Sept. 10, 1946. E. RAMSAY 2,407,448

MINING MACHINE

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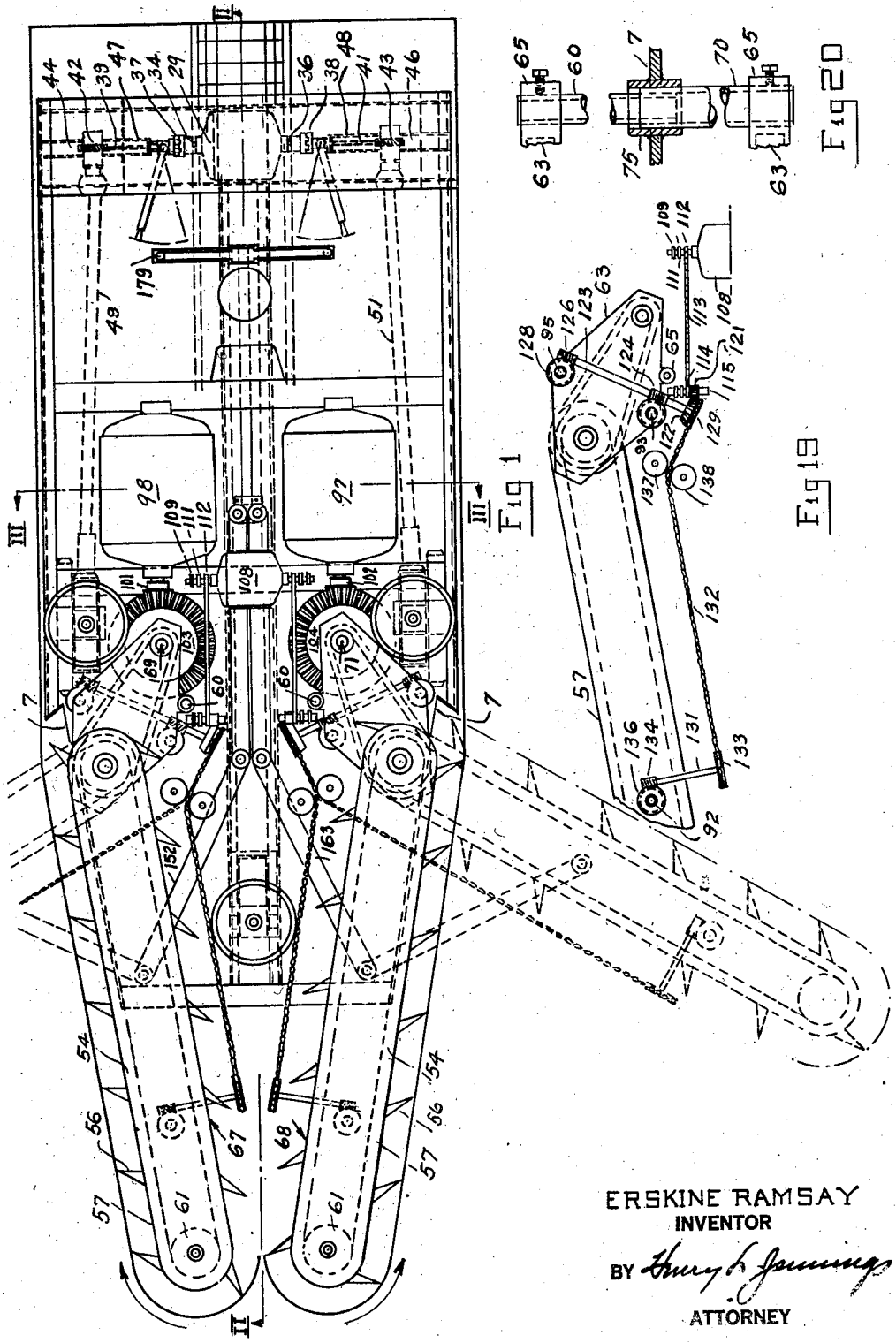


Fig 1

Fig 20

Fig 19

ERSKINE RAMSAY
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MINING MACHINE

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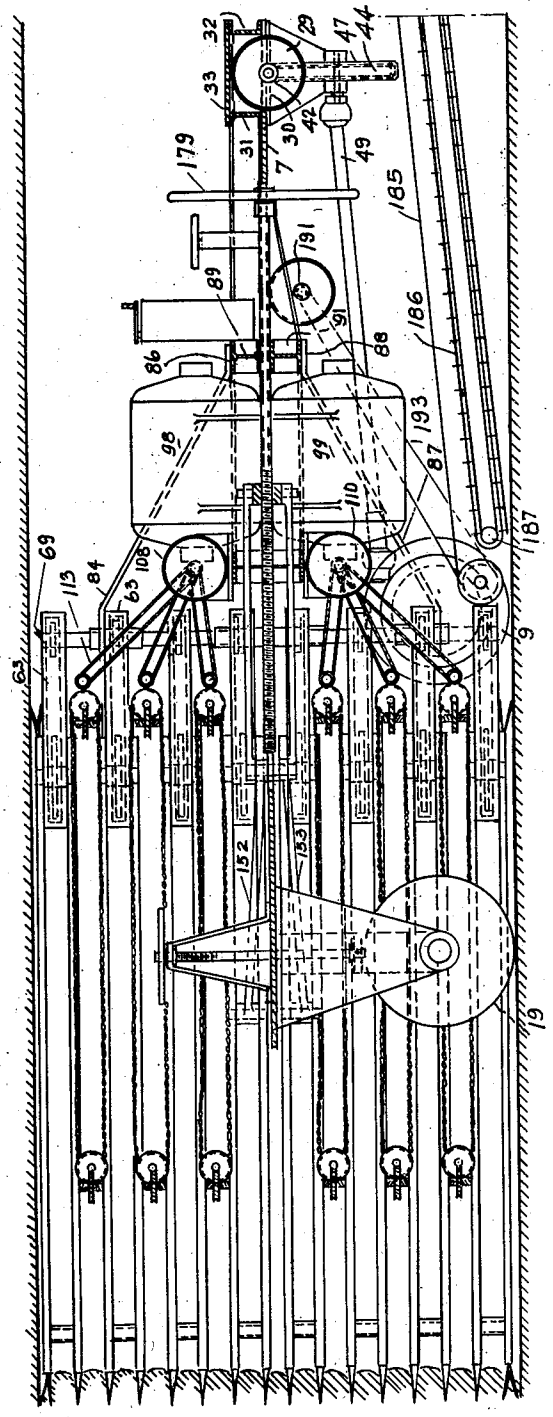


