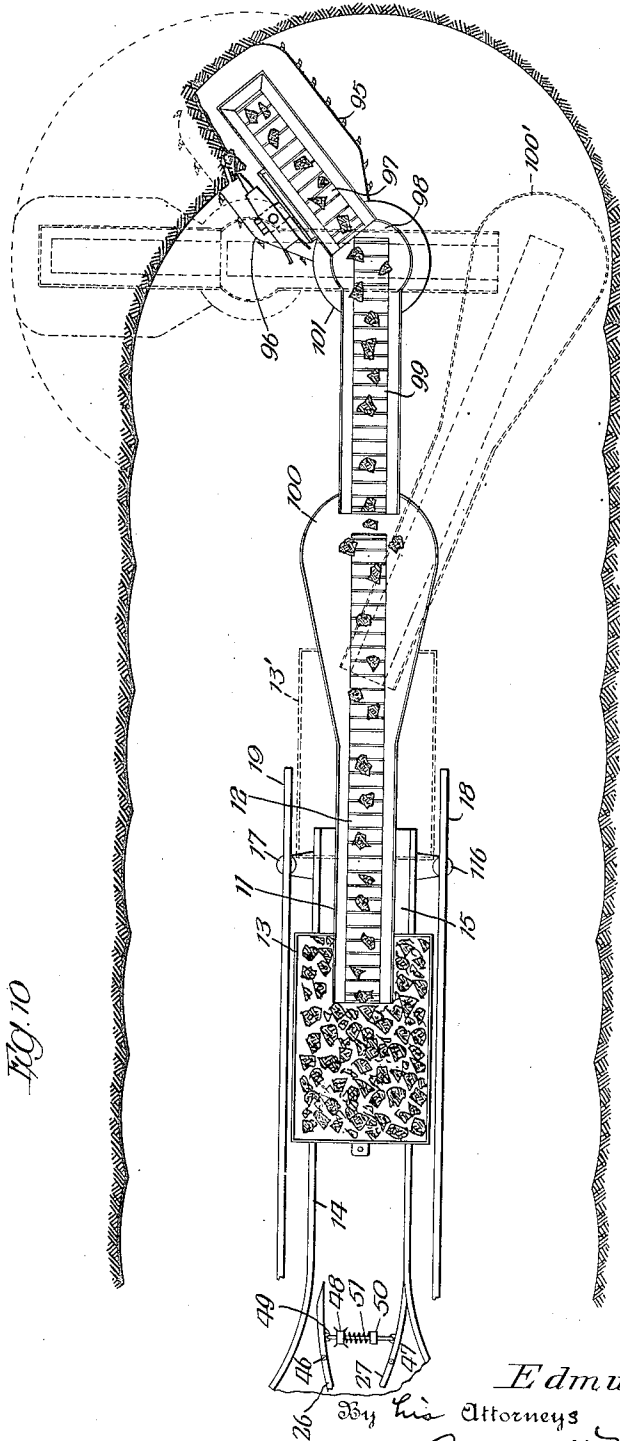


Fig. 10

Inventor

Edmund C. Morgan

By his Attorneys

Brown & Nissen

Jan. 29, 1924.

1,481,875

E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 4

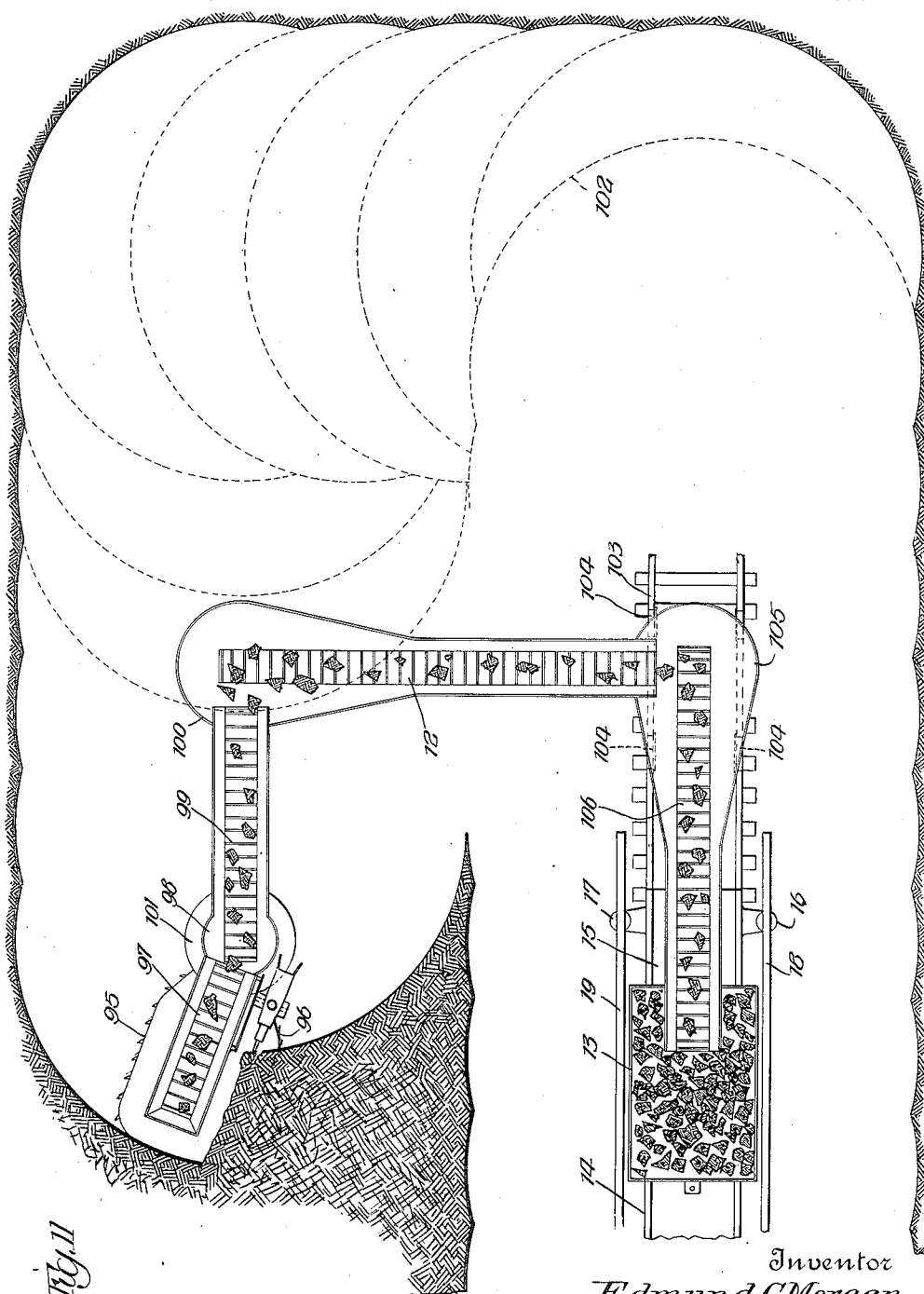


Fig. 11

Inventor

Edmund C. Morgan.

By his Attorneys

Brown & Nissen

Jan. 29, 1924.

