June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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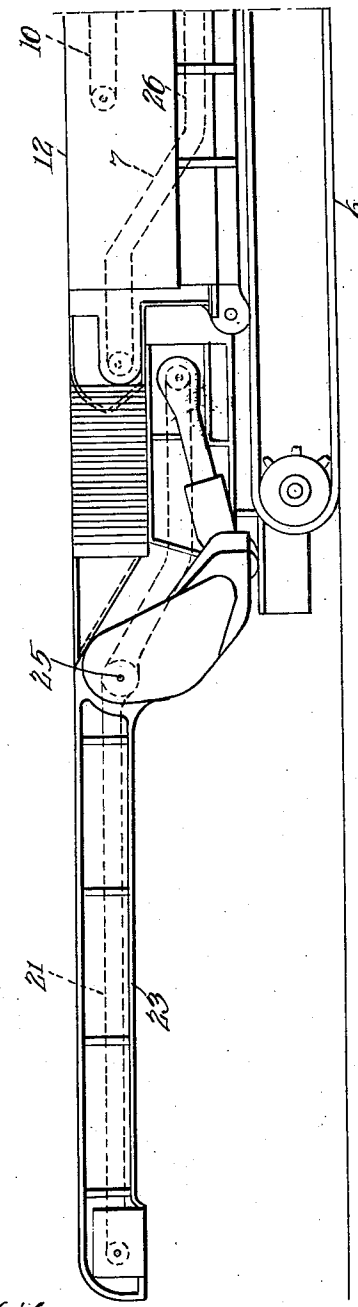


Fig. 1.

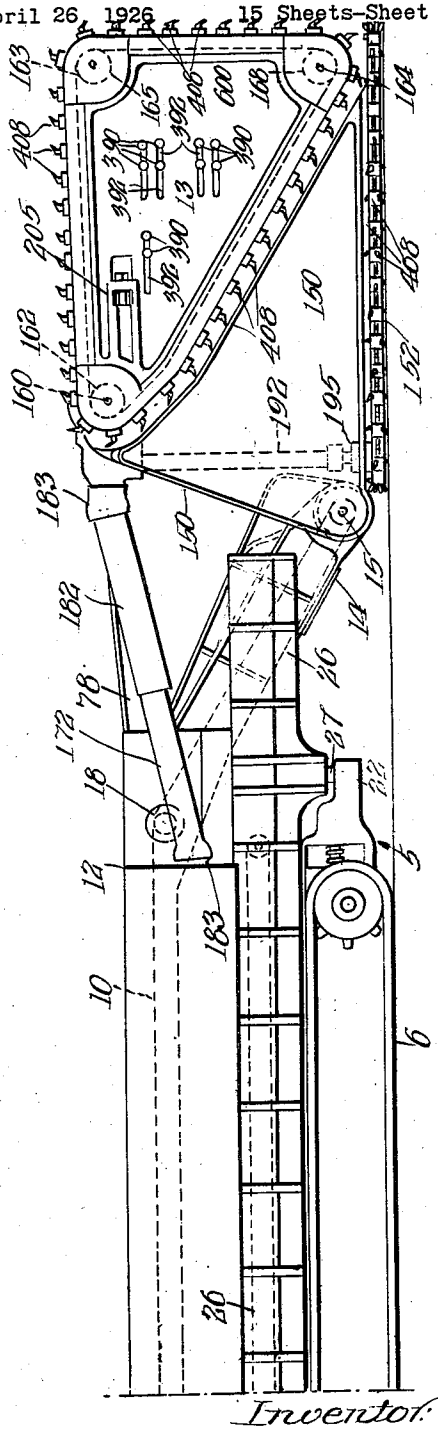


Fig. 1a.

Witnesses:
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MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 2

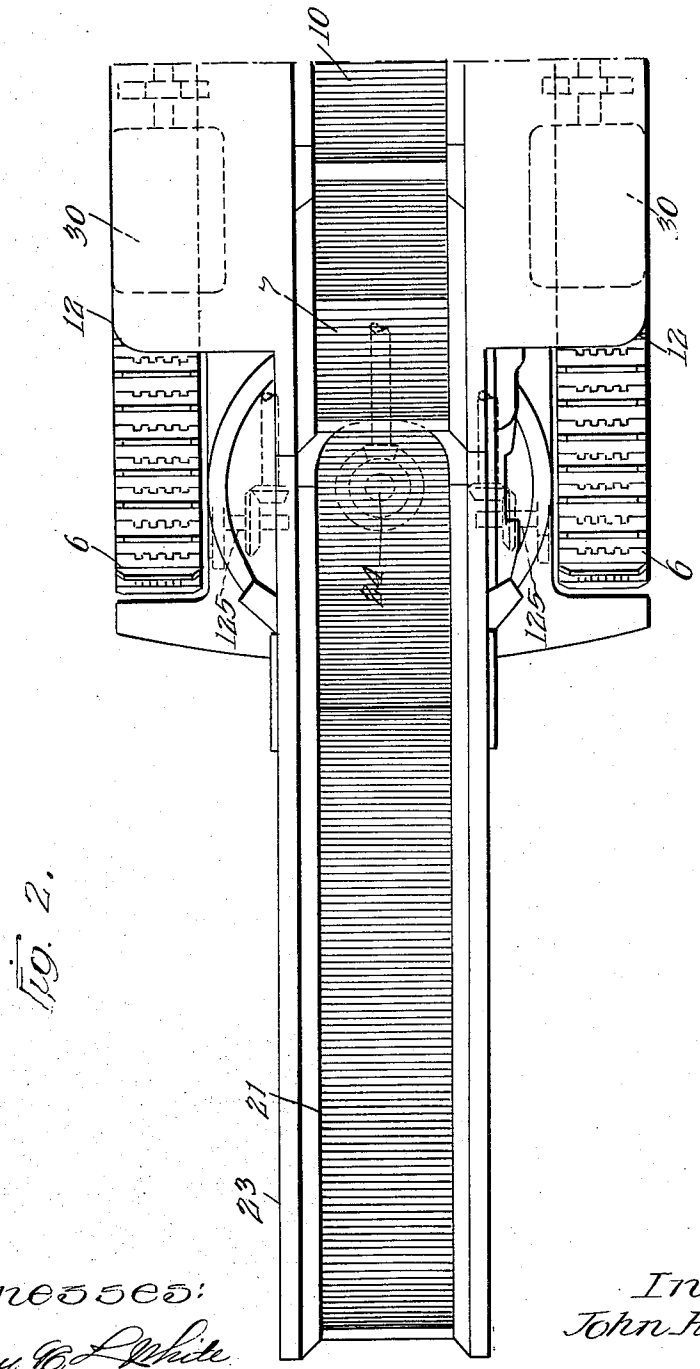


Fig. 2.

Witnesses:
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MINING MACHINE

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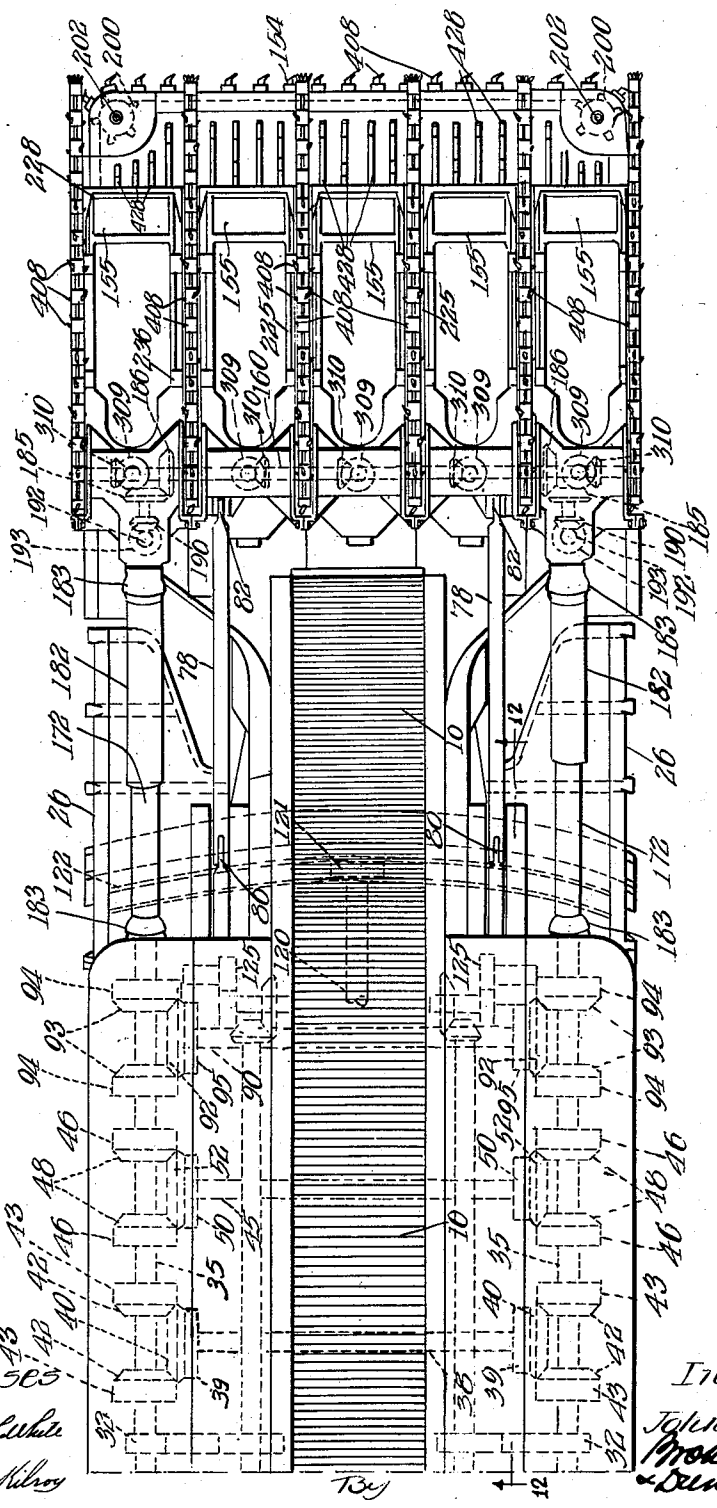


Fig. 2a.

Witnesses
Harry P. Lehrle
William D. Kilroy

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MINING MACHINE

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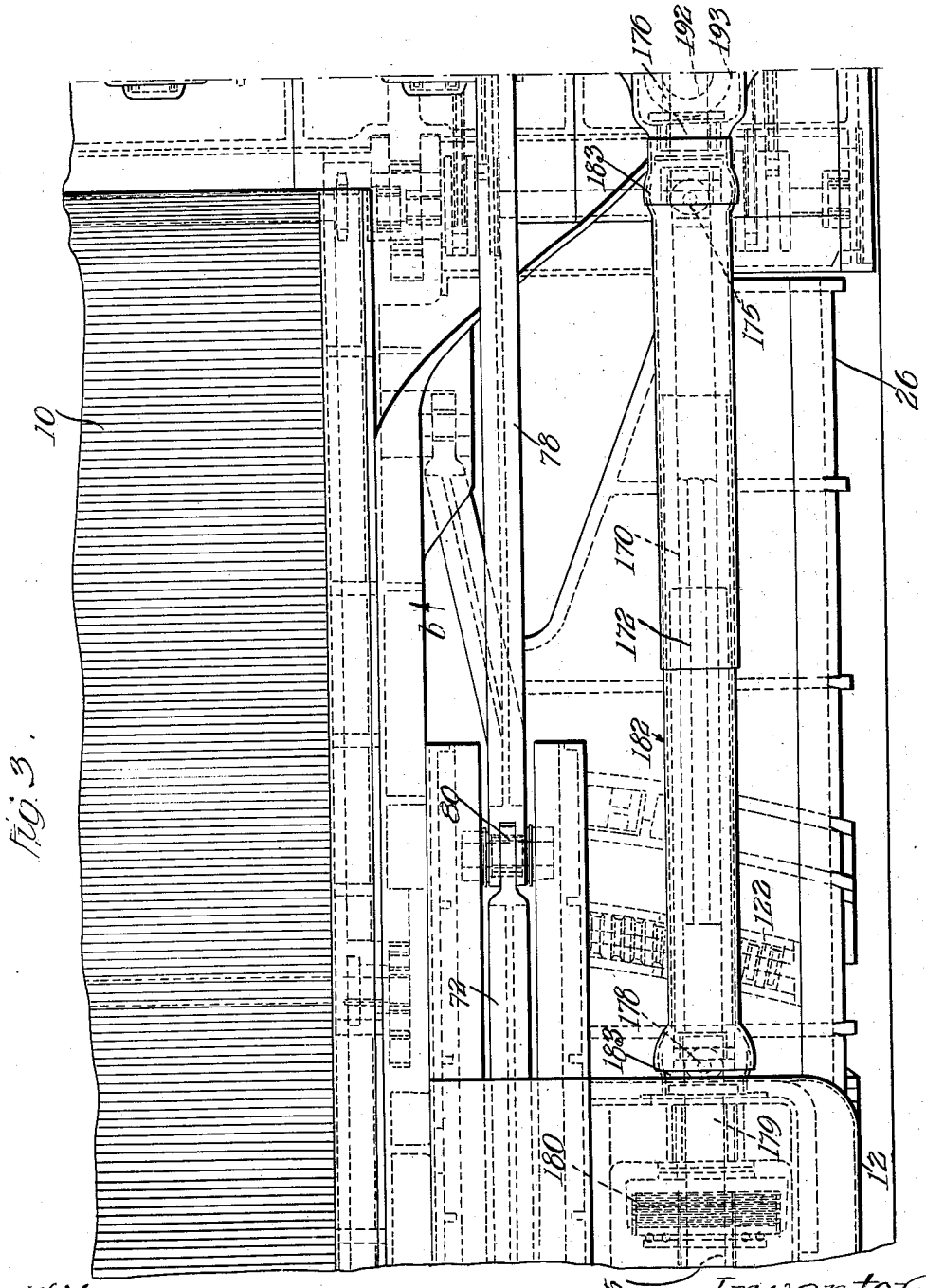


Fig. 3.