Fig 2

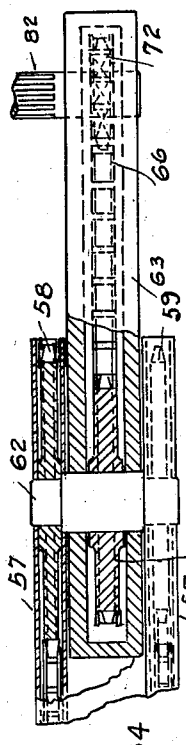


Fig 9

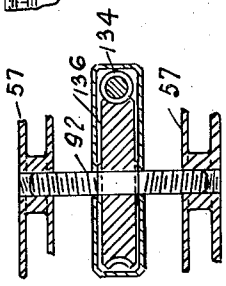


Fig 10

ERSKINE RAMSAY
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MINING MACHINE

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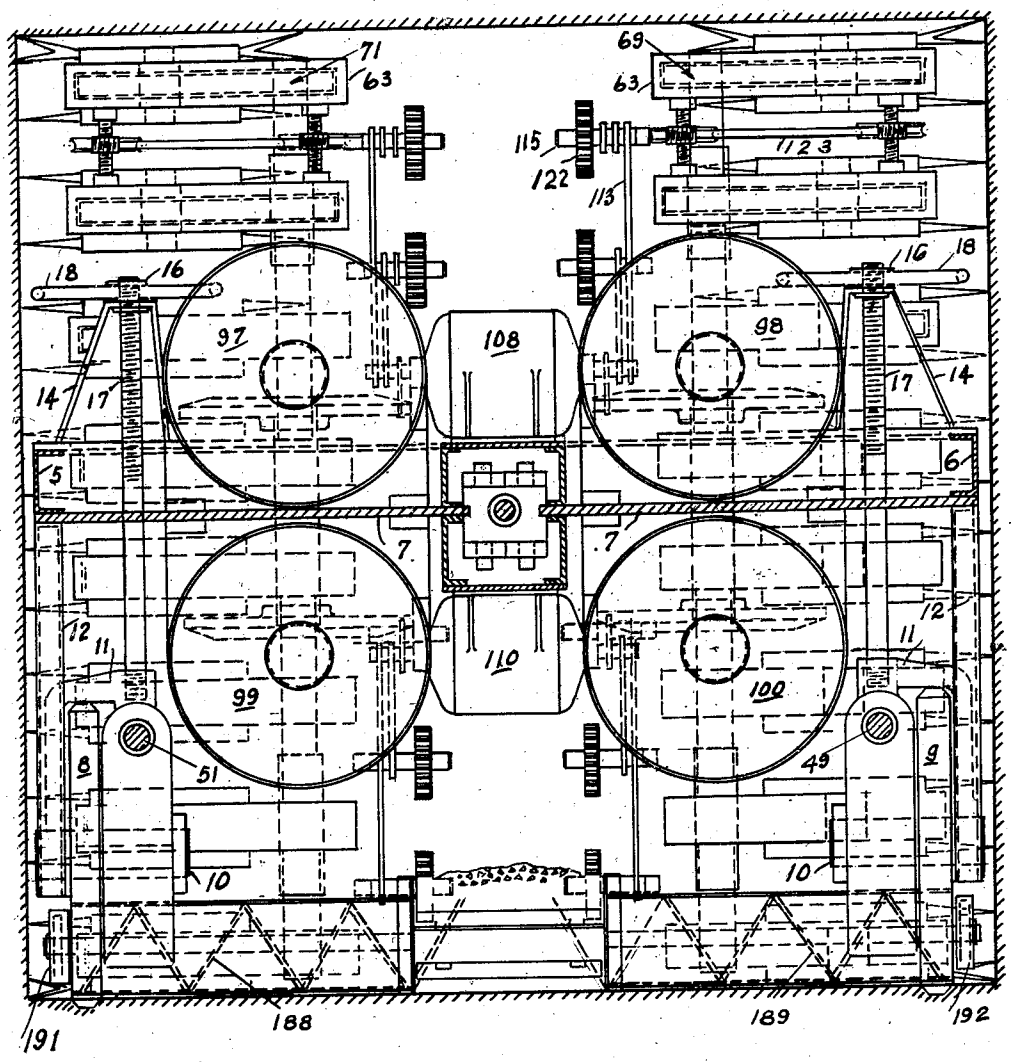


Fig 3

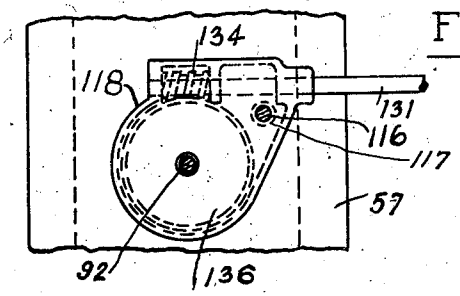


Fig 21

ERSKINE RAMSAY
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MINING MACHINE

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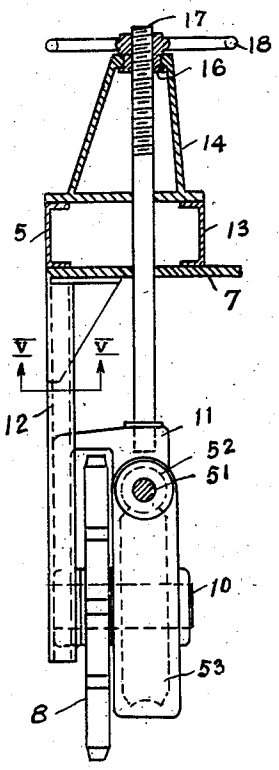