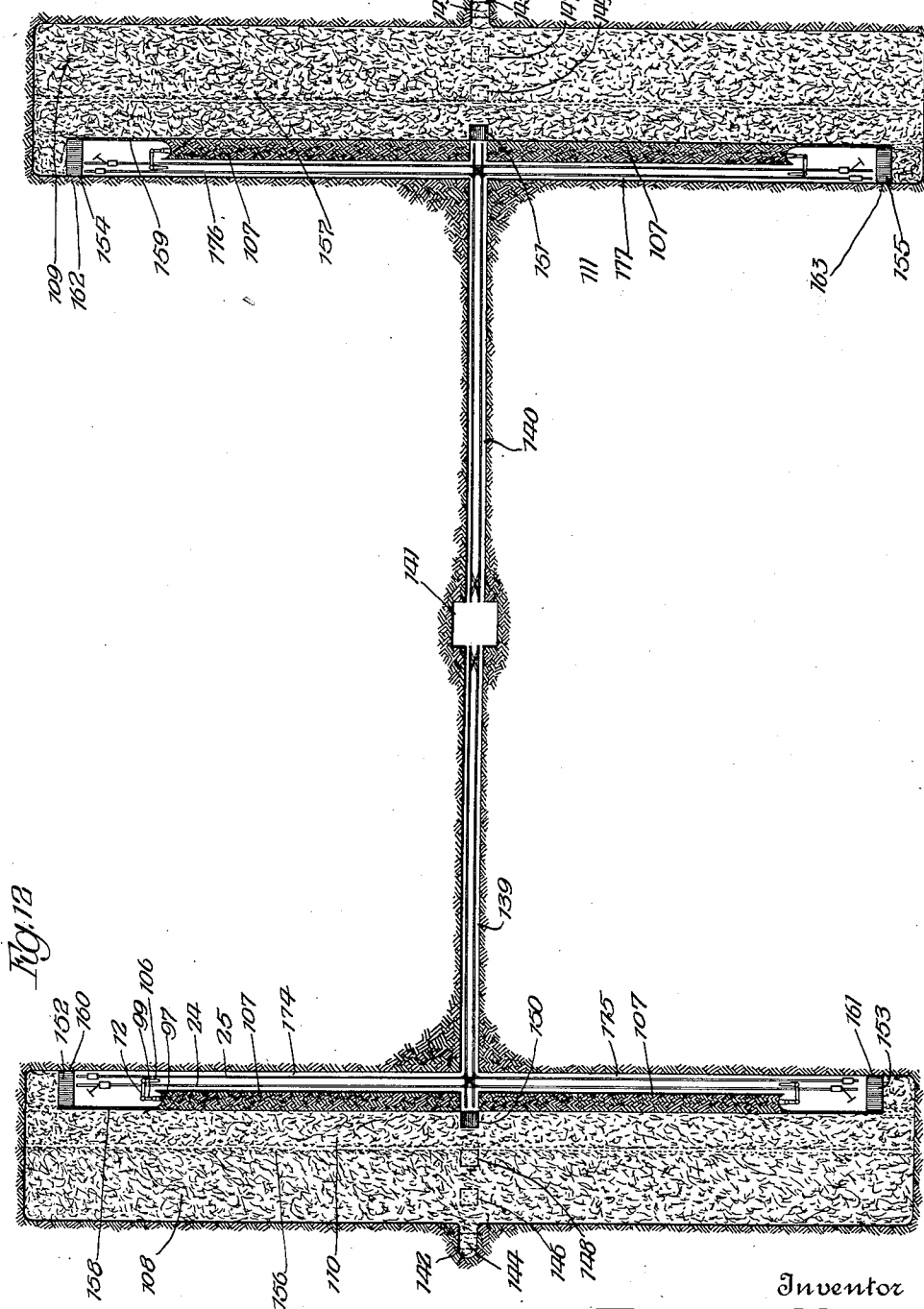
1,481,875

E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 5



Inventor

Edmund C. Morgan

By His Attorneys

Brown & Nissen

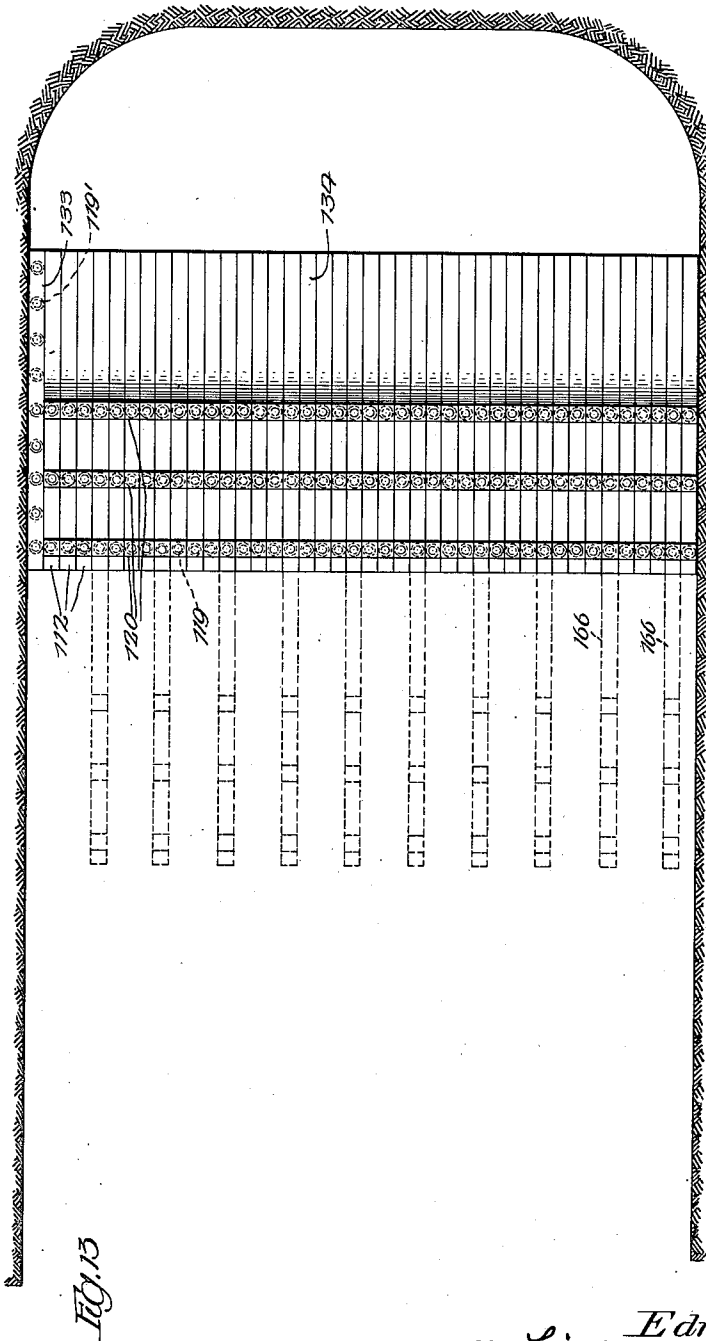
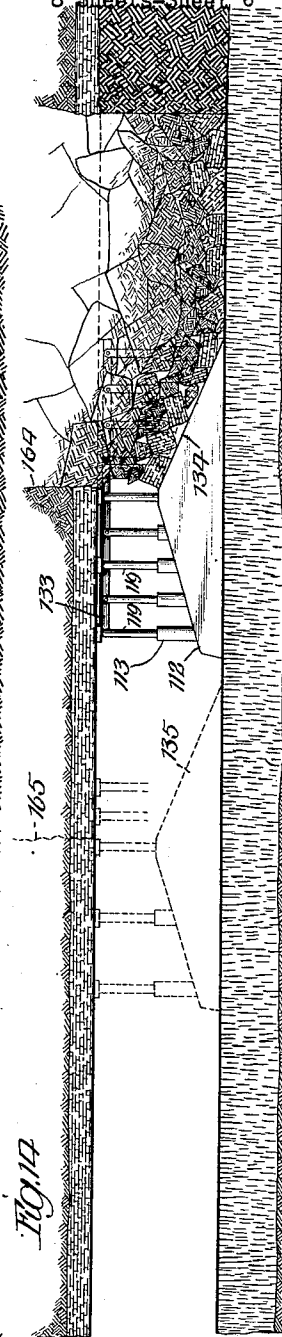
Jan. 29, 1924.

1,481,875

E. C. MORGAN
MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 6



Inventor

Edmund C. Morgan
By his Attorneys
Brown & Nissen

Jan. 29, 1924.