Witnesses:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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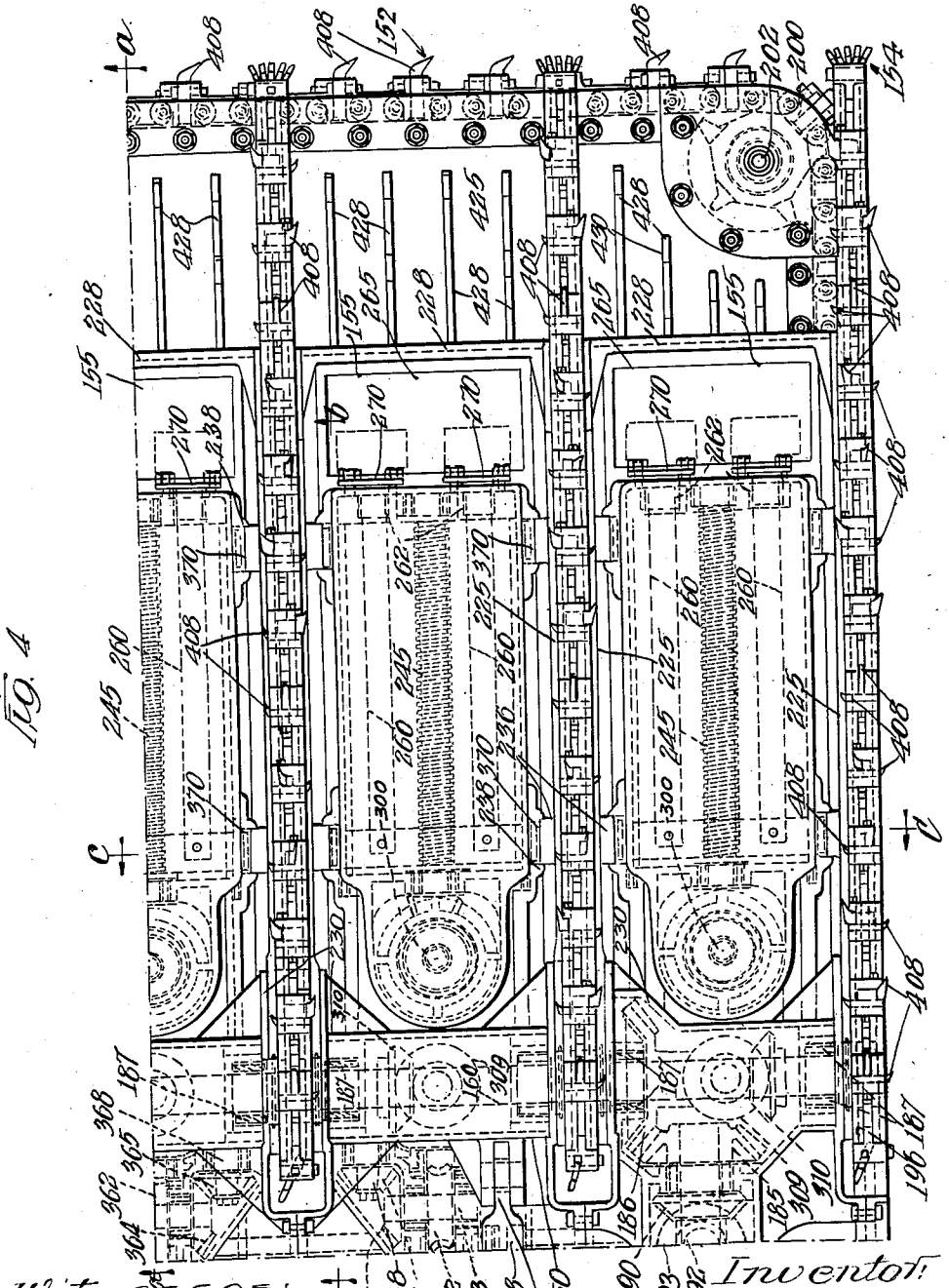


Fig. 4

Witnesses:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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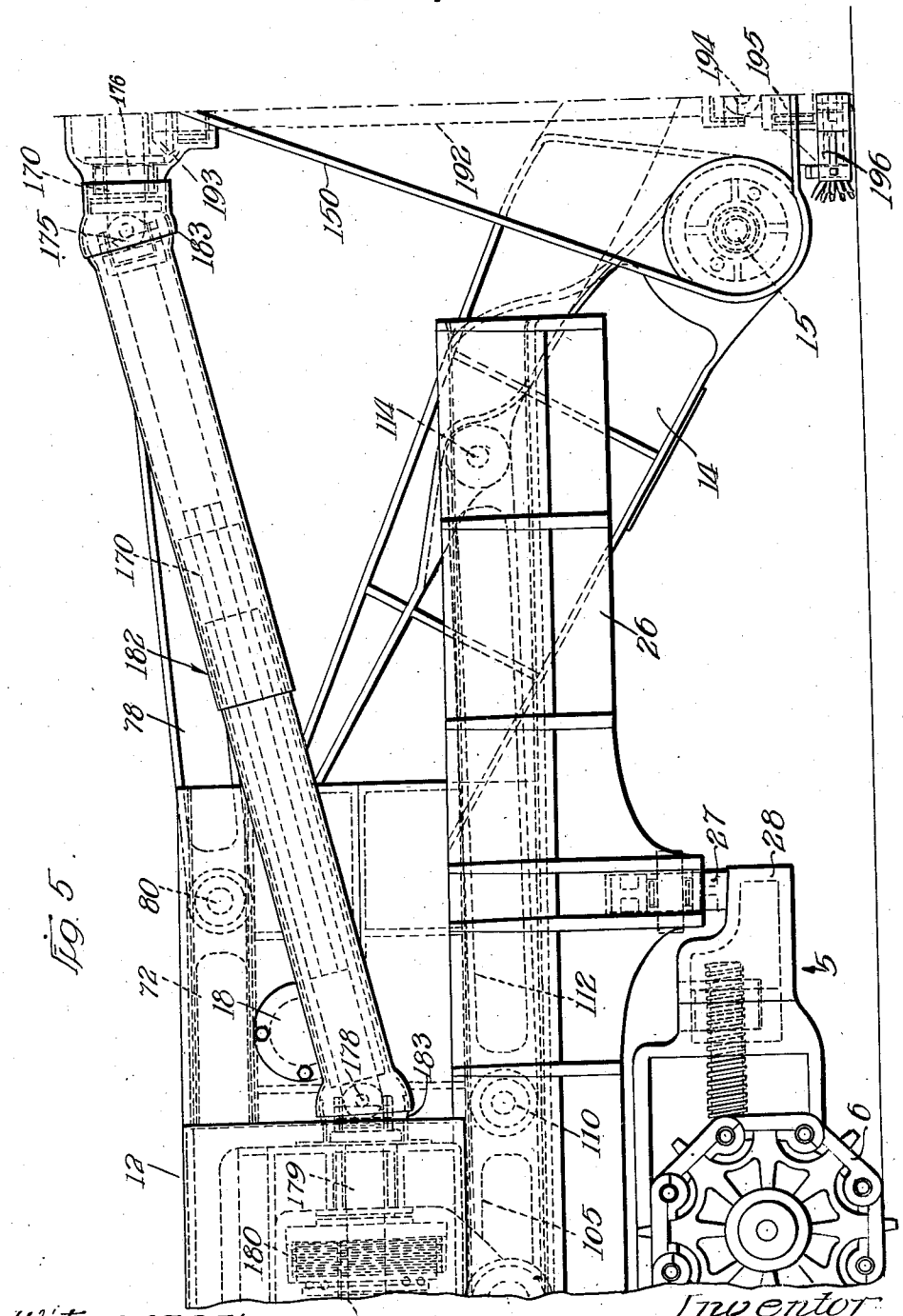


Fig. 5.

Witnesses:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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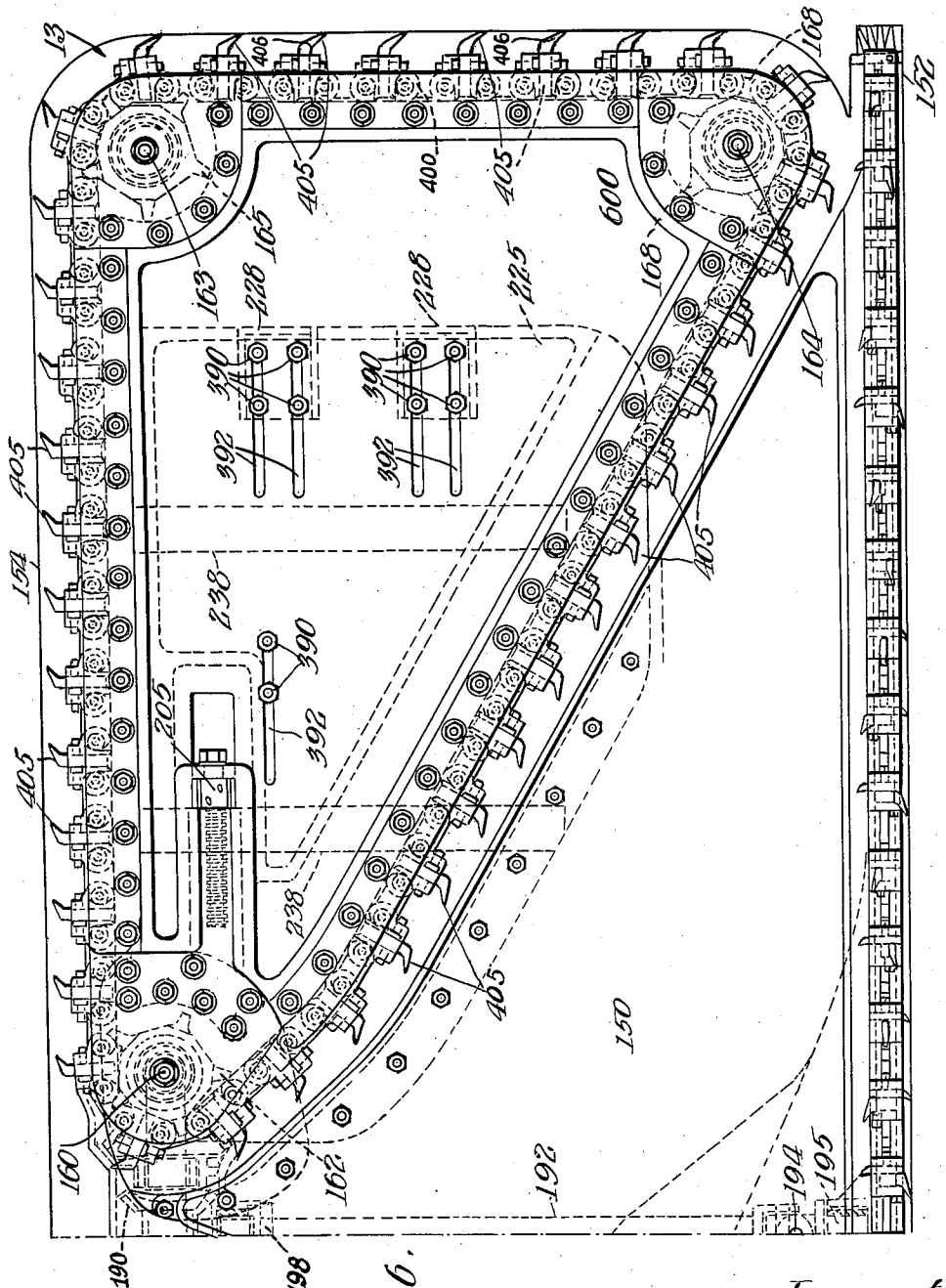


Fig 6.