Fig 4

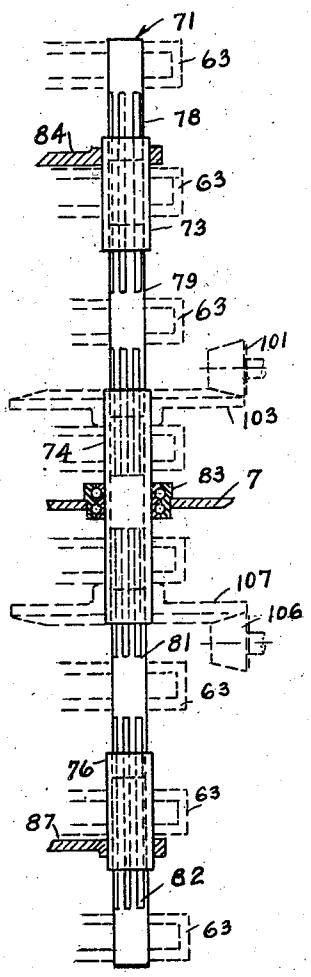


Fig 8

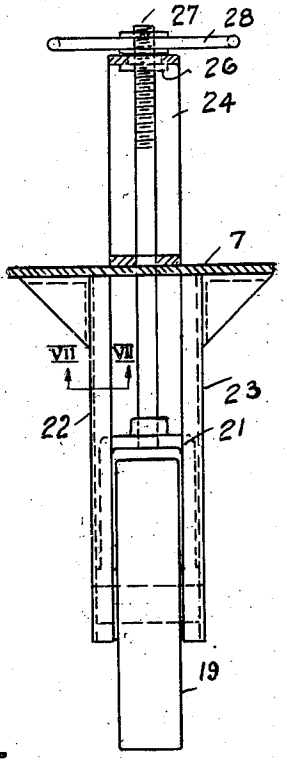


Fig 6



Fig 7

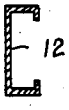


Fig 5

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MINING MACHINE

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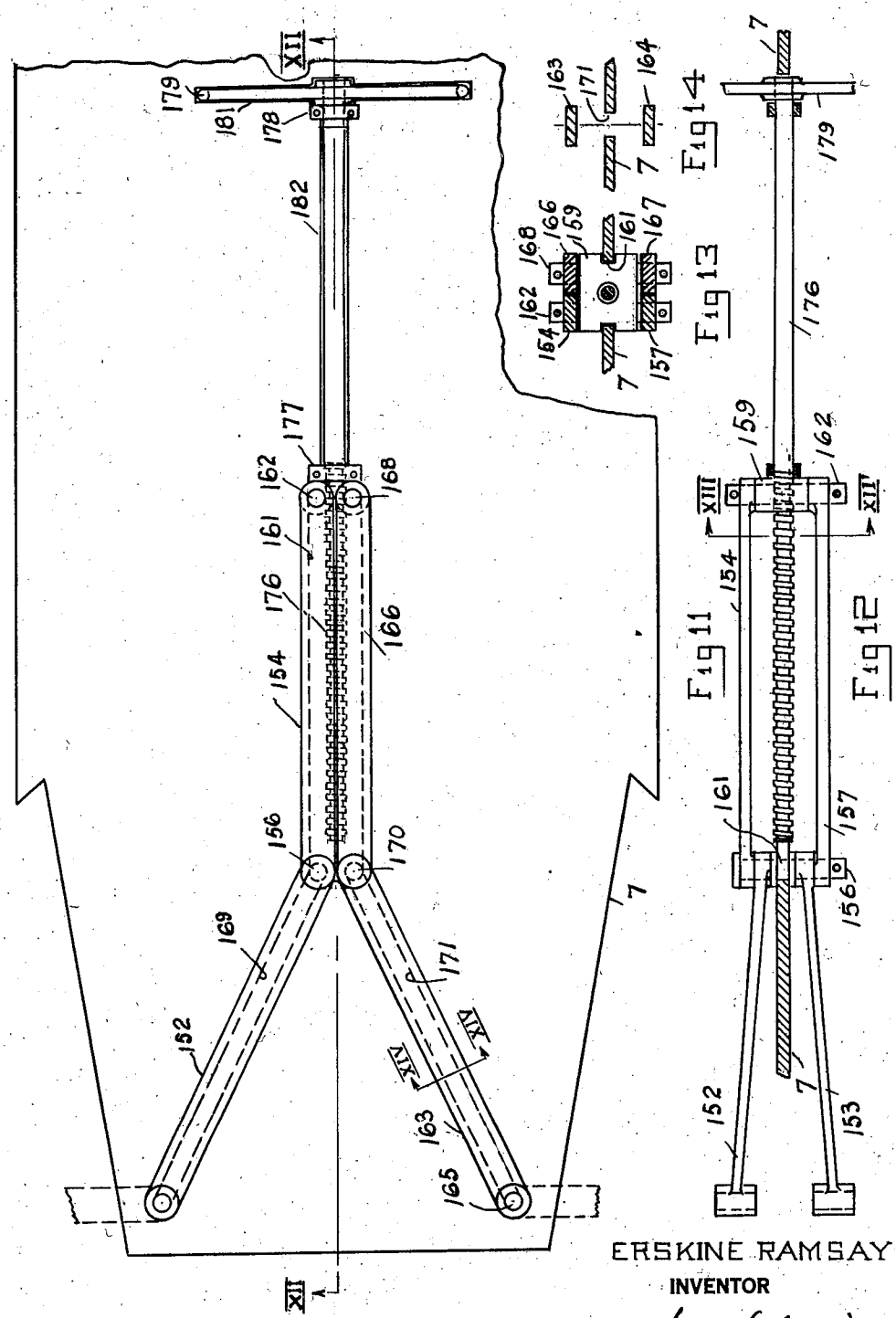