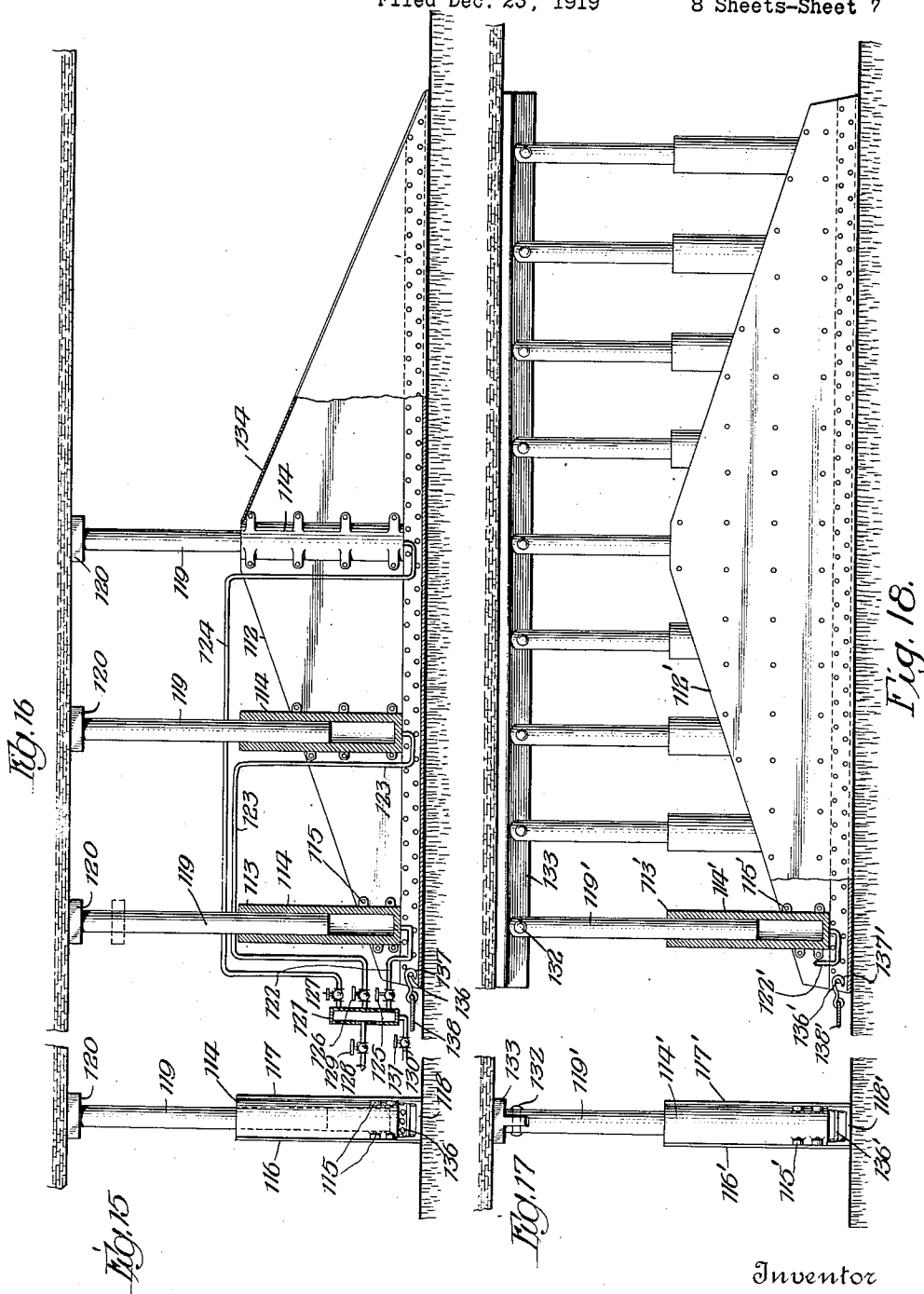
1,481,875

E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 7



Jan. 29, 1924.

1,481,875

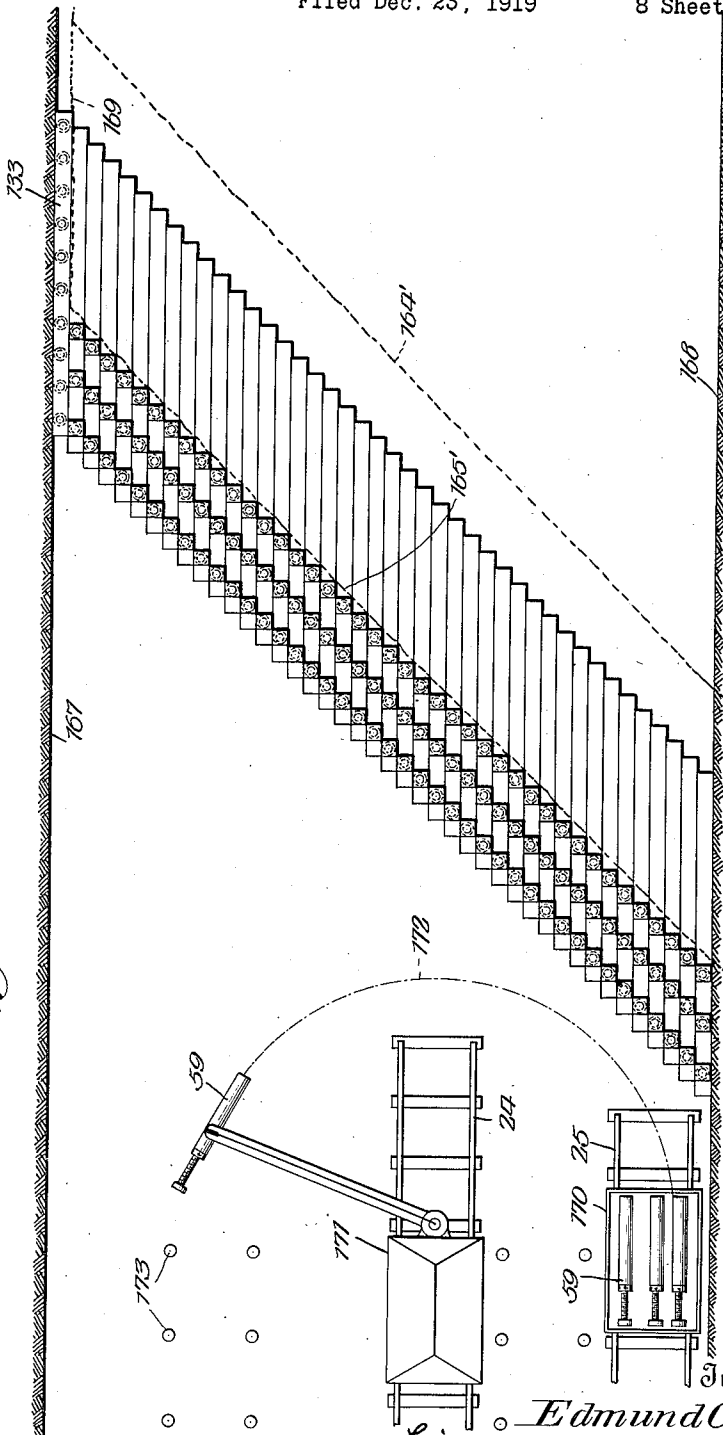
E. C. MORGAN

MINING SYSTEM AND APPARATUS

Filed Dec. 23, 1919

8 Sheets-Sheet 8

Fig. 10



Inventor
Edmund C. Morgan
By His Attorneys
Brown & Nissen

UNITED STATES PATENT OFFICE.

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

MINING SYSTEM AND APPARATUS.

Application filed December 23, 1919. Serial No. 346,902.

To all whom it may concern:

Be it known that I, EDMUND C. MORGAN, a citizen of the United States, and residing in New York city, county of New York, and State of New York, have invented certain new and useful Improvements in Mining Systems and Apparatus, of which the following is a specification.

My invention relates to a system and apparatus for mining material, and is particularly adapted for the mining of coal. One of the objects of my invention is the provision of improved apparatus for facilitating the mining and loading of material, particularly coal, in a mine. A further object of the invention is the provision of improved apparatus for facilitating the mining and loading of material and controlling the subsidence of the roof in the mine chamber after the mining operations have been completed. Another object of the invention is the provision of a system of mining in which the roof is supported as the mining proceeds and in which the subsidence of the roof is effected along predetermined lines and at predetermined positions.

Another object of my invention is the provision of means for supporting compactly roof propping mechanism. A further object is the provision of means for carrying electric trolley wire for mine cars, in such a manner that as the mining proceeds and the mine tracks are extended, such trolley wires may be accordingly extended. Another object of the invention is the provision of a system and apparatus for handling the material received from the mining and loading operations, and transporting such material out of the mine chamber.

A further object of the invention is the provision of a system for carrying out a retreating method of mining in which entries are driven horizontally in opposite directions from a vertical shaft, and then removing the material adjacent butt entries at the ends of the main entries and over a wide area while working toward the said shaft and leaving the roof free to subside while controlling the subsidence of the roof so that continuous mining and loading operations will not be interfered with. The method of

mining consists in producing the main entries and then the butt entries; the latter each time leaving a pillar which is removed before other butt entries adjacent thereto are produced, and as the mining approaches the vertical shaft a system of roof props is employed to control the subsidence of the roof where the coal has been removed.

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

Referring to the accompanying drawings, Fig. 1 represents a plan view of a part of my improved system of handling coal after being received from a loading machine, of providing an extensible ventilating partition, of providing extensible trolley wires for electric mine locomotives, and of providing means for transporting roof propping mechanism;

Fig. 2 is an elevational view of Fig. 1;

Fig. 3 is a sectional elevation taken on the line 3—3 looking in the direction of the arrows and omitting the roof propping mechanism as well as the mine car and conveyor to facilitate illustration of the mechanism carrying the roof props and the trolley wire reels;

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 is a sectional elevation taken on the line 5—5 of Fig. 1 and looking in the direction of the arrows;

Fig. 6 is an elevational view of the portion of the corrugated partition shown in Fig. 2;

Fig. 7 is a plan view of a section of partition together with overlapping extensions of adjacent partitions;

Fig. 8 is a sectional plan view taken on the line 8—8 of Fig. 6 to illustrate the overlapping of the edges of adjacent partitions.