Witnesses:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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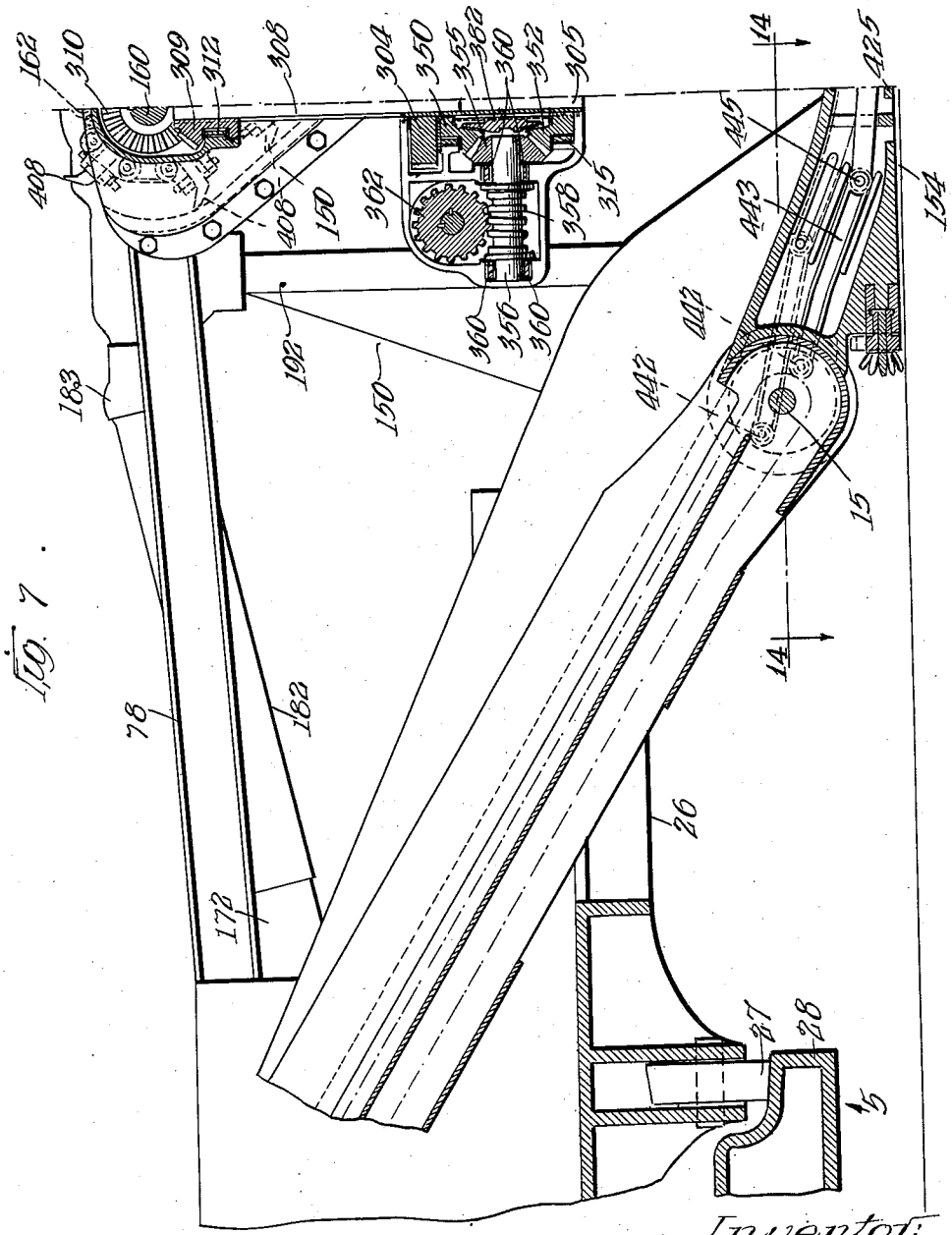


Fig. 7.

Witnesses:
Harry E. White
William P. Kilroy

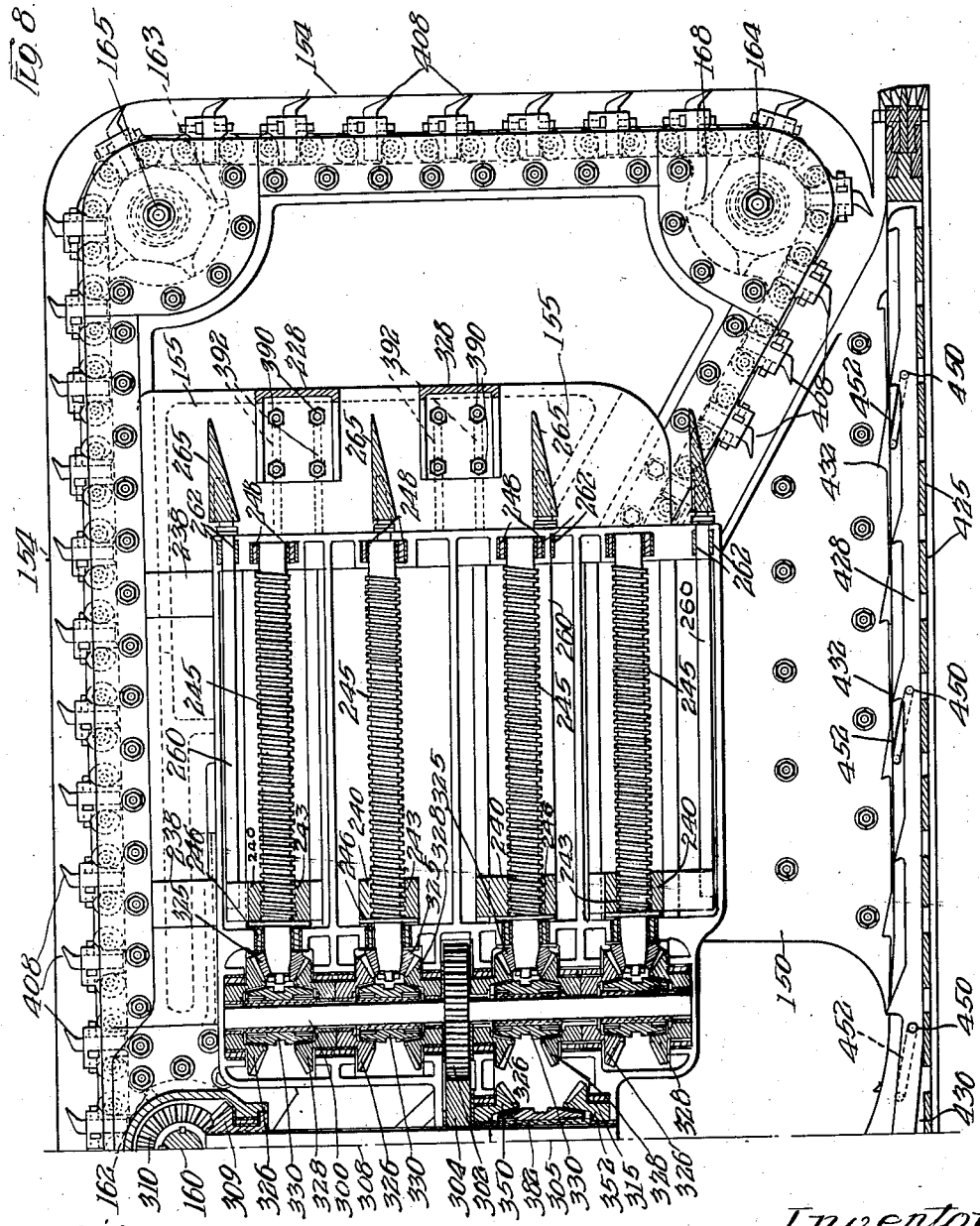
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 9

FIG 8



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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 10

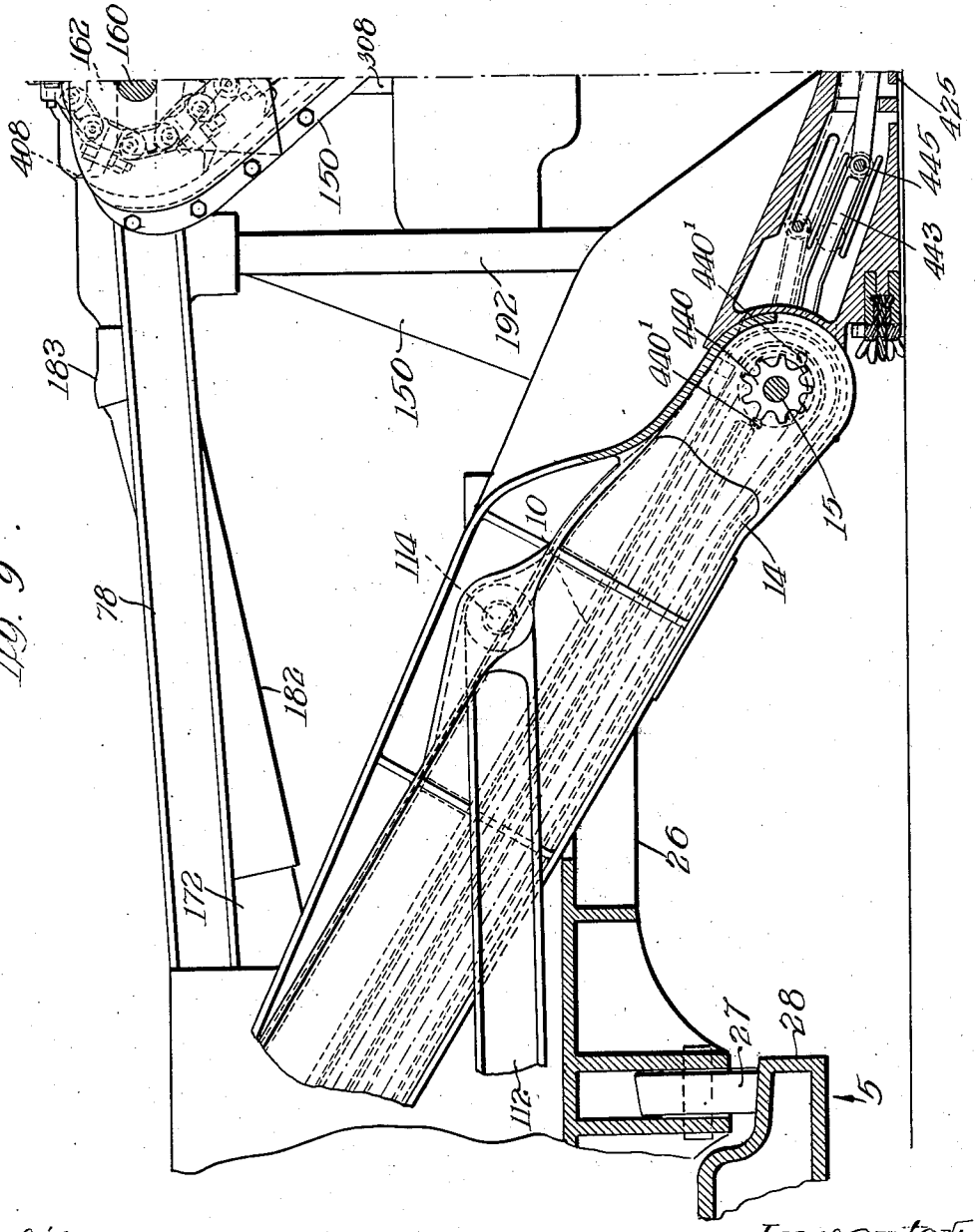


Fig. 9.