Fig 13

Fig 14

Fig 11

Fig 12

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MINING MACHINE

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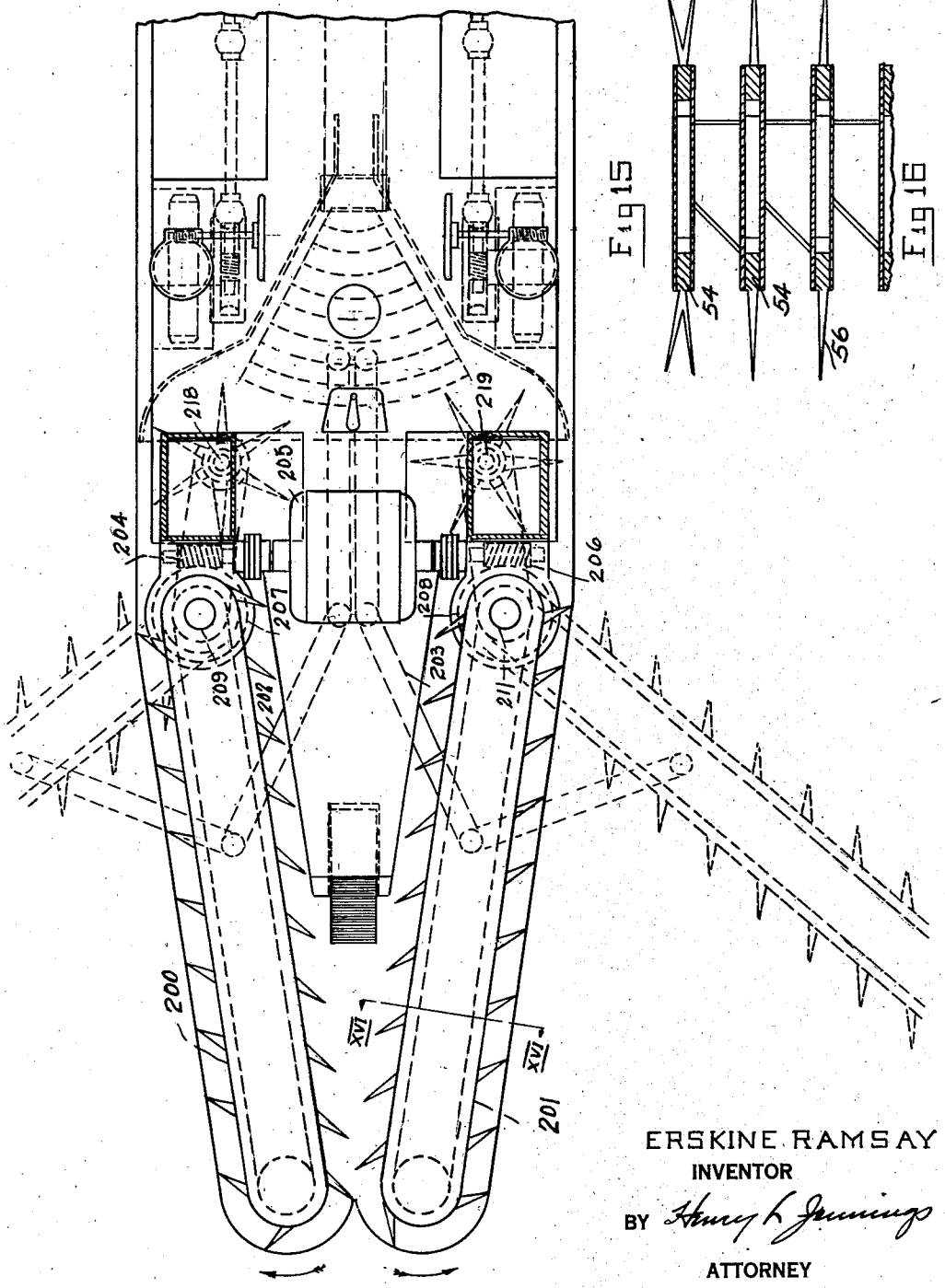


Fig 15

Fig 16

ERSKINE RAMSAY
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MINING MACHINE

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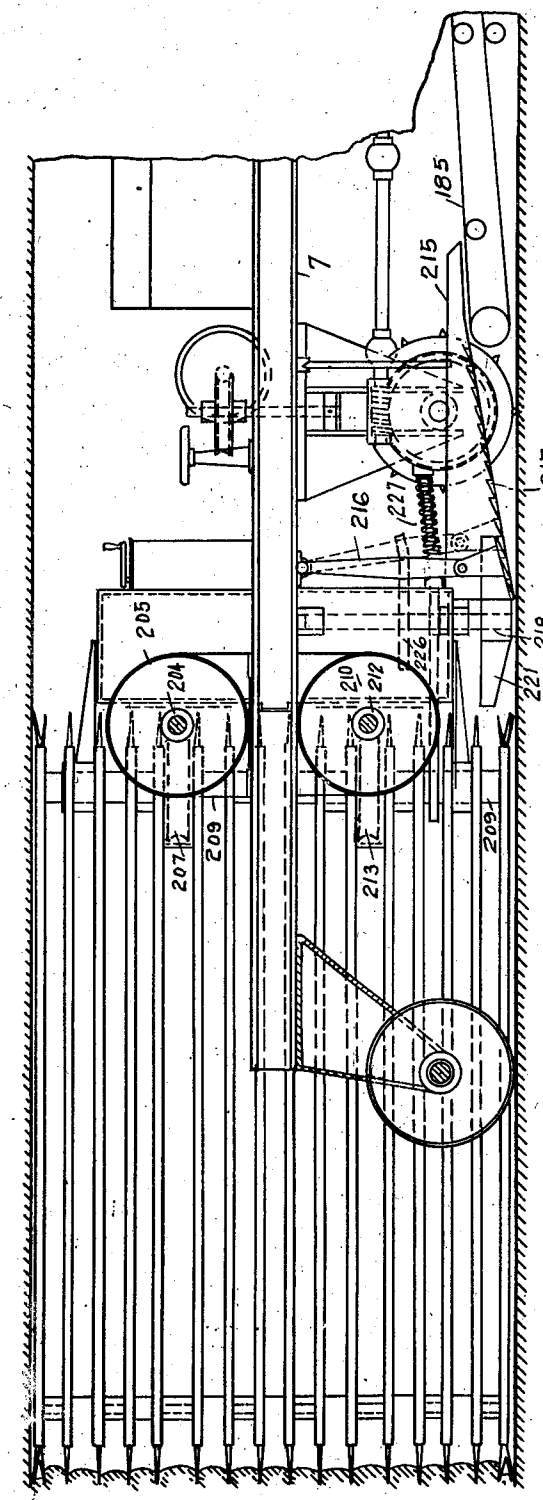


Fig 17

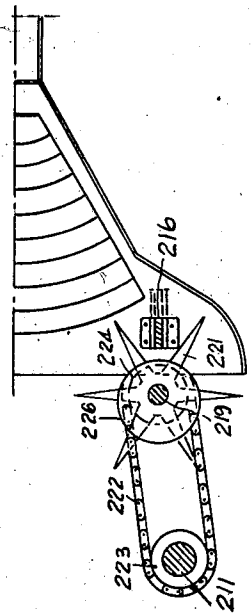


Fig 18

ERSKINE RAMSAY
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Patented Sept. 10, 1946 2,407,448

UNITED STATES PATENT OFFICE

2,407,448

MINING MACHINE

Erskine Ramsay, Birmingham, Ala.