Fig. 9 shows the supplemental partition adapted to be placed between the spaced-apart cross beams between the roof and the upper edge of the corrugated partition;

Fig. 10 is a plan view of loading apparatus which is adapted to cooperate with the system of mechanism shown in Fig. 1;

Fig. 11 is a plan view of a modified loading apparatus adapted for use over a larger area than in Fig. 10 but, like the latter, adapted for use with the system of apparatus shown in Fig. 1;

Fig. 12 illustrates the method of mining to which my improved system is particularly adapted, the subsidence of the roof taking place over the areas illustrated at the ends of this view while the mining and loading operations proceed toward the shaft at the center of said view;

Fig. 13 is a plan view of the system of roof props adapted to be located in position to control the subsidence of the roof.

Fig. 14 is an elevational view illustrating the mode of operation of the system of roof props shown in Fig. 13, in controlling the subsidence of the roof step by step;

Fig. 15 is an end view of one of the roof props shown in Fig. 13;

Fig. 16 is an elevational view, partly in section, of one of the multiple roof propping devices shown in Fig. 13;

Fig. 17 is an end elevational view of a modified roof propping device;

Fig. 18 is a side elevation of the multiple roof propping device shown in Fig. 17; and

Fig. 19 illustrates a modified arrangement of the series of roof props shown in Fig. 13 together with mechanism for handling the rear spaced-apart roof supporting jacks.

Referring to Figs. 1 and 2 of the accompanying drawings I have diagrammatically illustrated a portion of a loading machine having a supporting frame 11 and a conveyor 12 which is adapted to extend upwardly toward the rear so as to deliver the mined material into a mine car (13) resting on the rails (14) of the frame (15).

Mounted on the frame (15), as shown on Figs. 1 and 2, are spaced apart roof jacks (16 and 17) the plungers of which are pivotally connected to the spaced-apart longitudinal rails (18 and 19) the rear ends of which are connected by the cross rod (20) to the center of which is connected the upper end of a plunger of a roof jack (21). The roof jacks 16, 17 and 21) are preferably fluid pressure motors each provided with a piston or plunger. When these hydraulic jacks are operated by fluid pressure the spaced apart rails or bars (18 and 19) are pressed against the roof to securely hold in place the frame (15) and the parts mounted thereon. As the mining and loading operation proceeds the frame (15) may be moved in either direction as may be desired.

It will also be seen by referring to Fig. 1 that the frame (15) is provided with switch tracks (22 and 23) extending from the track (14) to the spaced-apart mine tracks (24 and 25). Switching rail sections

(26 and 27) are mounted on the frame (15) as shown in Fig. 1 for the purpose of directing cars from the track (14) on to either of the switches (22 or 23), or from either of the latter to the track 14. In the positions of the sections 26 and 27 shown in Fig. 1, the mine car 13 may be directed from the track 24 along the switch 22 onto the central track 14 into a position where it can be loaded with material from the conveyor 12. If desired a communicating track 28 may be located as shown in Fig. 1 so that a car may be transferred from one of the tracks 22 or 23 to the other whenever desired. However, the arrangement described is desirable particularly to enable an electric locomotive to bring into the mine chamber along the track 25 a series of empty cars and leave them on the track 25 while the locomotive is moved across a connecting track 28. Its trolley pole being shifted from the trolley wire extension 29 extending from the trolley wire 30 to the extension 31 on the other side of the track 28 and which is connected to the trolley wire 32 adjacent the track 24. After the electric locomotive reaches the track 24 it is in readiness to be connected to filled mine cars or those loaded with mined material so that the latter may be transported along the track 24 out of the mine chamber in which the mining operations are taking place.

To facilitate movement of the empty mine cars along the track 25 to the switch 23, rope winding mechanism may be provided comprising a rope drum 33 and a rope 34 suitably guided on a pulley 35 and connected at its free end to a hook 36 which may be attached to an empty mine car. By starting the motor which is diagrammatically illustrated at 45 in Fig. 1 a pull is exerted on the rope 34 to move the empty mine car along the track 25 to the switch 23 and along the latter to the track 14.

It should be noted that the track sections 26 and 27 are pivoted respectively at 46 and 47 to the frame 15 and provision is made for normally holding the section 27 in contact with the rail 14. Through a bracket 48 extending from the frame 15 passes a bar 49 on which is a collar 50 engaged by a spring 51 which also engages the bracket 48. When a car passes along the switch 23 the flanges of its wheels on one side of the car move the section 27 on a pivot 47 against the action of the spring 51 and at the same time the rod 49 pushes the other section 26 on the pivot 46 against the other rail 14. When the car passes the switch mechanism, the latter automatically replaces itself in a position shown in Fig. 1, and when the car, after being loaded, is moved rearwardly it will pass along the switch 22 onto the track 24.

In order to facilitate the movement of

the loaded mine cars along the track 24 so that they can be more easily connected to the electric locomotive to form a train, I have provided additional rope winding mechanism comprising a motor 52, a winding drum 53, a rope 54, guide pulleys 55 and 56, and a hook 57.

At the rear end of the frame 15 there is a platform at the lateral edges of which are located vertical spaced apart longitudinal plates 58 which form an open ended trough for receiving a considerable number of roof jacks 59 adapted to be placed in the mine chamber either directly between the floor and roof in suitable spaced-apart positions to serve as roof props or to be placed between the floor and transverse I-beams as shown in Fig. 2; also in Fig. 4. A plurality of such I-beams may be carried on the upper edges of the spaced-apart plates 58 as shown at 60 in Fig. 2. The roof props may be spaced apart as desired depending upon the character of material being mined and the tendency of the roof to subside. In some instances the I-beams may be of the length indicated at 60' in Fig. 4 but if greater supporting effect is desired such I-beams may be extended to the full width of the entry or mine chamber as shown at 60'', and the ends of the I-beams provided with additional upright props shown at 61 in Fig. 5.

In the system shown in Figs. 1 and 2 the apparatus is such that the I-beams 60 must be taken from their support, 58, and placed manually between the vertical roof props 59 and the roof. In my co-pending application Serial No. 377,415, filed November 9, 1921, for an improvement in system and apparatus for mining coal, I have shown apparatus by means of which this work may be done by power-operated mechanical means. The I-beams 60 may be moved into proper positions step by step as occasion requires and the said I-beams may be forced against the roof by means of the roof props or roof jacks as illustrated in Figs. 2 and 4.

It should also be noted that the spaced apart side tracks 24 and 25 may be provided with a plurality of extensions 67 stacked on top of each other as illustrated in Fig. 2. Pivotaly connected at 68 on both sides of the frame 15 on longitudinal spaced-apart parallel axes are laterally extending push plates 69 adapted to engage the stacks of track extensions 67 on the forward ends of the tracks 24 and 25 which have been already laid on the floor of the mine chamber. It will thus be seen that when the loading machines together with the frame 15 are moved forwardly the push plates will also be moved forwardly and the track extensions 67 will finally be moved off the tracks 24 and 25 and this operation will permit the lowermost track extension to

drop down into position to form a continuation or extension of the track previously laid. This takes place at both sides of the mine chamber.

At any desired intervals additional track extensions may be stacked up on the ends of the tracks 24 and 25 and so also at such intervals additional I-beams 60 and additional roof props or roof jacks 59 may be placed in the receiver 58. However, the supply of track extensions and the supply of I-beams and roof jacks may be replenished at any time even during the continuance of the mining, loading and transportation of the coal from the mine chamber.

At the sides of the vertical plates 58 are mounted reels 70 for carrying the trolley wires 30 and 32. As the mining operations progress the trolley wires are paid out from the reels and suspended from the ends of the I-beams 60' by means of suitable insulating mine hangers 30, 32. This is illustrated diagrammatically in Figs. 4 and 5.

When desired advantage may be taken of the presence of the spaced-apart roof jacks 59 to form ventilating chambers by means of the overlapping sections of corrugated metal shown in Figs. 1, 6, 7 and 8. Each section is provided preferably with a handle such as indicated at 71 and 72 in Fig. 6 by means of which the section may be located in proper position relative to a superposed overlapping section and when such sections have been adjusted to the positions shown in Fig. 6 they may be secured together by the bolts 73 and 74 which extend through holes in one section and vertical longitudinal slots 75 and 76 in the other section. Nuts 77 and 78 may be provided for the bolts to lock the sections together in adjusted positions so as to form a vertical wall or partition between the floor of the mine chamber and the cross beams 60' as shown in Figs. 2 and 6.