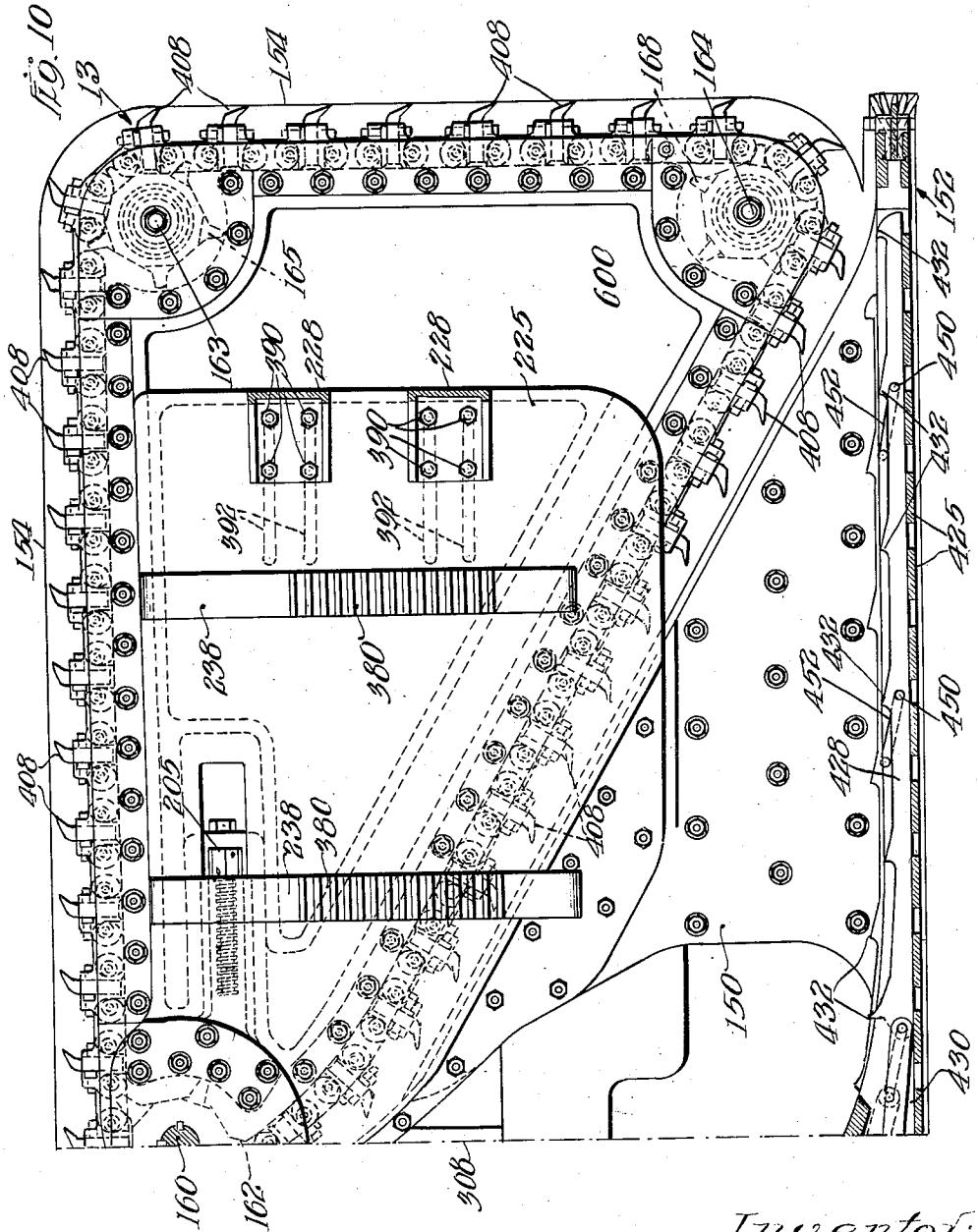
Witnesses:
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MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 11



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William P. Kilroy

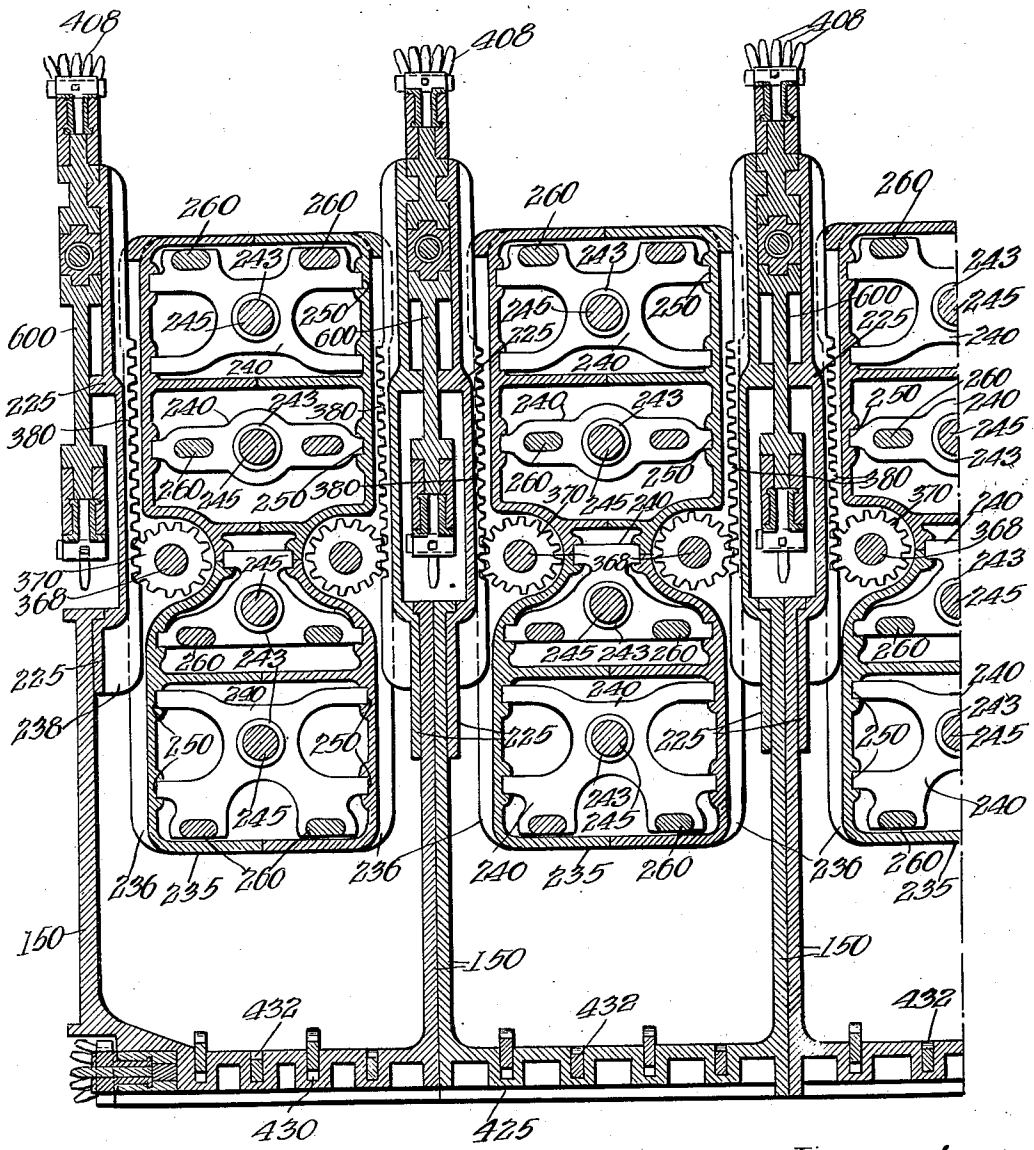
Inventor:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 12

FIG. 11.



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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

Filed April 26, 1926 15 Sheets-Sheet 13

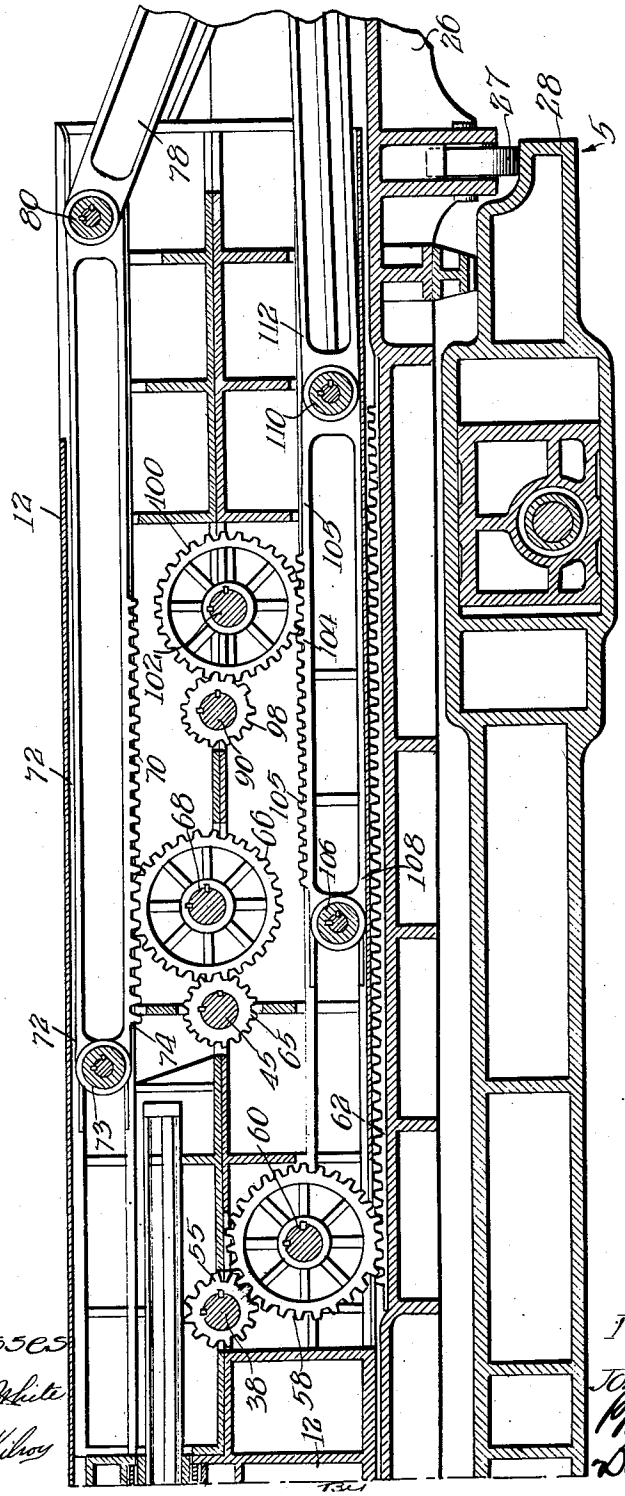


Fig. 12.