Application July 3, 1944, Serial No. 543,304

6 Claims. (Cl. 262—28)

1

This invention relates to machines for mining coal, and has for its principal object the provision of self propelled apparatus of the character designated which shall be adapted for driving headings and air courses in mines while moving forwardly and which shall be reversible and adapted for cutting out the pillars alongside said headings and air courses on reverse movement.

A further object of my invention is to provide a mining machine which shall embody a pair of gangs of cutter bars pivotally mounted on the front of the machine to project forwardly therefrom, together with means to swing and spread said gangs of bars apart and hold them to their spread-apart working positions, whereby a heading may be driven by forward movement of the machine with the gangs of bars held close together and upon reverse movement the gangs of cutters may be spread apart and operated to widen the heading and remove pillars.

A still further object of my invention is to provide a self propelled reversible mining machine adapted to make a cut moving forwardly or rearwardly and which shall include a conveyor for removing material broken down by the machine.

A further object of my invention is to provide a mining machine which shall embody a pair of gangs of cutter bars pivotally mounted on vertically disposed parallel shafts at the front of the machine to project forwardly therefrom, the construction of the shafts being such that the cutters in each gang may be separated or brought closer together and the shafts lengthened or shortened, thus to accommodate the machine to seams of various thicknesses.

As is well known in the art to which my invention relates, the mining of coal manually consists of the following laborious operations; (*a*) first the seam is undercut with pick and shovel or undercutting mechanism so that it may be broken down; (*b*) holes are then drilled for blasting and are loaded with explosive; (*c*) the explosive is fired, breaking down the coal; (*d*) the coal is then loaded in cars by hand or loading machine and hauled out of the mine; (*e*) the working plane must then be cleaned up and the roof timbered so that the operations just described may be repeated. It will be observed that by this system of mining, the only time coal is delivered from the mine is during the period (*d*) when it is being loaded in the cars.

It is accordingly a prime object of my invention to provide a machine which will mine coal with no manual digger or loading and which will

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deliver coal continuously from the beginning to the end of a shift.

Apparatus embodying features of my invention is illustrated in the accompanying drawings, forming a part of this application, in which

Fig. 1 is a plan view of a preferred embodiment of my improved mining machine;

Fig. 2 is a sectional elevation of the same;

Fig. 3 is a sectional view taken along the line III—III of Fig. 1;

Fig. 4 is a detail sectional view showing the means for raising the rear of the frame with respect to the supporting wheels;

Fig. 5 is a detail sectional view of the guide means of Fig. 4, taken substantially along the lines V—V of Fig. 4;

Fig. 6 is a detail sectional view showing the single front supporting wheel and its means of adjustment;

Fig. 7 is a detail sectional view taken along the line VII—VII of Fig. 6;

Fig. 8 is a detail sectional view of one of the sectional shafts upon which the gangs of cutters are mounted and indicating associated parts in dash lines for the sake of clarity;

Fig. 9 is a detail sectional view showing the drive for the cutter chains;

Fig. 10 is a detail sectional view showing one of the jacks employed for adjusting the spacing between the cutter chain housings;

Fig. 11 is a detail plan view showing the mechanism for swinging the gangs of cutters inwardly and outwardly;

Fig. 12 is a longitudinal sectional view taken along the line XII—XII of Fig. 11;

Fig. 13 is a sectional view taken along the line XIII—XIII of Fig. 12;

Fig. 14 is a detail sectional view taken along the line XIV—XIV of Fig. 11;

Fig. 15 is a plan view showing a modified form of my invention;

Fig. 16 is a detail sectional view taken along the line XVI—XVI of Fig. 15 and showing the mounting for the cutter chains;

Fig. 17 is a sectional elevation of the machine shown in Fig. 15;

Fig. 18 is a detail plan view showing the means for loading the coal on to the conveyor as it is broken down;

Fig. 19 is a detail view showing the mechanism for operating the jack screws between the cutter housings;

Fig. 20 is a detail view of one of the guide posts upon which the cutter driving sprocket housings are mounted; and

Fig. 21 is a detail view of a worm shaft mounting for one of the jack screws.

Referring now to the drawings, the main frame of my machine consists of longitudinally extending channel members 5 and 6 to which is welded a main frame plate 7 which extends from the rear to the front of the machine. At 8 and 9 are shown driving wheels, each of which is mounted on a stub axle 10, the axle being carried by a mounting bracket 11 which is vertically slidable in guides 12 secured to the underside of the main frame plate 7, which driving wheels form the principal support for the machine. See Figs. 3, 4 and 5. Mounted on the frame plate 7 is a short section of a channel 13, and secured to the channel 13 and to the channel 5 alongside thereof is a bracket 14 in which is rotatably mounted an adjusting nut 16, through which is threaded an adjusting screw 17. The screw 17 engages the top of the wheel housing 11 and the nut 16 may be rotated by means of the hand wheel 18, whereby the height of the frame, with respect to the driving wheels 8 and 9, may be varied.

The forward portion of the machine is supported by a single wheel 19 which is mounted in a wheel housing 21 which in turn is mounted in guides 22 and 23 secured under the underside of the main frame plate 7. Mounted above the main frame plate 7 is an adjusting bracket 24 in which is rotatably mounted an adjusting nut 26, through which extends a supporting, adjusting screw 27, operated by a hand wheel 28. By the means shown the front of the machine may be raised or lowered relative to the rear of the machine, and the inclination of the machine with respect to the horizontal thus varied.