Preferably each corrugated section 79 and 80 is composed of two sheets of metal 80 and 81 with their edges overlapping as shown in Figs. 7 and 8. The overlapping edges of the section 79 and 80 are adapted to fit against and overlap the adjacent edges of adjacent sections 82 and 83 as shown in Fig. 7.

In order to fill the space between the upper edges of the upper sections and the roof of the mine chamber I have provided the roof partition plates 84 provided with lower end angle irons or foot rests 86, 87 and 88 in position to engage the lower flanges of the I-beams 60', as shown in Fig. 6. Similar roof partition plates 89 and 90 are located on the other sides of the I-beams. As the mining and loading operation proceeds the ventilating partition may be extended to any distance along the mine chamber that may be desirable and the front end of the parti-

tion may always be located a short distance back of the receiver 58.

In order that the corrugated sections may be in readiness to extend the ventilating partition forward toward the space where the mining and loading operations are taking place I have provided a sled or carrier 91 connected by a tow rope or cable 92 to the rear end of the frame 15 or to the receiver 58 so that as the latter is moved forward the sled or carrier 91 will also be moved forward between the spaced-apart rows of roof jacks 59, as shown in Fig. 1. On the sled or carrier 91 is stacked any desired number of corrugated sections 79.

Doors may be provided in the ventilating partition adjacent the cross track 28. By referring to Fig. 1 it will be seen that I have shown two hinged doors 93 and 94 which may be swung to the dotted line positions when the mine locomotive is to be transferred from the track 25 to the track 24, for the purpose of taking back a train of loaded cars after having brought up on the track 25 a train of empty cars.

Referring to Fig. 10 it will be seen that I have shown a combined mining and loading machine for the rapid mining of coal from a mine chamber which is continually being lengthened and enlarged. Such mining and loading machine may comprise undercutting mechanism 95 and pick mechanism 96 mounted on a supporting frame work which also carries an arcuately swinging receiving conveyer which takes the broken down material and delivers it to the hopper 98 so that the intermediate conveyer 99 may transfer the material to the hopper 100 from which the material is taken by the conveyer 12 and delivered to the car 13. When the main frame 101 of the mining and loading machine is moved to the dotted line position shown in Fig. 10 the hopper 100 will occupy the position shown at 100' and the mine car 13 will occupy the position shown at 13' after the frame 15 has been moved forward to a new position. It should be noted that the mining and loading machine shown in Figs. 10 and 11 is particularly adapted for performing both advancing and retreating operations. When the machine is in the position shown in full lines in Fig. 10 advancing operations may be carried on to produce the main entries 139, 140 and also the butt entries 174, 175 and 176, 177. When retreating operations are to be carried out the mining operations are extended laterally, as shown in dotted lines in Fig. 10, and such operations are continued, as shown in dotted lines in Fig. 11. This may be done by the addition of the storage hopper conveyer designated 106 in Fig. 11. During the advancing operations along the main entries and along the butt entries both of the storage hopper conveyers 12 and 106 may be

used and when retreating operations are to be begun both of these storage hopper conveyers will be in readiness for transferring the dislodged material to the mine car, as shown in Fig. 11.

In Fig. 11 I have shown a modified mining and loading machine for very rapid mining and loading coal over a much larger area than is possible by the use of the mining and loading machine shown in Fig. 10. The dotted lines 102 indicate the various successive sections which have been dislodged and loaded prior to the position which is represented in full lines.

In the system shown in Fig. 11 a supplemental track 103 is laid in front of the track 14 on the frame 15. This supplemental track is thus adapted to form a continuation of the track 14 but its principal function is to support the truck wheels 104 of the truck on which the hopper 105 is mounted. This hopper 105 is provided with a conveyer 106 for taking the mined coal in the manner illustrated in Fig. 11 into the mine car 13.

The system of mining and loading coal shown in Fig. 11 is illustrated diagrammatically at 97, 99, 12 and 106 for delivery of coal to the mine cars on the tracks 24 and 25 (see Fig. 1). Fig. 12 also illustrates the reverse or retreating operation illustrated in full lines in Fig. 11 but in Fig. 12 this reverse operation is for the purpose of removing the pillars 107 after the spaces 108, 109, 110 and 111 have been mined of coal and the roofs permitted to subside.

In Figs. 13 to 18 inclusive I have shown multiple roof propping mechanism particularly adapted to controlling the subsidence of the roof over such portions where the mining of the coal has been completed, distant from the places where the mining and loading of the coal is continuing. This multiple roof propping mechanism is preferably composed of separate individual long and narrow frames 112, 112' each of which is provided with a series of roof jacks 113, 113'. Each of the roof jacks 113 comprises a hydraulic cylinder 114 which is secured at 115 to the spaced-apart vertical plates 116 and 117 which in turn are secured at their lower ends to the longitudinal U-shaped base piece 118. In the cylinder 114 is a plunger 119 which projects upwardly and carries at its upper end a roof plate or shoe 120.

Each of the cylinders 114 is provided at its bottom with a pipe connection extending to the supply chamber 121. The pipes 122, 123 and 124 which extend to the lower ends of the cylinders 114 are provided with valves 125, 126 and 127, respectively. A supply pipe 128 extends into the tank 121 and this supply pipe is provided with a valve 129. It will thus be seen that fluid pressure, either liquid or gaseous, but pref-

erably liquid, may be supplied simultaneously or independently to the individual roof jacks 114.

The tank 121 is also provided with an exhaust pipe 130 which is provided with a controlling valve 131.

The roof jacks shown in Fig. 16 may be operated individually into anchoring positions or released positions by manipulating the valves 125, 126, 127, 129 and 131. When the valve 131 in the exhaust pipe is closed and valves 125, 126 and 127 are open, the opening of the valve 129 in the supply pipe will cause pressure to be exerted simultaneously in the three cylinders shown in Fig. 16 to cause the roof plates 120 to be moved into anchoring positions. Whenever desired all of the valves shown in Fig. 16 may initially be closed and then each individual roof jack may be operated by opening the valve 129 and the valve 125, 126 or 127 according to the roof jack to be operated. In the same manner any individual roof jack may be released by opening its corresponding valve as well as the valve 131 in the exhaust pipe after closing valve 129 in the supply pipe. At this time if the individual valves of the roof props are kept closed the pressure medium in the corresponding roof jack cylinder will be confined to roof propping condition. For instance, the valves 125 and 126 could be kept closed when the valve 127 is open; then upon closing the valve 129 and opening the valve 131 the pressure in the cylinder 114 at the right in Fig. 16 would be relieved and the corresponding plunger would descend away from the roof, while the other two roof jacks remained in anchoring positions.

In Figs. 17 and 18 I have shown spaced-apart vertical plates 116', 117' secured at their lower ends to the longitudinal U-shaped base 118'. While in Fig. 16 I have shown only three roof jacks distributed over the rear half portion of the frame 112, in Fig. 18 I have shown nine roof jacks 113' distributed over the entire length of the frame 112'. The cylinders 114' are secured at 115' to the spaced-apart vertical plates 116', 117'. The pipe 122' may be connected to the bottom of each cylinder 114' and while the same system of controlling valves as shown in Fig. 16 may be used in Fig. 18 I prefer to operate the hydraulic jacks shown in Fig. 18, simultaneously, because their plungers 119' are pivotally connected at their upper ends at 132 to the longitudinal rail 133 which is adapted to bear against the roof as shown in Fig. 18.

The frames 112, 112' as shown in Figs. 16 and 18 are preferably inclined forwardly and rearwardly from points midway between the ends of such frames and the forward inclined edges are preferably connected by the crossplate 134 shown in Fig. 16,

so that when the roof subsides as illustrated in Fig. 14 the falling material will have a tendency to slide forward and not fill the frame 112 between the side plates 116 and 117. The forward upper inclined surface 134 also facilitates the movement of the frame 112 together with the roof jack 113 to the dotted line position 135 shown in Fig. 14. To effect such rearward movement of the series of multiple roof props I have provided a cross rod 136 at the rear end of the base plate 118, this cross rod being adapted to be engaged by hook 137 connected to one end of the draft rope 138. In a similar manner the frame 112' shown in Fig. 18, is provided with a rear cross rod 136' to receive the hook 137' connected to the forward end of the draft rope 138'.