Witnesses
Harry E. White
William P. Kilroy

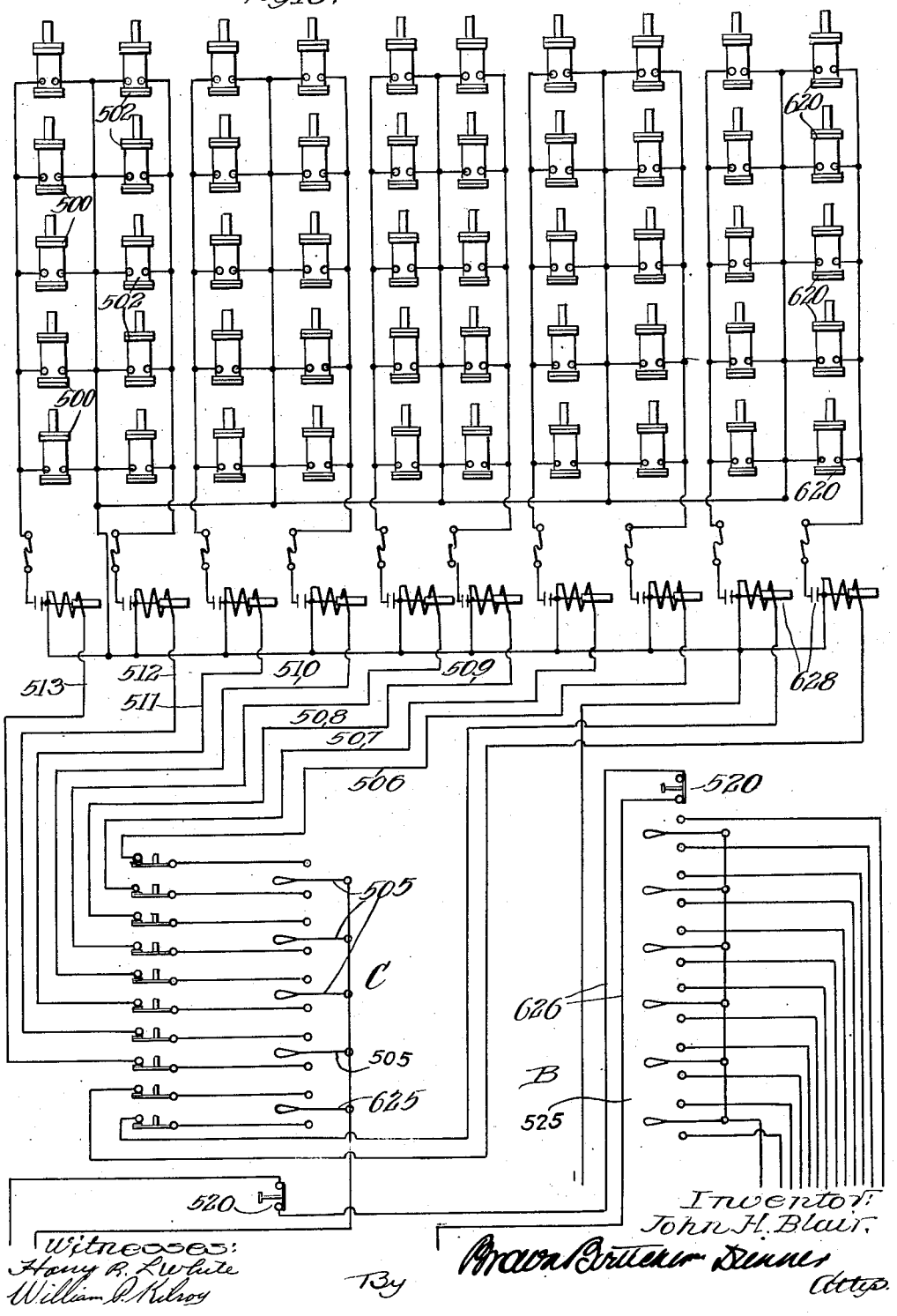
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MINING MACHINE

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Fig 13.



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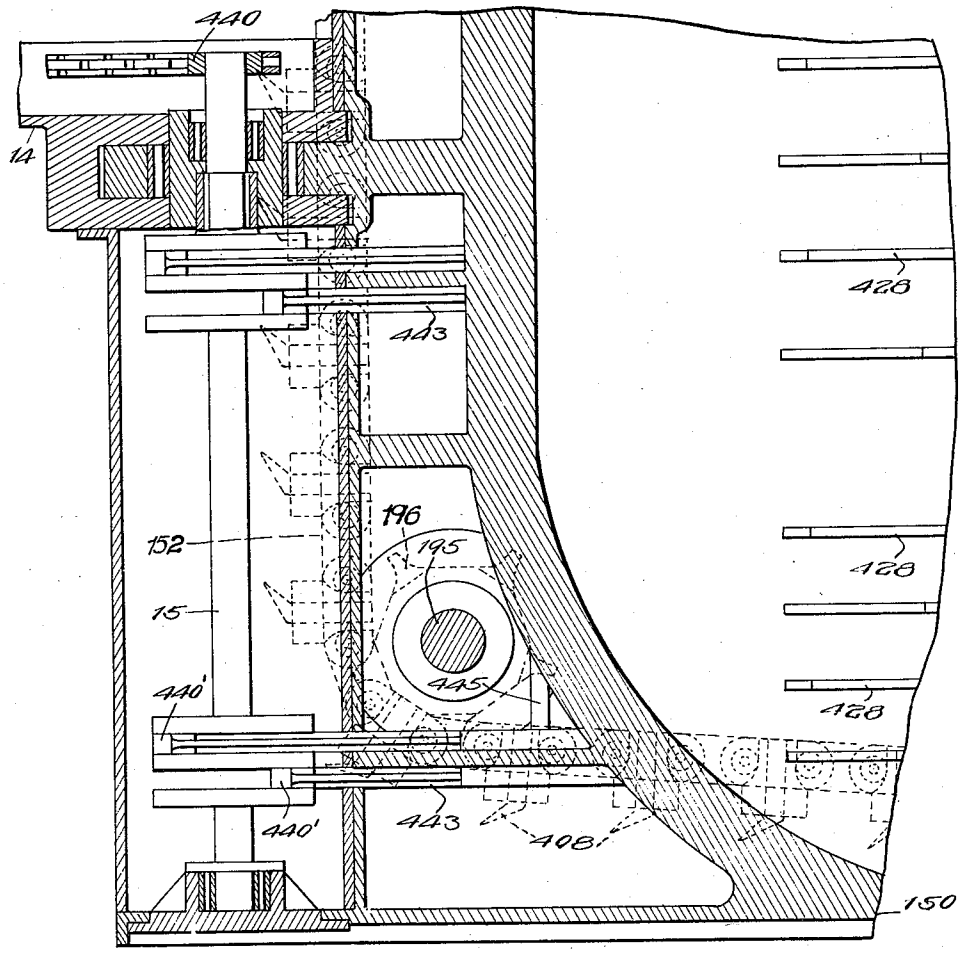
Inventor:
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June 10, 1930. J. H. BLAIR 1,762,154

MINING MACHINE

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Fig. 14



Witness:
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Patented June 10, 1930 1,762,154

UNITED STATES PATENT OFFICE

JOHN H. BLAIR, OF CHICAGO, ILLINOIS

MINING MACHINE

Application filed April 26, 1926. Serial No. 104,528.

This invention relates to mining machines, more particularly to machines for mining coal, although it is to be understood that the machine of my present invention may be used for mining gypsum, shale or any other material for the mining of which it is found suitable or adaptable.

I am aware that various mining machines have been provided and that various attempts have been made to increase the tonnage and capacity of the material handled and to decrease the cost of mining operations.

The proposals heretofore made have been costly and of limited capacity and they have not been generally practicable nor have they come into general use.

I have observed that the advantageous working positions of the machines of this sort heretofore employed are limited. The breakers or rams operate in most of their working positions against the butts of the coal or other material and at an angle to the seams or cleavage planes in the material. The slabs of material have been cut relatively wide, usually about four feet, and this, coupled with the angular operation of the breakers in most of their working positions, has resulted in chewing or cutting the material up too fine. Wide chunks frequently break and drop down, especially where the breakers are working in their horizontal position, which might otherwise be considered its most advantageous position, and these frequently clog up the entire machine and make it necessary to get in and break up the clogging material by hand. This all still further limits the capacity and tonnage which is not good to start with because of the manner of breaking and cutting employed.

On the whole, the proposals which have been made for cutting the kerfs closer together and thereby the material into smaller pieces, have been of limited capacity or tonnage and have usually required withdrawing or backing out of the cutter before the breakers could be brought into operation. The separate cutting and breaking operations objectionably decrease the speed of working and, as before, the breaking has again, at least in most of the working positions of the machine, been against the butts of the material and at an angle to the seams or cleavage planes with the same disadvantages as before. Cutting the slabs thinner vertically without decreasing their width, results in wide pieces dropping down and clogging the entire machine or requiring manual breaking up before they could be removed, and proposals in which breakers follow the cutters to operate upon the material after it is cut, are slow and limited in capacity, and the material is usually broken up finer than desired.

It is the object of my invention to provide an improved mining machine and method that will better serve the purposes for which intended, and particularly having greater capacity and tonnage, also not subject to clogging or the necessity of getting in and breaking up large slabs by hand and which will cut and break the material at convenient distances and in a manner to make lump coal, for example, of a suitable size.

According to my present invention, I provide a cutter and breaker or mining head, particularly adapted for use and operation at the front end of the loading machine disclosed in my U. S. Patent No. 1,749,968, issued March 11, 1930. The mining head of the present invention is particularly adapted to be substituted for the shovel or scoop of the above referred to Letters Patent and the push and pull mechanism of that Letters Patent with the breakers herein provided, are adapted for setting the breakers to operate with the seams or lines of cleavage in all of their working positions. The cutting and breaking head is operable selectively in all of its working positions and in restricted places without requiring definite cycles or orbital movements. The cutters preferably operate at convenient distances to make lump coal of the desired size, and the breakers operate without chewing up the material and without withdrawing the cutters before the breaking operation.

I provide for advancing the entire machine ahead slowly and for breaking the material as the machine advances and simultaneously with the cutting operation. The speed of the

entire mining operation and the capacity and tonnage of the machine is greatly increased, a particular commercial application of the machine now contemplated and of an entirely practicable and reasonable size being now estimated to have a tonnage of from 800 to 1000 tons a day. The possibility of wide chunks dropping and clogging up the machine is eliminated, as is the necessity of separating the cutting and breaking operations, as well as chewing or cutting up the material finer than desired.

It is to be understood that the present invention, while having particular utility in mining coal, is not to be limited to mining coal or the other materials above referred to, but may be used for mining any material not too hard for the cutters or breakers employed. It is to be also understood that while the push and pull mechanism at the front end of the machine of my Letters Patent above referred to has particular utility with the present invention, that this invention is not limited to use with the other details of that machine. For example, the swingable and extensible intermediate frame of the loading machine may be omitted and the other details may be varied as desired.

To acquaint those skilled in the art with the manner of constructing and practicing the present invention, I shall now describe the same in connection with a particular cutting and breaking mechanism embodying the invention.

In the drawings,

Figs. 1 and 1A are parts of a more or less diagrammatic side elevational view of a machine embodying the present invention (Figs. 1 and 1A are to be laid beside each other with Fig. 1 to the left and Fig. 1A to the right);

Figs. 2 and 2A are parts of a more or less diagrammatic plan view of the same (Figs. 2 and 2A are to be laid beside each other with Fig. 2 to the left and Fig. 2A to the right).

Figs. 3 and 4 are parts of an enlarged plan view of one side of the cutter and breaker head or member, showing the supporting, operating connections between the forward end of the machine and the side of the cutter and breaker head shown (Figs. 3 and 4 are to be laid beside each other with Fig. 3 to the left and Fig. 4 to the right);

Figs. 5 and 6 are parts of an enlarged side elevational view of the cutter and breaker head showing fragmentarily the adjacent end of the machine and the supporting, operating and drive connections between it and the head (Figs. 5 and 6 are to be laid beside each other with Fig. 5 to the left and Fig. 6 to the right);

Figs. 7 and 8 are parts of a vertical, longitudinal section taken on the line *a*—*a* of Figs. 3 and 4 (Figs. 7 and 8 are to be laid beside each other with Fig. 7 to the left and Fig. 8 to the right);

Figs. 9 and 10 are parts of a vertical section taken substantially on the line *b*—*b* of Figs. 3 and 4 with the adjacent tier of breakers removed to show the racks for the breaker carriage (Figs. 9 and 10 are to be laid beside each other with Fig. 9 to the left and Fig. 10 to the right);

Fig. 11 is a fragmentary, vertical, transverse section through the cutter and breaker head taken substantially on the line *c*—*c* of Fig. 4;

Fig. 12 is a fragmentary longitudinal vertical section through the machine on an enlarged scale and showing the means for racking the extensible frame and for driving or racking the upper and lower push and pull arms on one side of the machine;

Fig. 13 is a diagram of the electric circuit for operating the cutter and breaker head, and Fig. 14 is a fragmentary horizontal section taken on the line 14—14 of Fig. 7 and looking down.

Referring first to Figs. 1 and 2 of the drawings, the machine with which I have elected to show my present invention is the type more fully disclosed in my U. S. Patent No. 1,749,968, dated March 11, 1930.

It comprises in general the main body or base frame 5 mounted upon caterpillar treads 6, 6 for travelling over the ground and for moving the entire machine to the desired position, maneuvering it as desired and advancing the entire machine and the cutter and breaker head at the forward end thereof slowly toward and into the material being mined.