My improved machine is propelled forwardly or rearwardly, as required, by means of a reversing motor 29, which is mounted centrally at the rear of the machine in an opening 30, formed in the main frame plate 7.

The rear of the frame is reinforced for this purpose by means of cross channels 31 and 32, from which the motor 29 is suspended, and a cross plate 33 mounted on top of the channels 31 and 32. The motor 29 drives through shafts 34 and 36 protruding from its ends, the shafts 34 and 36 carrying elements of clutches 37 and 38 which may be connected selectively to worm shafts 39 and 41, having mounted thereon, respectively, worms 42 and 43. The worms 42 and 43 mesh with worm gears 44 and 46, mounted respectively in housings 47 and 48, on opposite sides of the machine. The worm gears 44 and 46 are connected, respectively, to forwardly extending drive shafts 49 and 51, each of which carries on its forward end a worm 52 which meshes with a worm gear 53. The worm gears 53 are connected to the drive wheels 8 and 9. See Fig. 4. By the means shown, the drive wheels 8 and 9 may be driven in unison or may be driven separately to change the direction of the machine.

The cutting mechanism employed with my improved machine comprises cutter chains 54 having mounted thereon cutters 56. See Fig. 16. This mechanism is so well known in the art to which my invention relates it requires no detailed description. The cutter chains are mounted in pairs in housings 57 having driving sprockets 58 and 59 at the rear and smooth pulleys 61 at the front around which the cutter chains run. See Fig. 9. The sprockets 58 and 59 for each housing 57 are mounted on a short shaft 62 which in turn is journalled in the walls of a supporting housing 63. Mounted in the housing 63 between the sprockets 58 and 59 is a sprocket 64 which is driven by a chain 66.

The upper housing 63, on the inner side thereof, is provided with an integral bracket 65 which is secured to a guide post 60. See Fig. 20. The next lower housings are provided with similar brackets which are slidably mounted on said guide post. The guide post 60 is hollow and has its lower end slidably mounted in a sleeve 75 which is fixedly supported in the frame plate 7. Beneath the frame plate 7 is a similar guide post 70' which is secured to the lowest bracket 65 on the lowest housing 63, and on which the intermediate brackets are slidably mounted. The guide post 60 telescopes in the hollow post 70. The structure described permits vertical movement of the housing 63 but, in association with the main driving shaft, about to be described, holds said housing against angular movement.

It will be noted from a consideration of Fig. 1 that the cutting mechanism just described is mounted in two gangs indicated generally by the numerals 67 and 68, which extend forwardly from the machine, and which may be brought close together to the full line positions shown in Fig. 1 or spread apart to the dotted line positions by mechanism to be described later. The gang of cutters 67 is supported and driven from a main supporting and driving shaft 69, while the gang of cutters 68 is supported and driven from a main supporting and driving shaft 71. Details of the construction and mounting of the shafts 69 and 71 is shown in Fig. 8. Mounted on the shafts 69 and 71 in each of the housings 63 is a driving sprocket 72 which drives the sprocket 64 through the chain 66. See Fig. 9.

Each of the driving and supporting shafts comprises a plurality of internally toothed sleeves 73, 74 and 76, into which fit externally toothed shaft sections 78, 79, 81 and 82. Each of the sections thus described has fixedly mounted thereon one of the housings 63. The central sleeve section 74 is mounted in a suitable bearing 63 in the frame plate 7 and is held against vertical movement therein. The upper end of each of the shafts 69 and 71 is braced by means of a member 84 in which the shaft may rotate and move vertically and which extends downwardly and rearwardly to join the main frame at 86. The lower end of each of the shafts is braced by a member 87 in which the shaft may rotate and move vertically and which extends rearwardly and upwardly to join the main frame at 88. In order to provide additional support and stiffness to the main frame I secure cross channels 89 and 91 thereto where the braces 84 and 87 are joined, as may be seen in Fig. 2. It will also be seen from the construction just described, that the sectional shafts 69 and 71 may be lengthened or shortened by relative movement between the outwardly toothed sections and the sleeve members.

The cutter chain housings 57 are spaced apart and supported with respect to each other by means of jack screws 92, 93 and 95, the latter two being interposed between adjacent housings 63. As shown in Fig. 2, there are three sets of these jack screws above, and three below the frame plate 7. A detail of one of these jack screws is shown in Fig. 10. These jack screws are operated in unison by mechanism about to be described and function to adjust the gangs of cutters to the width of the seam being mined. With a thick seam, the cutter housings are separated

further, while with a narrow seam they are brought closer together. In event a very narrow seam of coal is encountered, the upper section 78 and the lower section 82 of the shaft, either or both, may be removed. This may be accomplished by screwing the associated jack screws 92, 93 and 95 entirely out of their adjacent housings. It will be seen from the foregoing description that the vertical support for the gangs of cutters 67 and 68 is derived from the shaft section 74, the bearing 83, and the frame plate 7. The cutter housings 57 and 63, below the frame plate 7, therefore, are suspended by the jack screws 92, 93 and 95, while those above the frame plate 7 bear downwardly on their associated jack screws.

The gangs of cutters hereinbefore described are driven by means of four motors 97, 98, 99 and 100. These motors are mounted, two above the main frame plate 7, and two below, as may be seen in Fig. 3. Each of the motors 97 and 98 has mounted on its shaft a pinion 101 which meshes with a gear 103, mounted on the driving and supporting shaft 69 or 71 as the case may be. Similarly the motors 99 and 100 are each provided with a pinion 106, only one being shown, which mesh with a gear 107 mounted on the shaft 69 or 71, as the case may be, below the frame plate 7. The cutter chains on the gangs 67 and 68 are driven by their respective motors in opposite directions as shown by the arrows in Fig. 1 so that the cutting by each gang is done by the outside flight as it moves rearwardly.