By referring to Fig. 12 it will be seen that when the main entries are driven in opposite directions from the vertical shaft 141, these main entries 139 and 140 are extended to the limits 142 and 143 and at the latter places the subsiding of the roof is controlled by such a series of multiple roof props as those shown in Figs. 13 to 18 inclusive. The dotted line squares 144 and 145 in Fig. 12 illustrate the first positions of the roof props and the dotted line squares 146, 147, 148 and 149 designate successive positions before the positions indicated by the full lines 150 and 151 are reached. The full lines 152, 153, 154 and 155 illustrate additional series of such roof props as illustrated in Figs. 13 to 18 inclusive. The spaces designated 108, 109, 110 and 111, in Fig. 12, have been completely mined of coal and the roofs allowed to subside, but the series of multiple roof jacks shown at 150, 151, 152, 153, 154 and 155, in Fig. 12, are relied upon to properly support the roof adjacent to places where the mining operations are continuing.

It will also be seen by referring to Fig. 12 that the space 108 is wider than the space 110. This is so illustrated because when the first butt entries are produced the tendency is for the roof to be sustained until it reaches approximately the width illustrated by the space designated at 108. In other words, when the butt entries are first driven the widths thereof will not be sufficient in most instances to cause the roofs to subside but as soon as the butt entries are of sufficient width to cause the overhead weight to subside the roofs such subsidence may be definitely controlled by the roof breaking the props illustrated in Figs. 13 to 18 inclusive. The dotted lines 156 and 157 indicate a narrow strip of coal between the body of coal which has been mined and the material which has subsided from the roof in the spaces 108 and 109. Such a narrow strip of coal is shown at 158 and also at 159 in Fig. 12 because it is believed to be impracticable to attempt to cut into the material

such as rock and slate which has subsided from the roofs into the spaces 110 and 111.

By referring to Fig. 13 it will be seen that the type of multiple roof supporting mechanism shown in Figs. 15 and 16 are placed alongside of each other in a series across the mine chamber whereas the type of multiple roof supporting mechanism shown in Figs. 17 and 18 is placed close to one of the mine walls so that the longitudinal rail 133 will sustain the adjacent body of coal and preserve the same from being crushed by effecting a shearing action of the roof as predetermined by the position of such rail 133. The type of multiple roof supporting mechanism shown in Figs. 17 and 18 are particularly adapted to be located at the coal walls at the points indicated at 160, 161, 162 and 163 of Fig. 12. It should be particularly noted that the multiple roof supporting mechanism illustrated in Figs. 13 to 18 inclusive are provided with comparatively long bases so that the pressure of the roof on the roof supporting mechanism will be distributed over large areas. It can readily be seen that if a series of individual roof props were used, each having a base equal approximately to the cross sectional area of a cylinder 114, the roof pressure thereon might be sufficient to cause such roof props to be projected into the floor of the mine chamber when such floor happened to be of comparatively soft material and the subsidence of the roof would constantly be so irregular as to render mining operations inefficient. Moreover, upon the subsidence of the roof, due to a lack of sufficient floor support, the heaving of the floor adjacent the roof props having small bases, would often be sufficient to prevent the recovery of the roof props themselves, and if the roof subsided entirely such roof props would be completely buried.

By the use of multiple roof props each having a long narrow frame, and therefore a comparatively large base, a series of such roof props arranged as shown in Fig. 13 becomes very effective to sustain the roof where desired and thereby control the shearing of the roof immediately in front of the closely adjacent roof plates 120. The large floor area of the series of roof props will enable the latter to sustain the roof even when the floor is comparatively soft and the overhead pressure tending to cause the roof to subside is comparatively great. The forwardly extending portions of the frame 112 will not interfere with the control of the subsidence of the roof, as illustrated in Fig. 14, because these forwardly extending portions are inclined downwardly and forwardly at 134. This forwardly extending portion of each multiple roof prop gives the latter an increase in the floor engaging area

where desired and the inclined portion relieves the shock and jar of the falling material and facilitates the movement of the props back to the dotted line position 135, as shown in Fig. 14. In this view the full line positions of the roof propping mechanism are those to effect the control of the subsidence of the roof so that the latter will shear along the predetermined line 164. When it is desired to cause the roof to subside so that it will shear along the line 165 the position indicated at 135 is relied upon. When the roof props are released by means of the valve mechanism illustrated in Fig. 16, they are preferably drawn rearwardly by the draft ropes 138 to occupy the spaced-apart positions shown at 166 in Fig. 13. The pressure on the roof will thus be gradually distributed and gradually changed from the area at the right hand portion of Fig. 14, near the line 164, to that portion of the roof to the left of the line 165. It should be understood that since the tendency for the roof to subside is gradual there will be ample time in which to actually change the roof props to their new locations just back of the line 165 before the roof or any portion of it comes down after being freed by the removal of the jacks from their full line positions in Fig. 14 to their dotted line positions illustrated at 135. It should be understood, however, that, after the roof jacks have been removed to their new locations, the latter will resist subsiding of the roof to the left of the line 165 but will permit gradual and free subsidence to the right of the line 165, in the manner indicated in Fig. 14, to the right of the line 164.

In Fig. 19 I have shown a series of roof props similar to those shown in Fig. 13 but arranged on a diagonal line relative to the coal wall 167 so as to direct the subsidence of the roof toward the space 168 where the roof has previously subsided, thereby taking the pressure away from the coal wall 167 and minimizing the danger of crushing such coal wall or portions thereof when the roof subsides. The dotted line 164' indicates a previous line of shearing upon subsidence of the roof as controlled by a previous position of a series of roof props, this dotted line 164' corresponding to the shearing line or surface 164 of Fig. 14. The dotted line 165' indicates the shearing line or surface as controlled by the diagonally arranged series of roof props. This line 165' corresponds to the line 165 of Fig. 14. The line 169, in Fig. 19, illustrates the vertical shearing surface of the roof as determined by the rail 133 of the coal wall roof prop, illustrated in Figs. 17 and 18. The particular arrangement shown in Fig. 19 is directly adaptable to the wall at 162 in Fig. 12, and also at 161. Of course such a diagonal arrangement reversed may also be used at the walls 160 and

163 and the angularity may be varied as desired.

I have also shown, in Fig. 19, a car 170 on the track 25 for carrying a plurality of roof jacks 59. On the track 24 is a crane 171 for moving the jacks 59 from the car 170 along the line 172 for location at the places indicated at 173.

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 desire, therefore, not to be restricted to the precise construction herein disclosed. While the coal may be mined and loaded in various ways and by the use of various apparatus, and while the system and apparatus herein disclosed may carry out other methods than that illustrated in Fig. 12, I prefer to use a mining and loading machine intermediate the system shown in Fig. 1 and the mechanism for controlling the subsidence of the roof so that the entire system of mining by the use of the apparatus herein disclosed may be carried on with comparative rapidity and a large volume of coal removed in a comparatively short space of time thereby being able to use many roof props in the various entries and in the chambers where the coal is being mined before the sagging roof exerts too great a pressure on such roof props. Furthermore, such rapid operations can be effected before water accumulates by seepage. If the same output had to be effected by hand operations almost entirely, a great many more entries would have to be driven and the mining operations in each entry would have to be so prolonged that not only would the roofs exert undue pressure on the roof props in many instances but there would also be likely to be accumulations of water in such mine chambers. By means of the system illustrated in Fig. 1, of the accompanying drawings, connected to the mechanism for controlling the subsidence of the roof, by the coal mining and loading machine illustrated in Fig. 10 or Fig. 11, the mining operations illustrated in Fig. 12 may be carried on so rapidly as to assure a large output and also so as to assure efficient operation because the coal is removed before the roofs have a chance to subside sufficiently to exert any great pressure on the roof props located along the cross entries or butt entries 174, 175, 176 and 177.

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

1. In a system of mining, the combination with a mine track, of roof-propping mechanism comprising a series of individual roof props arranged in lateral alignment transversely of the rear end of said track, and mining and loading mechanism for mining material from a pillar between said mine

track and a worked-out space in the mine and delivering the mined material to mine cars on such track.

2. In a system of mining, the combination with extensible track mechanism, of mining and loading mechanism for mining and loading material into mine cars on the forward end of said track after the latter has been extended from time to time during advancing operations of the mining and loading mechanism, and roof-propping mechanism beyond the forward end of the track for controlling the subsidence of the roof beyond such roof-propping mechanism during retreating operations of said mining and loading mechanism.

3. In a retreating system of mining, the combination with roof-propping mechanism adapted to be gradually shifted to new locations to control the subsidence of the roof behind such roof-propping mechanism, of mining and loading apparatus in advance of such roof-propping mechanism in position to operate on a rear working face of a mine vein, and mine track apparatus for mine cars to receive mined material from said mining and loading apparatus and adapted to be retracted from the roof-propping mechanism as the latter is advanced toward the mining and loading apparatus.