The particular tread arrangement and the frame arrangement and other details of the main machine, per se, may be varied as desired. I particularly contemplate at present eliminating, for mining purposes, the extensible frame, to be hereinafter referred to. In the particular machine shown, however, which is merely for the purpose of imparting a clear understanding of my invention in connection therewith, the main conveyor section 7 lies along the central part of the main frame or truck 5 and this main conveyor has a drop front and a raised rear, as shown in dot and dash lines in Fig. 1. The drop front of the conveyor 7 receives the coal or other material from the front conveyor section 10 which is mounted upon an extensible frame 12. The forward end of the frame 12 bears the cutter and breaker head or member designated generally at 13, and this cutter and breaker head 13 is suitably articulated at the front end of the swingable front conveyor arm to operate in an improved and highly effective manner upon the material in all of its working positions, as will be hereinafter pointed out.

The forward end of the front conveyor section 10 is adapted to be swung up and down

with the articulated arm 14 and cutter and breaker head 13 to permit cutting and breaking and operation of the cutter and breaker head as a whole in different vertical positions. The cutter and breaker head 13 may be swung selectively about its articulated or pivotal mounting 15 at the front or outer end of the arm 14. It may be swung to or fro through any range of movement about the pivot 15 without the necessity of a complete cycle or definite fixed orbital movement of the member 13 about its pivot. This permits cutting and breaking in restricted places and up close to corners and overhead roofs, such as are usually present in coal mine passages, without the necessity of requiring a fixed sweep or movement in spite of obstructions or the lack of any necessity for the entire movement and without the necessity of always allowing sufficient clearance for a complete cycle or movement.

The front conveyor carrying arm 14 is in turn pivoted or articulated at 18 on the front end of the extension frame 12 and is adapted to be swung selectively about the pivot 18 up and down in vertical directions. The arm 14 is adapted to be swung selectively up and down to position the member 13 at any desired height or level, but like the cutter and breaker head 13 there is no definite cycle of movement required of the arm 14 in any of the working positions of the head 13 and it need never be swung from the working position of the cutter and breaker head upwardly or to any other position to receive the coal or other material from the head 13. The cutter and breaker head 13 delivers the material to the conveyor 10 in any and all of its working positions without moving the arm 14 or the front conveyor 10.

In the particular embodiment shown, the frame 12 is extensible and retractable longitudinally of the machine for the purpose of moving the cutter and breaker head 13 in or out without moving the entire machine, it being understood, as already pointed out, that I propose in practice to dispense with this extensible and retractable feature and that, in operation, the cutter and breaker head will be preferably advanced into the material by a slow movement of the entire machine by means of the caterpillar treads 6, 6.

The raised rear of the main conveyor 7 overlies the drop front of a delivery conveyor section 21 disposed at the rear of the machine and receiving the material from the main conveyor 7. The rear conveyor 21 has a conveyor arm 23 which, in the embodiment shown, may be swung up and down selectively in vertical direction and, in the embodiment shown, the rear conveyor frame, together with the conveyor 21 is adapted to be swung laterally about a king pin 24 (Fig. 2), so that the material may be delivered from the machine to any desired vertical or lateral position. The pivot about which the rear conveyor frame 23 is adapted to be swung vertically is designated generally at 25 in Fig. 1. The central main conveyor section 7 is mounted upon a laterally swingable frame 26 having rollers 27 operating upon a track 28. The frame 12 is mounted for extension and retraction upon the laterally swingable frame 26 and the rear end of the frame 26 is mounted to swing laterally about the king pin 24, the intermediate conveyor 7 and front conveyor 10 swinging laterally as a unit about this pivot 24 to position the cutter and breaker head 13 in any desired lateral position.

While the particular source of power may, of course, be varied, the source employed in the particular machine shown comprises a pair of electric motors 30, 30. The motors which I contemplate employing in the particular machine shown are of 50 horse power rating mill type.

These motors 30 are mounted upon the frame 12 as shown in Fig. 2, one upon each side of the machine. Drivingly connected through suitable reduction gearing 32, one with each motor 30 and extending longitudinally one along each side of the machine, are a pair of shafts 35, 35.

As in my application above referred to, these shafts 35, 35 form the main drive shafts for racking the extension frame 12 in and out, for selectively swinging the cutter and breaker head 13 about its pivot 15 and for swinging the front conveyor arm vertically. In addition, in the present invention, they drive the cutter and breaker mechanism, as will be pointed out later. The main transverse or cross shaft for racking the extension frame 12 in and out is designated at 38 in Fig. 2A. This cross shaft 38 is provided at each of its opposite ends with a brake 39 and with a bevel gear 40. Each of the bevel gears 40 meshes with a pair of bevel gears 42, which gears are selectively connected with the drive shafts 35 to turn therewith by means of clutches 43. The gears 42 on one side of the gears 40 turn the shaft 38 in one direction and the gears 42 on the other side of the gears 40 turn the shaft 38 in the opposite direction. The brakes 39 normally operate when there is no power application to the shaft 38 to lock the same against turning and the frame 12 against movement. The drives at each of the opposite ends of the shaft 38 provide a powerful balanced drive and they are operated, varied, connected and disconnected together.

Forwardly or outwardly of the cross shaft 38 is a second cross shaft 45 which is similarly selectively connected with the main drive shaft 35 to turn in one direction or in the other direction selectively, as desired, through pairs of clutches 46 and associated bevel gears 48 which mesh with bevel gears 50, the shaft 45 being provided with brakes 52 for locking

the shaft 45 and thereby the upper push and pull arms against movement when there is no power application to the shaft 45.

Fixed upon the cross shaft 38 are a pair of pinions, one of which is shown at 55 in Fig. 12. Each of these pinions 55 meshes with a larger gear 58, the gears 58 being suitably keyed or fixed upon a cross shaft 60 suitably journaled on the frame 12. The gears 58 mesh with racks 62 on the non-extensible laterally swingable frame 26 so that when the cross shaft 38 is turned in one direction, the gears 58 turn therewith, and by their engagement with the racks 62, rack or move the extensible frame 12 forwardly or outwardly. When the cross shaft 38 is driven in the opposite direction, the frame 12 is racked or retracted inwardly.

Fixed on the cross shaft 45 to turn therewith are a pair of pinions, one of which is shown at 65 in Fig. 12. Each of these pinions 65 meshes with a somewhat larger gear 66 fixed upon short transverse shafts 68 suitably journaled on the frame 12. Each of the gears 66 meshes with a rack 70 formed on the under surface of the associated push and pull arm 72, it being understood that there is one of these arms on each side of the machine. The operating movement of the arms 72 is always either in tension when the operation is through a pulling of said arms, or in compression when the operation is through a pushing of said arms. At their rear ends the arms 72 have guide rollers 73 which operate in and are guided by tracks 74 formed on the frame 12.

Links 78 pivoted at 80 to the forward or outer ends of the push and pull arms 72 extend forwardly or outwardly and are pivoted at their opposite ends at 82 (2A and 3) to the cutter and breaker head 13 eccentrically of the pivotal mounting 15 thereof. The plan view of Fig. 3 is of that portion of the cutter and breaker head on one side of a medium line longitudinally through the machine, it being understood that the cutter and breaker head and connecting links 78, as well as the drive connections and other parts to be hereinafter described, are duplicated on the other side of that median line, as shown in Fig. 2. The links 78 also always operate in tension or compression to swing the cutter and breaker head 13 selectively to or fro about its pivoted or articulated mounting 15. When the cross shaft 45 is turned in one direction, the arms 72 are pulled or drawn rearwardly to swing the cutter and breaker head 13 in a counterclockwise direction about its pivot 15, and when the cross shaft 45 is turned in the opposite direction the arms 72 are forced or pushed outwardly to push the cutter and breaker head 13 in a clockwise direction about its pivotal mounting 15. Through the clutches 46 the cutter and breaker head 13 may be swung to any desired distance and in either direction selectively as desired, about the pivot 15.

The cutter and breaker head 13 may thus be operated selectively about its pivot without any necessity of completing an orbital or cycle of movement each time. It may be swung into any desired position and through any desired range and back.

Forwardly of the cross shaft 45 is a third cross shaft 90 suitably journaled on the frame 12. The cross shaft 90, like the shafts 38 and 45 has fixed on its opposite ends bevel gears 92, each of which meshes continuously with a pair of reversing bevel gears 93, the bevel gears 93 on one side of the gears 92 operating cumulatively on opposite ends of the shaft 90 to turn the same in one direction and the bevel gears 93 on the other sides of the gears 92 operating cumulatively on opposite ends of the shaft 90 to turn this shaft 90 in the opposite direction.

Each of the gears 93 has a clutch 94, for selectively fixing these gears on the shaft 35 for rotation therewith and the opposite ends of the shaft 90 may have brakes 95 for normally locking the shaft 90 against rotation when there is no power application thereto.

Fixed on the cross shaft 90 are a pair of spur pinions 98, one of which is shown in Fig. 12, and these pinions 98 mesh with somewhat larger spur gears 100 mounted on relatively short transverse shafts or spindles 102 which may be suitably journaled on the frame 12. The spur gears 100 mesh with racks 104 on the upper surfaces of associated push and pull or rack arms 105, it being understood that like the arms 72 there is one of the arms 105 on each of the opposite sides of the machine, these arms being similarly operable so that a detailed description of one will suffice for both. At their rear ends, the push and pull or rack arms 105 have guide rollers 106 which operate in and are guided by suitable tracks 108 on the frame 12.

At their front or forward ends, the arms 105 are pivotally connected at 110 with push and pull links 112, the opposite or front ends of which links 112 are in turn pivotally connected at 114 with the front vertically swingable conveyor frame or boom arm 14, as shown in Fig. 5.

By turning the front cross shaft 90 in one direction, the arms 112 will be retracted to swing the conveyor arm 14 downwardly or in a clockwise direction about its pivot 18, and by turning the cross shaft 90 in the opposite direction the conveyor arm or boom frame 14 will be swung vertically upwardly or in a counterclockwise direction. The vertical swinging of the arm 14 is wholly selective in all of the operating positions of the machine, and by swinging it vertically the cutter and breaker head 13 may be positioned at any vertical height or vertical position in the mine passage or other place. The vertical swing-

ing movement of the conveyor arm 14 and the swingable part of the front conveyor 10 associated therewith is not progressive and there is no orbital or cycle of movement which must be completed each time. The selective swinging or angular movement of the arm 14 permits positioning the cutter and breaker head in any desired vertical position and the independent and selective swinging of the cutter and breaker head about its pivot 15 by the push and pull arms 72 permits swinging the cutter and breaker head selectively about its pivot 15 in any of its working positions so that the breaker rams or members may be positioned horizontally or to operate with the seams or lines of cleavage in the coal or other material in any of the vertical positions of the cutter and breaker head, as will hereinafter appear. In this manner, the push and pull arms 112 are utilized to swing the cutter and breaker head angularly to any desired vertical position and wholly selectively, and the push and pull arms 72 are operable selectively to compensate for the different angles of the cutter and breaker head in its various vertical positions and to position the cutter and breaker head for effective operation upon the material in all other positions, particularly positioning the breaker rams or members to operate horizontally or with the seams or lines of cleavage in the coal or other material in all of the working positions of the cutter and breaker head.

A longitudinal shaft 120 suitably driven by the motors 30 has a pinion 121 which meshes with an arcuate rack 122 on the under surface of the laterally swingable frame 26 for the purpose of swinging the same and the cutter and breaker head 13 at the forward end thereof laterally, as desired. This lateral swinging movement is wholly selective in all of the working positions of the machine all as more fully disclosed in my U. S. Patent No. 1,749,968, issued March 11, 1930.

Each of the two threads 6 is driven at each of its opposite ends from the motors 30 as through gearing designated at 125 (Fig. 2), it being apparent that the two treads 6 may be driven in the same direction to advance the machine slowly into the material or in the opposite direction to propel the machine rearwardly and either tread may be adapted to be driven relative the other tread, or they may be adapted to be driven in opposite directions to turn the machine abruptly and maneuver the same into and out of inaccessible places.

Referring now to Figs. 3, 4, 5, 6 and 7, the cutter and breaker head 13 comprises a frame 150 swingably mounted at 15 at the outer or forward end of the arm 14 and pivotally connected at 82 to the outer or forward ends of the push and pull links 78.