All the jack screws 92, 93 and 95 above the frame plate 7, may be driven in unison from a motor 108 mounted centrally of the machine above the frame plate 7. Similarly, all of the jack screws 92, 93 and 95, below the frame plate 7 may be driven in unison by means of a motor 110, mounted beneath the frame plate 7. Inasmuch as the driving means for all the sets of jack screws are identical, only one will be described, having particular reference to Fig. 19. Each of the motors 108 and 110, as may be seen from Fig. 1, has a shaft on both ends, each of which drives three sprockets 109, 111 and 112. Each of the sprockets 109, 111 and 112 is connected by means of a chain 113 to a sprocket 114 mounted on a shaft 115. As may be seen in Fig. 19, the shaft 115 has mounted thereon a pinion 121 which meshes with a gear 122 mounted on a shaft 123, which is supported in turn, from the jack screws 93 and 95. Mounted on the shaft 123 are worms 124 and 126 which mesh respectively with worm gears 127 and 128 mounted respectively on the jack screws 93 and 95.

The shaft 123 also has mounted thereon a sprocket 129 which drives a shaft 131 mounted near the outer end of the housing 57, through a chain 132 and sprocket 133 mounted on said shaft 131. The shaft 131 has mounted thereon a worm 134 which meshes with a worm gear 136, carried by the jack screw 92. The worm shaft 131, as may be seen in Fig. 21, is held against turning about the jack screws by a guide post 116 mounted above on the housing 57 which telescopes into a sleeve 117 on the housing below, and which coacts with the gear housing 118 for the worm gear 136. Interposed between the sprocket 129 and the sprocket 133 are guide rollers 137 and 138 which are suitably mounted on the housing 57 so that the housing 57 may swing outwardly relative to the housing 63, as shown in Fig. 1, without dislocating the chain 132 with respect to the sprocket 129. The construction and manner of

drive of each set of jack screws 92, 93 and 95 is similar to that just described and its description will not be repeated. It will be understood, however, that as the housings 57 and 63 are raised or lowered, compensation for the varying distances between the motors 108 and 110 and their associated driven sprockets must be made. This may be accomplished by shortening or lengthening the chains 113, 116 and 118 or by any other suitable means known to the art.

The mechanism for varying the positions of the gangs of cutters 67 and 68 relative to each other will now be described. Referring particularly to Figs. 1 and 11 to 13, the gang of cutters 67, above the frame plate 7, has connected thereto an operating link 152 and beneath the frame plate 7 has connected thereto an operating link 153. The links 152 and 153 are connected to rearwardly extending links 154 and 157 by means of a pin 156. The links 154 and 157 are connected at their rear ends to a cross head 159 mounted in a guide slot 161 in the frame plate 7. A pin 162 extends downwardly through the cross head 159 and joins both the links 154 and 157 thereto. Similarly the gang of cutters 68 has connected thereto operating links 163 and 164 by means of a pin 65 which links, in turn, are connected to links 166 and 167 by means of a pin 170. The links 166 and 167 are connected by means of a pin 168 to the cross head 159. A guide way 161 is formed in, and extends along the frame plate 7, as shown in Fig. 11, the length of the links 154 and 157. It then divides to form flaring guideways 169 and 171. These flaring guideways 169 and 171 accommodate the pins 156 and 170, respectively, which connect the upper and lower links 152 and 153 and 163 and 164, respectively. The cross head 159 is projected forwardly and retracted rearwardly by means of a jack screw 176 in threaded engagement therewith, which jack screw is mounted in bearings 177 and 178, on the plate 7, and is provided with a hand wheel 179 by means of which it is operated. As will be seen in Fig. 11, the frame plate 7 is cut out at 181 and 182 to provide room for the jack screw 176 and wheel 179. It will be seen from Fig. 1 that when the operating links 152 and 153 are retracted to the full line positions shown, the gangs of cutters 67 and 68 are drawn toward each other so that a cut of minimum width is made. When the cross head 159 is moved forwardly so that the operating links 152 and 163 assume the dotted positions shown in Fig. 1, the gangs of cutters 67 and 68 are spread apart to their widest working positions. It is contemplated that when the gangs of cutters are in the dotted positions shown in Fig. 1, the machine will be propelled rearwardly and the pillars and sides of a course already driven, broken down. It will thus be seen that by means of my improved machine a mining operation may be carried on with a minimum, or no timbering, as the timbering required will be that necessary to support the roof of a course at the rear of a machine. This timbering will be removed as the machine moves rearwardly upon a reverse operation. A course is driven while the machine is being propelled forwardly and the pillars at the side removed as the machine is being propelled rearwardly. It will be understood that it may sometimes be necessary to omit the mining of pillars where required to support structures, streams, or highways on the ground above. This can readily be done by means of my machine by bringing the gangs of cutters to the full line positions shown in Fig. 1 and by then moving rearwardly to a

point where the removing of pillars is to commence again, when the gangs of cutters 67 and 68 are again separated.

In order that the material may be removed from the machine as it is broken down, I provide conveying mechanism which will now be described. Mounted centrally beneath the machine and supported from the frame thereof in any suitable manner, not shown, is a conveyor 185 comprising a conveyor belt 186, mounted on pulleys 187, only one being shown. The forward end of the conveyor 185 is just to the rear of the driving and supporting shafts 69 and 71 and in order to remove the material broken down into its path, I provide transversely extending screw conveyors 188 and 189 driven from a motor 190 mounted on the frame plate 7, and driving the screw conveyors 188 and 189, respectively, through sprockets 191 and 192, from sprocket chains 193. The flights of the conveyors 188 and 189 are oppositely pitched so that coal is brought in from the sides toward the center, into the path of the conveyor 185. It is contemplated that the conveyor 185 will be in sections so that it may be lengthened and shortened as shown and described in my prior Patent No. 2,320,653, dated June 1, 1943.

Referring now to Figs. 15, 17 and 18, I show a modified form of my invention which, while including the principal features heretofore described, is somewhat simplified and differs principally in the manner of drive. In accordance with this modification, I show gangs of cutters 200 and 201 which are similar to the gangs 67 and 68, already described, and which may be brought to the full line positions shown in Fig. 15, or spread apart to the dotted positions shown therein, by means of operating links 202 and 203; which links operate in a manner identical to the links 152 and 163, heretofore described and shown in Fig. 1. In this modification I show no means for separating the separate cutter chain housings but these details have not been repeated for the reason that the distinctive features of this modification may be better understood and illustrated without them. In accordance with this modification the gangs of cutters 200 and 201 are driven by means of two motors 205 and 210 mounted respectively above and below the frame plate 7. The motor 205 has on its shaft, which protrudes from both ends thereof, worms 204 and 206 which mesh, respectively, with worm gears 207 and 208, mounted on gang supporting and driving shafts 209 and 211. Likewise, the motor 210 drives worms 212, only one being shown, which mesh with worm gears 213, mounted on the supporting and drive shafts 209 and 211, beneath the frame plate 7.