4. In a system of mining, the combination with a mine track adapted to be extended along a mine entry, of a mining and loading machine adapted to operate on a working face of a mine vein at the rear portion of said entry and deliver material to mine cars on said track, and a series of roof props extending across the rear end of said entry and adapted to be advanced gradually to control the subsidence of the roof back of such props and protect the space where mining and loading operations are being carried on.

5. In a system of mining, the combination with a series of spaced-apart roof props, of a longitudinal ventilating partition comprising corrugated sections adapted to rest against said roof props, and means for securing such sections together in overlapping positions to form such a partition.

6. In a system of mining, the combination with a series of spaced-apart roof props, of I-beams adapted to be located between the roof and the upper ends of said roof props, a ventilating partition comprising corrugated sections adapted to rest against said roof props and abut against the lower surfaces of said I-beams, means for securing said sections together in overlapping positions to span the space between the floor and said I-beams to form such a partition, and additional plates between the I-beams to fill the spaces between the upper edges of said corrugated partitions and the roof of the mine chamber.

7. In a system of mining, the combination with an extensible ventilating partition comprising corrugated sections, of means for securing said sections in position to form such ventilating partitions, a carrier for a plurality of said sections, and means for moving said carrier along said mine chamber adjacent the forward end of said partition as the latter is extended.
8. In a system of mining, the combination with extensible track mechanism, of a magazine connected therewith, said magazine being adapted to carry a plurality of roof props for erection at intervals as said track mechanism is extended, a sectional partition extensible in accordance with the extensions of said track mechanism, and means connected to said magazine for carrying partition sections.
9. In a system of mining, the combination with extensible track mechanism comprising a portable frame, of a carrier connected thereto adapted to carry roof propping mechanism, a trolley wire reel on said carrier to pay out a trolley wire when said frame is moved forward, an additional carrier connected to said first-named carrier for carrying partition sections, and means for securing such sections in overlapping relation to cooperate with said roof propping mechanism when the latter is in roof propping position, to form a ventilating partition extensible in accordance with the extensions of said track mechanism.
10. In a system of mining, the method which consists in driving an entry through the material to be mined, supporting the roof of such entry, mining the material at the forward end of said entry, controlling the subsidence of the roof in the space from which the material has been mined by supporting the roof at predetermined locations adjacent the unmined mass, and continuing the mining of the unmined mass by retreating operations along one side of said entry toward the beginning of the latter while continuing to gradually shift the line of roof support.
11. In a system of mining, the method which consists in mining material to form a long entry comparatively narrow in width by advancing operations, continuing the mining by removing one of the side walls of the entry by retreating operations, and during such retreating operations supporting the roof in advance of the space where mining operations are being carried on and gradually retreating the line of roof support to control the subsidence of the roof over the space where the material has been mined out.
12. In a system of mining, the combination with a series of roof supports each having a base of a comparatively large area, of a longitudinal wall rail, and an additional roof support for projecting said rail against the roof at a wall adjacent one end of said series of roof supports.
13. In a system of mining, the combination with an elongated base frame adapted to rest on and slide over the floor of a mine chamber, of a plurality of spaced-apart roof jacks mounted on said base frame, and a roof-engaging beam connecting the upper ends of said roof jacks to occupy a position parallel to said base frame.
14. In a system of mining, the combination with a base frame having a forward downwardly inclined upper surface, of roof-supporting mechanism mounted on said base frame at the rear portion thereof back of said inclined surface and comprising a roof-engaging beam, and means for controlling the operation of said roof-supporting mechanism.
15. In a system of mining, the combination with a base frame having a forward extension with an upper downwardly inclined surface, of a plurality of spaced-apart hydraulic roof jacks mounted on said frame in spaced-apart relation on the rear portion thereof back of said inclined surface, a longitudinally extending beam connecting the upper ends of said roof jacks, and means for controlling the operation of said roof jacks.
16. In a system of mining, the combination with a narrow elongated base frame, of roof-supporting mechanism mounted thereon and comprising a longitudinally extending beam occupying a position in a vertical plane extending through said base frame, and means for controlling the operation of said roof-supporting mechanism.
17. In a system of mining, the combination with a narrow elongated base frame having a comparatively large area adapted to rest on and slide over the floor of a mine chamber to distribute the pressure exerted on such frame, of a roof jack mounted on said frame, and a forward extension from said base frame having a downwardly inclined upper surface.
18. In a system of mining, the combination with an elongated narrow base frame adapted to rest on and slide over a mine floor, of a roof jack mounted on said frame, and a forward extension from said base frame tapering downwardly toward the mine floor in position to receive material subsided from the roof of the mine chamber in advance of said roof jack.
19. In a system of mining, the combination with a long narrow U-shaped channel iron serving as a base frame, of upwardly extending spaced-apart side plates secured to the sides of said channel iron, and roof supporting mechanism resting on said channel iron and secured to said side plates.
20. In a system of mining, the combination

tion with a long narrow base frame, of spaced-apart upwardly extending side plates secured to said base frame and inclined upwardly from the forward end of said frame, a cover plate for such forward inclined edges of said side plates, and roof propping mechanism mounted between said side plates rearwardly of said cover plate.

21. In a system of mining, the combination with a base frame adapted to rest on and slide over a mine floor, of roof jack mechanism mounted on said base frame to serve as a roof support in a mine chamber, and an extension from the forward portion of said base frame having an upper surface inclined downwardly toward the floor in position to receive material subsided from the roof of the mine chamber and adapting said base frame to be withdrawn from such subsided material.

22. In a system of mining, the combination with a long narrow base frame, of spaced-apart upwardly extending side plates secured to said base frame and having upper edges inclined upwardly from the forward lower end of said base frame, a cover secured to said edges and extending from the lower ends of said base plates at the forward end of said base frame upwardly and rearwardly to approximately the center of said side plates, a plurality of fluid pressure cylinders mounted on said base frame and secured to said side plates between the latter including one at the center, one at the rear and another intermediate, plungers movable in said cylinders, roof plates mounted on said plungers, and means for controlling the fluid pressure on said cylinders to effect the operation of said plungers to move said roof plates against the roof while the pressure is distributed over the comparatively large area of said base frame.

23. In a system of mining, the combination with a series of individual long narrow base frames, of upright extensions secured to said base frames to form upright vertical flat surfaces adapted to fit against similar surfaces next adjacent in such series, and roof supporting mechanism individually mounted on said base frames and upright extensions to form roof breaking apparatus by distributing the pressure over a comparatively large area of said base frame and controlling the subsidence of the roof along lines predetermined by the positions of said roof supporting mechanism.

24. In a system of mining, the combination with a series of individual supporting frames having upper surfaces downwardly inclined toward the mine floor, of roof propping mechanism mounted on said frames back of said inclined surfaces, and means for operating said roof propping mechanism to form a break line for the sub-

sidence of the roof into the space above and in front of said inclined surfaces, and means on said frames for attachment of draft mechanism to secure the withdrawal of said individual supporting frames while said inclined surfaces are slid out from under the subsided material.

25. In a system of mining, the combination with a series of long narrow channel irons adapted to form a series of base frames, spaced-apart side plates secured to said base frames to form vertical outer surfaces adapted to fit against similar surfaces of the next adjacent in the series, downwardly and forwardly inclined upper surfaces formed by cover plates between said side plates, a plurality of spaced-apart fluid pressure roof jacks mounted on each of said base frames between the side plates and secured to the latter, and means for controlling the operation of said roof jacks to form a line of breakage of the roof when the latter subsides into the space above and in front of said inclined surfaces while the pressure of the roof immediately above the roof propping mechanism is sustained by the distribution of such pressure over the comparatively large area of said base frames resting on the floor of the mine chamber.

26. In a system of mining, the combination with long narrow individual supporting frames adapted to rest on the floor of a mine chamber in a diagonal series relatively to an upright wall in a mine chamber, of roof propping mechanism mounted on said supporting frames, and means for operating said roof propping mechanism to predetermine a line of breakage upon the subsidence of the roof over a predetermined space and to cause said roof subsidence to tend to move the subsiding material away from said upright wall and relieve the pressure on the latter.

27. In a system of mining, the combination with a pair of spaced-apart parallel mine tracks adapted to extend along a mine entry, of an extensible ventilating partition comprising detachable and adjustable sections extending along the mine entry between said mine tracks, a cross track between the spaced-apart tracks, doors for normally maintaining the continuity of said partition but permitting cars to travel from one mine track to another over said cross track, and a series of spaced-apart roof props located between said spaced-apart parallel tracks in position to support the sections of said extensible ventilating partition.