The cutter and breaker mechanism comprises, in general, a horizontally operable under cutter 152, a plurality of vertically operable endless cutter chains 154 and a battery or tier of breakers 155 disposed between each pair of cutters 154. In the particular embodiment of the invention shown, the cutter and breaker head is provided with six vertically operable cutter chains 154 and with five tiers of breakers 155. The particular number of vertical cutters and breakers employed may be increased or decreased to suit any particular purpose or they may be varied for any other desired reason. It is important, however, regardless of the number of cutters and breakers employed, that the vertical cutters be spaced to cut the coal or other material into relatively narrow widths. This feature, coupled with the provisions which I make for simultaneously operating the cutters and the breakers to break down the relatively narrow width cut selectively as the machine is advanced into the material and without the necessity of withdrawing the cutters or otherwise separating the cutting and breaking operation and without the necessity of following the cutting operation with the breaking operation in a progressive cycle, are highly important aspects of my invention.

It will be understood that any increase or decrease in the number of vertical cutters employed, will simply increase or decrease the number of relatively narrow widths of the material cut without materially or impracticably increasing the widths of the slabs of material themselves. By cutting the slabs of relatively narrow widths and operating the breakers simultaneously with the advance of the cutters, the capacity and tonnage of the machine is greatly increased. Furthermore, the breakers operating upon these relatively narrow slabs break them up into larger lumps than it has been usually possible to secure before and without chewing the slabs up or pulverizing or breaking them too fine and, at the same time, the possibility of causing a chunk or slab of a width as wide or wider than the entire machine, to break off and drop down and clog the machine, making it necessary to get in and break up the same by hand, is eliminated. The widest piece that could possibly break off and fall down could be no wider than the distance between the vertical cutters. A chunk of that width would not clog up or stall the machine and because of the narrower width and greater vertical connection with the face of the material, the possibility of chunks that wide breaking off and falling down is greatly decreased.

Because of the smaller or less width of the chunks or slabs cut, the breakers will break them more uniformly and into larger lumps, particularly lumps of the desired size for lump coal and, at the same time, the smaller or decreased widths of the slabs expedites

and speeds up the accompanying breaking operations.

Suitably journaled in the cutter and breaker frame 150 is a cross shaft 160. This cross shaft 160 forms the main power shaft of the cutter and breaker head 13 and it is from this shaft that the vertical cutters 154 and the breakers 155 are driven or receive their power. The endless cutter chains 154 are trained about and have driving engagement with sprockets 162 to be driven thereby. The vertical cutter chain driving sprockets 162 are suitably fixed upon the shaft 160 to turn therewith.

Suitably journaled at the top of the forward or outer end of the frame 150 are relatively short cross spindles 163 and suitably journaled at the bottom of the forward end of the frame 150 are similar cross spindles 164. Each cutter chain 154 passes or is trained about an idler sprocket 165 on the spindle 163 and about an idler sprocket 168 on the cross spindle 164. Each cutter chain 154 thereby travels or operates in a generally triangular path disposed in a vertical plane.

The main power shaft 160 of the cutter and breaker head receives power cumulatively from the motors 30 on the main machine through a pair of main longitudinal power takeoff shafts 170, one extending forwardly from the front end on each side of the machine. The power shafts 170 have telescoping or sliding driving connection at 172 to permit extension and retraction thereof with the different positions of the cutter and breaker head 13 and without interfering with or impairing the drive thereto.

Each of the shafts 170 has universal driving connection at 175 at their outer ends with relatively short shafts 176 and, in the embodiment shown, the opposite ends of the shafts 170 have universal driving connection at 178 with short stub shafts 179 which in turn are shown as connected through clutches 180 with the forward or outer ends of the longitudinal drive shafts 35 on the main frame of the machine. The universal driving connections at the opposite ends of the shafts 170 permit this shaft to accommodate itself to the different positions of the cutter and breaker head 13 without in any way interfering with the drive thereto. The clutches 180 may be controlled manually or otherwise, as desired, for the purpose of connecting and disconnecting the drive to the cutter and breaker head 13 selectively at will, from the main machine, for example. The shafts 170 may be enclosed in extensible and retractable telescoping tubes 182 which may have ball ends for cooperation with socket hoods 183 on the frames 12 and 150.

The outer or forward ends of the relatively short shafts 176 have bevel gears 185 suitably fixed thereon for rotation therewith, and these gears 185 mesh with a cooperating bevel gear 186 fixed upon the cross shaft 160 to turn or rotate the same therewith. The bearings for the shaft 160 may be as indicated at 187 and each relatively short shaft 176 has fixed thereon rearwardly of its outer end for rotation therewith a bevel gear 190.

At each of the opposite sides of the rear end of the cutter and breaker head 13 there is a vertical under-cutter drive shaft 192 and each of these shafts 192 has fixed thereon a bevel gear 193 which meshes with the adjacent bevel gear 190 on the shaft 176 and imparts the drive from the shafts 176 to the vertical shafts 192. The lower ends of the shafts 192 have universal driving connection at 194 with short shafts or spindles 195 which bear the driving sprockets for the under-cutter 152. The universal driving connections 194 maintain the drive properly to the under-cutter 152 in all of the different positions of the head 13 and the shafts 192 are preferably each provided with a suitable clutch 198. The clutches 198 may be operated manually or otherwise, as desired, and they are adapted for selectively connecting and disconnecting the drive to the under-cutter independently of the drive to the cutters 154 and breakers 155.

The drive sprockets on the spindles 195 are indicated at 196 and the endless chain under-cutter 152 is trained about and has driving engagement with the sprockets 196 at the rear end of the head 13. At the front end of the head 13 the under-cutter 152 is trained about idler sprockets 200, each one suitably journaled at 202, at each one of the opposite front corners of the head 13. The under-cutter 152 thereby operates in a generally rectangular path, disposed in a generally horizontal plane.

For the purpose of adjusting the tension of or taking up any slack in the cutter chains 154 independently, each of said cutter chains 154 may be provided with a take-up device or adjustment 205, as shown in Fig. 6. These take-up or adjustment devices 205 are operable independently for each chain 154 and are operable to adjust the chain and chain guide means independently of the breakers 155.

In the embodiment shown, the breakers 155 are mounted and operate in tiers in the vertical compartments between the vertical cutter chains 154. In the machine shown there are six vertical cutter chains and, therefore, five of such compartments, one between each pair of cutter chains, it being understood that the particular number of compartments and the particular number of tiers of breakers 155 will vary with the number of vertical cutters employed. The frame 150 has side members 225 vertically disposed and defining each of the opposite sides of the breaker compartments. The outer ends of the side members 225 are spaced transversely by laterally dis-

posed channel members 228 and their opposite or rear ends are spaced transversely by the frame members 230 of the frame 150.

In the particular embodiment of the invention shown, each group of breakers 155 comprises a tier of four, there being five of such tiers or groups of breakers in the particular embodiment of the invention shown. As already pointed out, this may vary as desired and the particular number of breakers in each tier, one vertically above the other, may be varied, as desired.

Each tier or vertical group of breakers is mounted in a common breaker casing 235 (Fig. 11). Each of the breaker casings 235 are provided on their opposite sides, as shown in Figs. 4 and 11, with vertical guides 236 which operate in cooperating guides 238 on the side members 225, each case 235 being adjustable vertically to adjust the vertical positions of the entire tier of breakers 155 carried by the casing 235, as a unit.

Each breaker 155 of each tier comprises a reciprocable block 240 having an internally threaded opening 243 horizontally therethrough for threaded or screw engagement with a quick acting high speed screw 245. The screws 245 are journaled at their rear ends in bearings 246 in the casing 235 and at their front ends in bearings 248 in the casing 235. Each of the reciprocable blocks 240 is guided for reciprocable movement at each of its opposite sides 250 on the sides of the casing 235, it being understood that the blocks 240 are moved rectilineally outwardly by the rotation of the screws 245 in one direction and rectilineally inwardly or retracted by rotation of the screws 245 in the opposite direction.

Suitably secured at their rear ends to each of the reciprocable blocks 240 are a pair of forwardly extending stem members 260. These stem members 260 extend slidingly through the opposite end of the casing 235 at 262 and have suitably secured for movement therewith, upon their forward or outer ends forwardly of the front end of the casing 235, the breaker or ram heads 265.

The breaker or ram heads 265 are, in the embodiment shown, in the form of relatively wide blade members having their bases rigidly secured at 270 to the forward ends of the reciprocating stems or arms 260. From their rear or base ends the breaker heads 265 are tapered forwardly, as shown in Fig. 8, forming a generally wedge-shaped vertical section with a relatively sharp, wide breaker edge at the forward end. These relatively sharp front breaker edges are disposed transversely of the cutter and breaker heads and in a generally horizontal plane to engage the coal or other material between the cutters 154 in the planes of cleavage or seams in the material. They are forced powerfully into engagement with the material by the outward reciprocation of the blocks 240 and are withdrawn from the material for a succeeding breaking engagement therewith by reciprocation or retraction of the blocks 240 rearwardly or in the opposite directions.

The formation of the breaker heads or rams 265 particularly adapts them for breaking the coal into lumps of the desired size for lump coal, especially in combination with the vertical cutters 154 and their relatively close relation or disposition which cuts the coal or other material into relatively narrow vertical slabs or chunks. The narrow slabs cut and the simultaneous operation of the breakers between the relatively close cuts, together with the formation of the breakers, breaks the material into lumps of the desired size, as distinguished from chipping the material into very fine pieces by pointed stems or the like, and as distinguished from endeavoring to break up a wide block or slab in any manner, either with the cutting operation or after the same, as has usually been necessary in the prior art.

As already referred to, the selectively operable push and pull arms or mechanisms are adapted to move the entire breaker and cutter head 13 as a unit into any desired vertical position, and this push and pull mechanism is operable to position the reciprocating breakers in generally horizontal planes in any and all of their working positions. This is highly advantageous in that the cutter and breaker head is thereby not only selectively movable into any desired vertical position, but the breakers may be set to operate with or along the seams or planes of cleavage in the material in any and all of the working positions of the breakers. The breakers are thereby adapted to operate with the butts of the material in all of the working positions of the machine, and this is important in that operation of the breakers at an angle to the butts of the material or at an angle to the seams or planes of cleavage therein which has been necessary in most of the working positions of the prior art machines, is eliminated. Chewing up of the material into particles which are too fine is thereby avoided, and the material is thereby broken down quicker and more easily and expeditiously, all of which improves the results secured and the tonnage and capacity of the machine.

For the purpose of rotating or turning the screws 245, I provide each tier thereof with a vertical drive shaft 300, which drive shaft 300 is drivingly connected through meshing spur gears 302 and 304 with a drive sleeve 305. Each of the drive sleeves 305, there being one for each vertical group or tier of breakers 155, has splined or sliding driving engagement with a vertical shaft 308. Each of the shafts 308 has fixed upon its upper end a bevel gear 309 meshing with a bevel gear 310 on the main power shaft 160. The shafts 308 may be suitably journaled at their

upper ends at 312 on the frame 150 and the sleeves 305 may be suitably journaled at their lower ends at 315, it being understood that the entire breaker case 235 and the gearing associated with the shafts 300 and 308, together with the breakers and other parts associated with each tier thereof are movable vertically up and down along the shafts 308.

The rear end of each screw 245 has a bevel pinion 325, each of which pinions 325 is in constant meshing engagement with a pair of reversing bevel gears 326 and 328. The gears 326 and 328 are mounted loosely upon the shaft 300 and splined upon the shaft 300 for movement therealong and rotation therewith, one, at the rear end of each of the screws 245, is a double-end clutch member 330. The clutch members 330 are adapted to be shifted in one direction electrically, as will be hereinafter pointed out, or in any other suitable manner, to fix the gear 326 for rotation with the shaft 300 to turn the screw 245 in one direction and the clutch members 330 are shiftable in the opposite direction to release the gears 326 and connect the gears 328 for rotation with the shaft 300 to turn the screws 245 in the opposite direction. In this manner the breakers are moved selectively out or in, as desired.

For the purpose of raising and lowering the breaker casings 235 and the tier or group of breakers 155, all as a unit therewith independently of the cutter chains 154 and the remainder of the cutter head, that is, for moving the breakers up and down vertically relative the cutter head, I provide each of the driving sleeves 305 with a pair of reversing bevel gears 350 and 352 loosely mounted thereon. As shown in Fig. 7, the bevel gears 350 and 352 have constant meshing engagement with a bevel pinion 355 suitably fixed on the forward end of a spindle 356 which has a worm 358. The spindles 356 may be journaled in bearings 360, and each of the worms 358 meshes with a worm gear 362. As shown in Fig. 4, each of the worm gears 362 is fixed on a short shaft 363 to turn the same therewith, and fixed also upon each end of each of the shafts 363 to turn or rotate therewith is a bevel gear 364.