In accordance with this modification I provide a different means for raising the material being broken down by the gangs of cutters into the conveyor 185. This means for raising the material comprises a scoop 215 which is suspended by means of links 216 from the frame plate 7. The bottom 217 of the scoop is formed with a series of inclined planes and vertical faces as shown in Fig. 17 so that when it is reciprocated, it propells the material in it upwardly and delivers it into the conveyor 185. Mounted in suitable bearings at the sides and in front of the scoop 215 are shafts 218 and 219 upon which are mounted propellers 221. The shafts 218 and 219 are driven by means of sprocket chains 222, mounted on sprockets 223, on the supporting and drive shafts 209 and 211, and sprockets 224 on the shafts 218

and 219. It will be seen that as the material is drawn rearwardly by the gangs of cutters 200 and 201, it is thrown by rotation of the propellers 221 into the scoop 215.

Also mounted on each of the shafts 218 and 219, is a cam 226 which, as the shaft rotates, engages the supporting link 216 and causes the scoop to reciprocate back and forth. A spring 227 pulls the scoop 215 quickly forward when released by the cam 226.

From the foregoing description the operation of my improved mining machine will be readily understood. The gangs of cutters 67 and 68 or 200 and 201, as the case may be, are driven in the directions shown by the arrows so that the outer flight of each gang of cutters moves rearwardly. When the machine is being propelled forwardly, the gangs of cutters are brought to the positions shown in Fig. 1 and Fig. 15, that is, as close together as possible, so that they assume a somewhat wedge shape, narrow at front, and the flights act to break down the coal along the outer sides the full length of both gangs and across the front at the ends. When the course has been driven the desired length, the cutter gangs are spread outwardly to the dotted positions shown in Fig. 1 and Fig. 15, whereupon the pillars at the sides of the course are removed. The machine when being propelled rearwardly, is supported from cave in by the pillars at the sides thereof and, as the coal is removed, the earth may be allowed to cave in behind the cutters as they recede, except where necessary for support of the ground above. As the coal is broken down, it is picked up and removed by the conveyors shown. In accordance with the modification shown in Fig. 1, the depth occupied by the gangs of cutters 67 and 68 or the distances between the cutter housings may be varied by means of the jack screws and mechanism for driving them shown therein and the machine thus accommodated to seams of different thicknesses and friability; the greater the friability, the greater the distance between cutter housings. With very thin seams, one or two of the cutter housings may be removed.

From the foregoing it will be apparent that I have devised an improved self propelled reversible mining machine which is adapted to drive headings and air courses in mines while moving forwardly and which shall be adapted on reverse movement to remove the pillars alongside thereof. It will further be seen that I have devised simple effective means for operating gangs of cutter bars whereby said improved result may be obtained.

While I have shown my invention in but two forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In a mining machine, a main frame, a pair of vertically disposed driving shafts mounted side by side at the front of the frame, a gang of cutters embodying a plurality of cutter chain housings mounted on each of the shafts and extending forwardly therefrom, cutter chains mounted in the housings and having cutter elements extending outwardly therefrom, means to drive the cutter chains from the drive shafts in opposite directions with the cutter elements on the outer flights moving rearwardly toward the machine.

spreader arms adjustably mounted on the frame between the gangs of cutters and pivotally connected to the gangs of cutters to vary the distance between the outer ends of said gangs, a pair of driving wheels mounted on opposite sides of the frame, reversible means for driving the wheels, and means to raise and lower each of the driving wheels separately with respect to the frame.

2. In a mining machine, a main frame, a pair of vertically disposed driving shafts mounted side by side at the front of the frame, a gang of cutters embodying a plurality of cutter chain housings mounted on each of the shafts and extending forwardly therefrom, cutter chains mounted in the housings and having cutter elements extending outwardly therefrom, means to drive the cutter chains from the drive shafts in opposite directions with the cutter elements on the outer flights of each chain moving rearwardly toward the machine, spreader arms pivotally connected to the gangs of cutters, a cross head to which the inner ends of the spreader arms are pivotally connected, guide means for the crosshead carried by the frame, a jack screw mounted on the frame and connected to the cross head and adapted to adjust the position of the crosshead, and reversible means for driving the machine forwardly and rearwardly.

3. Apparatus as defined in claim 2 in combination with means for varying the distance between the cutter housings whereby to vary the vertical distance occupied by the gangs of cutter housings.

4. In a mining machine, a main frame including longitudinal beams and a plate spanning the beams, a main guide way formed in the plate and extending longitudinally thereof, flaring branch guide ways connected to the forward end of the main guide way and extending laterally at an

angle thereto, a pair of cutter gangs pivotally mounted on the frame and extending forwardly therefrom on opposite sides of the guideway, and reciprocable links connected to the cutter gangs and adapted to travel in the guideways for varying the angular positions of the cutter gangs.

5. In a mining machine, a main frame including longitudinal beams and a plate spanning the beams, a main guideway formed in the plate and extending longitudinally thereof, flaring branch guideways connected to the forward end of the main guideway and extending laterally at an angle thereto, a pair of cutter gangs pivotally mounted on the frame and extending forwardly therefrom on opposite sides of the guideway, reciprocable links connected to the cutter gangs and adapted to travel in the guideways for varying the angular positions of the cutter gangs, a pair of driving wheels mounted on opposite sides of the frame, reversible means for driving the driving wheels, and means to raise and lower the driving wheels with respect to the frame.

6. In a mining machine, a main frame, gangs of cutters pivotally mounted on the main frame to project forwardly side by side from the main frame and each comprising a plurality of housings having cutter chains mounted therein, jack screws for separating the cutter chain housings, said jack screws being disposed between the housings, means to operate the jack screws in unison to vary the distances between the housings, an extensible drive shaft for each of the gangs of cutters, means to drive the drive shafts in opposite directions whereby the outer flights of the cutter chains move rearwardly toward the machine, and means to swing the gangs of cutters around their pivots to vary the relative distances between the outer ends thereof.

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