28. In a system of mining, the combination of roof propping mechanism comprising a series of individual roof props arranged in lateral alignment extending from the solid wall of a mine vein, each of said

- roof props comprising elongated roof and floor shoes adapted to extend in cooperation with adjacent floor and roof shoes over wide areas to distribute the supporting pressure over such wide areas, and an additional mine wall roof prop comprising longitudinal elongated roof engaging rails adapted to be located at the upper edge of the upright mine wall.
29. In a system of mining, the combination with roof propping mechanism comprising a series of individual roof props arranged in predetermined diagonal alignment relative to an upright mine wall, each of said roof props comprising elongated floor shoes adapted to fit against adjacent floor shoes and cooperate with the latter to form a continuous floor engaging surface extending over a wide area diagonally along such upright mine wall, and means individual to each of said roof props for effecting the anchoring and releasing of the same.
30. In a system of mining, the combination with roof propping mechanism comprising a narrow elongated floor engaging shoe, and a plurality of spaced-apart roof props arranged in a series along said floor shoe and each comprising a roof engaging shoe.
31. In a system of mining, the combination with a series of individual roof props arranged in lateral alignment from an upright solid mine wall, each of said roof props comprising an elongated floor shoe and a series of spaced-apart roof engaging shoes, and an additional roof prop adapted to be located at the solid mine wall and comprising a roof engaging rail extending along the upper edge of the solid mine wall to assure a break line along such upper edge when subsidence occurs back of the first named series of roof props.
32. A method of mining consisting in providing a series of individual roof props in roof-propping position extending from the upright solid wall of a mine vein into the mine chamber to provide a predetermined subsidence break line, and providing a narrow longitudinal support along the upper edge of the mine wall to prevent roof subsidence from crushing the mineral at the mine wall and securing a longitudinal subsidence break line along the upper edge of such wall.
33. In a system of mining, the combination with a longitudinal roof-engaging narrow elongated shoe, of roof jack mechanism for anchoring said shoe at the upper edge of a mine wall to protect the latter and determine a roof subsidence break line substantially at the upper edge of such mine wall, and a series of individual roof jack mechanisms arranged in a series extending away from the mine wall to determine a roof subsidence break line in continuity with the wall break line.
34. In a system of mining, the combination with a series of roof props each comprising roof-engaging means and an elongated floor-engaging shoe extending substantially beyond the roof-engaging means, of a longitudinal wall rail, and an additional roof jack projecting said rail against the roof and adjacent one end of said roof props, said rail extending over the full length of the floor-engaging shoe.
35. In a system of mining, the combination with a series of roof props each comprising an elongated floor shoe adapted to cooperate with adjacent floor shoes to extend over a wide area diagonally from an upright solid mine wall, and an additional roof-propping device comprising an elongated roof-engaging shoe extending along the upper edge of the upright mine wall the full length of the floor engaging shoe to predetermine a line of roof support against the tendency of the roof to subside and confine such subsidence to a predetermined area at one side of such series of roof props and diagonally from said upright mine wall.
36. In a system of mining, the combination with roof propping mechanism comprising a series of individual roof props arranged in diagonal alignment relative to a mine wall, each of said roof props comprising a base of comparatively large area, and an additional mine wall roof prop comprising a longitudinal rail to serve as a roof engaging shoe at the upper edge of the upright mine wall adjacent one end of such series of roof props.
37. In a system of mining, the combination with a series of roof props arranged in lateral alignment and each comprising floor and roof-engaging mechanism, of elongated extensions of said floor engaging mechanism with the space above said extensions free and unobstructed for the subsidence of the roof, and an additional roof prop having an elongated roof engaging shoe adapted to engage the upper edge of a solid mine vein to protect the upright mine wall and confine the roof subsidence laterally of said roof shoe in the space above said extensions.
38. In a system of mining, the combination with a series of roof props each comprising an elongated floor shoe and a plurality of spaced-apart roof shoes distributed along said floor shoe, of elongated extensions for said floor shoes with the space above said extensions free and unobstructed for the subsidence of the roof, and an additional roof prop comprising an elongated floor shoe and elongated roof shoe each of a length approximately equal to the combined length of one of said floor shoes and its extension, and adapted to be located at the

solid upright mine wall to protect the same and confine roof subsidence laterally of said additional roof prop in the space above said extensions.

base frame, and fluid pressure operated mechanism on said base frame back of said extension in position to engage the roof to support the same.

39. In a system of mining, the combination with a series of roof props arranged in lateral alignment and each comprising floor and roof shoes, of elongated extensions for the floor shoes, the upper surfaces of said extensions being inclined downwardly away from said roof props and the space above said inclined surfaces being free and unobstructed for the subsidence of the roof, and an additional roof prop having an elongated roof shoe at the upright solid mine vein and extending along the end extension of the series to protect the solid mine wall and confine subsidence of the roof to one side of said additional roof prop and to the space above said inclined surfaces.

45. In a system of mining, the combination with an elongated rigid base frame adapted to move over a mine floor, of a plurality of spaced-apart hydraulic roof jacks mounted on said frame in tandem, and means comprising valve mechanism mounted on said frame at the rear end thereof to control each of said roof jacks independently of the others.

40. In a system of mining, the combination with an elongated base frame adapted to rest on and slide over a mine floor and provided with vertical spaced-apart outer plane walls in parallelism with each other, of a plurality of roof jacks spaced apart along said base frame for arrangement in tandem, and means comprising valve mechanism on said base frame back of the series of roof jacks for controlling each of the latter in anchoring and releasing the same independently of each other.

46. In a system of mining, the combination with an elongated base frame, adapted to move over a mine floor and provided with outer spaced-apart walls adapted to fit in sliding engagement with adjacent elongated frames, of a plurality of roof jacks spaced apart along said base frame for arrangement in tandem, and means comprising valve mechanism on said base frame for controlling the operation of said roof jacks independently of each other.

41. In a system of mining, the combination with an elongated base frame adapted to rest on and slide over a mine floor and having vertical spaced-apart outer plane walls in parallelism, of a plurality of roof jacks mounted thereon in tandem, and means for controlling the operation of said roof jacks individually.

47. In a system of mining, the combination with an elongated base frame adapted to move over a mine floor and having spaced-apart outer walls extending in parallelism to each other, of a plurality of roof jacks mounted on said frame between said walls and arranged in tandem, and means for controlling the operation of said roof jacks.

48. In a system of mining, the combination with a narrow elongated base frame having spaced-apart outer walls, of a plurality of spaced-apart hydraulic roof jacks mounted on said frame in spaced-apart relation and in tandem between said walls, and means connected to said roof jacks for controlling the actuation and release thereof.

42. In a system of mining, the combination with a narrow elongated base frame having parallel spaced-apart outer plane walls and a flat plane bottom, of a plurality of spaced-apart hydraulic roof jacks mounted on said frame in spaced-apart relation and in tandem, and means connected to said roof jacks for controlling the actuation and release thereof individually.

49. In a system of mining, the combination with a narrow elongated base frame rigid throughout and having outer walls adapted to slide along adjacent elongated frames rectilinearly, of roof-supporting mechanism mounted on such narrow elongated base frame between said walls, and means for controlling the operation of said roof-supporting mechanism.

43. In a system of mining, the combination with a narrow elongated base frame rigid throughout and having outer walls adapted to slide along adjacent elongated frames rectilinearly, of roof-supporting mechanism mounted on such narrow elongated base frame and comprising parts movable relatively to said rigid base frame, and means for controlling the operation of said roof-supporting mechanism.

50. In a system of mining, the combination with an elongated base frame adapted to move over a mine floor and comprising an extension having an upper downwardly inclined surface, of roof jack mechanism mounted on said frame, and means for controlling the operation of said roof jack mechanism.

44. In a system of mining, the combination with an elongated base frame having a comparatively large area adapted to rest on the floor of a mine chamber to distribute the pressure exerted on said frame, of a forward downwardly inclined extension from said

51. In a system of mining, the combination with an elongated base frame having a forward downwardly inclined extension to form an inclined plane on its upper surface, of roof-supporting mechanism on said frame back of said inclined surface, and means for controlling the operation of said roof-supporting mechanism.

52. In a system of mining, the combination with a plurality of roof props arranged in lateral alinement to form a line of roof support at the rear end of a main entry in a mine, of another series of roof props arranged in lateral alinement at the rear ends of a plurality of butt entries extending from said main entry, and means for mining the pillars between said main entry and said second named series of roof props by retreating operations toward said main entry. 10

In testimony whereof I have signed my name to this specification on this 17th day of December A. D. 1919.

EDMUND C. MORGAN.