Each of the bevel gears 364 meshes with a bevel pinion 365 fixed upon shafts 368 which extend longitudinally forwardly and have fixed thereon spur pinions 370, as shown in Fig. 11. There are preferably two shafts 368 for each breaker casing 235 and therefore four pinions 370 for each casing, two on each side thereof. The pinions 370 mesh with vertical racks 380 which may be formed on the guides 238 which have relatively fixed positions upon the side members 225. For selectively turning the shafts 368 in opposite directions, or, that is, in either direction, as desired, to rack the breaker casing 235 and associated tier of breakers 155 up or down selectively as desired, the driving sleeve 305 has fixed thereupon for rotation therewith between the reversing gears 350 and 352 a double end clutch member 382. By shifting the clutch member 382 into engagement with the gear 350, the gear 350 is connected to turn with the shaft 308 and the pinions 370 are turned in one direction to rack or move the breaker case 235 and associated breakers vertically in one direction and by shifting the clutch member 382 into engagement with the gear 352 the pinions 370 are turned in the opposite direction to rack or move the associated tier of breakers vertically in the opposite direction. In this manner the breakers may be adjusted up or down relative the cutters, as desired.

For taking up or slacking the cutter chains the cutter bars 600 which carry the cutter chains 154 are preferably adjustable in and out relative the breakers and the main mounting. Bolts 390 operating in elongated slots 392 permit this in and out adjustment and are adapted for securing or locking the cutter bars in any desired adjusted position.

The vertical cutters 154 are preferably disposed with their upper runs inclined upwardly toward the front, as shown, so that they take at the front only with a lead or clearance provided rearwardly of the front end of the cutter. The under-cutter 152 is preferably inclined rearwardly from its front end so that it also takes or cuts at the front only with a lead or clearance rearwardly thereof.

The endless cutters may, on the whole, be of standard or any other suitable or preferred construction, comprising pivotally connected links 400, as shown in Fig. 6, with alternate links provided with sockets or apertures adapted to receive the shanks of the usual cutting bits 405. The bits at the forward end are angularly disposed and converge as shown at 406, so that relatively sharp points define the width of the cut. These relatively sharp points wear off quickly in actual practice and it is necessary to make the cut relatively wide. To overcome this disadvantage, I preferably provide each cutter chain with auxiliary side teeth 408 which have flat cutting edges, as shown in Fig. 6. These relatively flat cutting edges of the auxiliary teeth 408 provide edges which do not wear off so quickly by reason of their different angular positions, and these edges keep the gauge of the kerf, keeping the greater wear from the teeth 406. In this manner the width of the kerf may be kept to the same gauge and it is possible to cut shallower or narrower kerfs. This decreases the amount of waste which is especially important where relatively large capacities or tonnages are being handled. The auxiliary teeth 408 are preferably disposed with one

opposite each of the teeth 405 and they thereby serve the additional function of balancing the teeth 405 in the operation of the cutters.

While I have shown the cutters and breakers as operated electrically from two motors, it is to be understood that they may be operated mechanically, pneumatically, or otherwise, as desired.

For the purpose of moving the broken coal or other material which falls to the bottom 425 of the breaker and cutter head back and delivering it to the forward end of the conveyor 10, I provide a plurality of feed back or drag links 428 spaced relatively close together transversely of the machine as shown in Fig. 4. Each feed back or drag link 428 is operable in a longitudinal slot or opening 430 through the bottom 425 and each link 428 has a push and pull and a raising and lowering movement in operation.

Each link 428 has suitable teeth 432 on its upper surface and, in operation, these teeth are simultaneously lifted and drawn back into the dotted line positions of Fig. 10 to engage beneath the material and feed the same rearwardly to the forward end of the conveyor 10, from which, in the particular machine shown, the material is fed to the conveyor 7 and then to the discharge conveyor 21 for delivery to any desired point.

For the purpose of operating the links 428, I drive the shaft 15 at the front end of the front conveyor 10 as by means of a sprocket 440 and I provide the shaft 15 with an operating eccentric having crank or eccentric pins 442 pivotally connected at 445 with the drag link 428 to reciprocate the come-along or drag link 428 to and fro with the throw of the eccentric pins 442 which accompanies rotation or turning of the shaft 15. The eccentric actuating or drag link throw pins 440′ of the alternate drag links which are arranged at spaced intervals across the bottom of the cutter and breaker head are preferably disposed diametrically opposite (Figures 9 and 10) so that upon outward or forward movement of every other link, the links alternating with the forwardly moving links will be retracted or moved rearwardly and vice versa, there being 180° difference in the actuating cranks or throws imparted to the drag links alternately across the machine. As the links 428 are drawn rearwardly by the eccentric pins 442 and links 443, they are simultaneously raised or elevated by pins 450 which operate in inclined cam guides 452. As the links 428 are forced forwardly or in the opposite direction, the pins 450 and inclined cam guides again depress or lower the links to take the teeth 432 properly beneath the material. Obviously, the links 428 may operate up closer to the shaft 15 and thereby up closer to the front or forward end of the conveyor 10, if desired. The drive means for the drag links 428 may be provided with clutch or any other suitable or preferred means for selectively connecting the drive thereto and disconnecting it therefrom. In the particular embodiment of the invention illustrated, four drag links or come-alongs 428 are disposed in each compartment. This may, of course, be varied, as desired, but it is desirable that they be disposed relatively close transversely of the machine to properly take up the material and deliver it rearwardly to the conveyor at all times.

Obviously, the lifting of the tiers or batteries of breakers 155 relative the cutter and breaker head, gives an extra operating height to the machine and permits lifting them to provide coal or material clearance for the broken coal at the bottom. In this manner proper feeding of the material to the conveyor as it is cut and broken down is assured at all times, and the possibility of clogging and requiring getting in and breaking up the material by hand is eliminated.

As already pointed out, it is to be understood that steam or any other suitable or preferred source of power may be employed instead of the electric motors 30 for operating the cutter and breaker head and the various other parts of the machine and for imparting the various operating movements.

Also, where the machine of my present invention, and particularly the cutter and breaker head is not limited to be electrically controlled, it may be electrically controlled, and I shall now describe in connection with the circuit diagram of Fig. 13 the circuit connections for controlling the cutter head electrically as I have provided for doing.

The circuit for the main machine and for operating the push and pull arms 78 and 112 may be substantially as in the Letters Patent hereinbefore referred to with the apparatus stationed at the rear substantially the same as before. In this case, however, the operator's stations B and C are substituted for the operator's station B and C of the above Letters Patent.

In the particular layout shown, each row or horizontal group of breakers is provided with five solenoids 500, one for each of the five in the row. Assuming that the solenoids 500 move the breakers out or withdraw the same, the same tier of breakers is provided with a second set of five solenoids 502 for moving the breakers in or imparting the ramming or breaking operation.

Each tier of breakers has a controller 505 at the station C and each controller 505 has a neutral position, a second position for energizing the solenoids 500 to move the breakers 155 out, and a third position for energizing the solenoids 502 to move the breakers in. For example, the "in" connection for the first tier of breakers, comprising its five members in a row, is designated at 506, the "out"

connection for the first tier at 507, the "in" connection for the second tier at 508, the "out" connection for the second tier at 509, the "in" connection for the third tier at 510, the "out" connection for the third tier at 511, the "in" connection for the fourth tier at 512 and the "out" connection for the fourth tier at 513.

For raising and lowering the breakers on the shafts 308 I provide a battery or group of solenoids 620 controlled at the station C by the controller 625, connected to the solenoids 620 thru conductors 626 and relays 628.

Each of the stations B and C may be provided as before, with a suitable switch 520 for opening both of the motor circuits from either of the stations B or C.

The operator's station B is provided with a controller 525 for operating the push and pull arms 78 and 112 to move the entire cutter and breaker head to any desired vertical position and to position the breakers generally horizontally in any position so that they will operate with the seams or lines or planes of cleavage in the material. The entire breaker and cutter head is raised and lowered from the station B and the laterally swingable frame of the machine is swung from the station B and extended and retracted where there is any extension and retraction. The caterpillar or tread feed is also controlled from the station B, all as more fully disclosed in my above referred to application, for the purpose of maneuvering the machine and advancing the cutter and breaker head slowly into the material.

In operation I preferably cut in from 18 to 24 inches, although this may be varied and the material is broken down selectively as the machine feeds the cutter and breaker head in.

I claim:—

1. In a machine of the class described, the combination of a first vertically swingable arm, a push and pull arm having articulated connection with said first arm for swinging same vertically, a breaker and cutter head pivoted at the outer end of said first arm, and having breaker and cutter means thereon and a push and pull arm having articulated connection with said breaker and cutter head for swinging same about its pivot on said first arm, for setting the breaker for operating with the seams in the material.

2. In a machine of the class described, the combination of a first vertically swingable arm, a first push and pull arm, link means forming an articulated connection between said push and pull arm and said first arm, a breaker and cutter head pivoted at the outer end of said first arm, a second push and pull arm, a second link forming an articulated connection between said second push and pull arm and said breaker and cutter head, and means for selectively and independently operating said first and second push and pull arms to raise and lower the breaker and cutter head and set same for operation with the seams in the material in all of the angular positions of said first arm.

3. In a machine of the class described, the combination of a swingable conveyor, a breaker and cutter head pivoted at the outer end of said conveyor, and a pair of push and pull members, one connected to swing the conveyor and the other connected to swing the cutter and breaker head.

4. In a machine of the class described, the combination of a frame, a swingable arm thereon, a conveyor extending along said arm and swingable therewith, a breaker and cutter head pivoted at the outer end of said arm, said breaker and cutter head comprising a plurality of cutters for forming a plurality of relatively closely spaced substantially parallel vertical kerfs, breakers positioned between said cutters and operable upon the material between said kerfs.

5. In a machine of the class described, the combination of a frame, a swingable arm theron, a conveyor extending along said arm and swingable therewith, a breaker and cutter head pivoted at the outer end of said arm, said breaker and cutter head comprising a plurality of cutters for forming a plurality of relatively closely spaced substantially parallel vertical kerfs, breakers positioned between said cutters and operable upon the material between said kerfs, and under-cutter underlying the breakers and the said first cutters and operable in a generally horizontal plane upon the material, and means for feeding the material to said conveyor.

6. In a machine of the class described, the combination of a frame, a vertically swingable arm at the forward end thereof, a power shaft on said frame, a breaker and cutter head articulated at the outer end of said arm, breaker and cutter means on the breaker and cutter head, a drive shaft on the breaker and cutter head for said breaker and cutter means, a shaft drivingly connecting the power shaft on the frame with the shaft on the breaker and cutter head, said last shaft being extensible and retractable and having universal joint connection at its opposite ends with the power shaft on the main frame and with the shaft on the breaker and cutter head.

7. In a machine of the class described, the combination of a frame, a vertically swingable arm at the forward end thereof, a power shaft on said frame, a breaker and cutter head articulated at the outer end of said arm, cutter means on said head, reciprocable breaker means on said head, a drive shaft on the breaker and cutter head for said breaker and cutter means, a shaft drivingly connecting the power shaft on the frame with said last shaft, and a pair of push and pull members operated by the power shaft on the frame, one

connected to swing the vertically swingable arm and the other connected to swing the cutter and breaker head and operable to position said breaker means for operation with the seams in the material in all of the vertical positions of said head.

8. In a machine of the class described, the combination of a frame, a vertically swingable arm at the forward end thereof, a power shaft on said frame, a breaker and cutter head articulated at the outer end of said arm, cutter means on said head, reciprocable breaker means on said head, a drive shaft on the breaker and cutter head for said breaker and cutter means, a shaft drivingly connecting the power shaft on the frame with said last shaft, a pair of push and pull members operated by the power shaft on the frame, one connected to swing the vertically swingable arm and the other connected to swing the cutter and breaker head and operable to position said breaker means for operation with the seams in the material in all of the vertical positions of said head, and a reversible driving connection between the power shaft on the frame and said push and pull members.

9. In a machine of the class described, the combination of a frame, a vertically swingable arm at the forward end thereof, a power shaft on said frame, a breaker and cutter head articulated at the outer end of said arm, cutter means on said head, reciprocable breaker means on said head, a drive shaft on the breaker and cutter head for said breaker and cutter means, a shaft drivingly connecting the power shaft on the frame with said last shaft, a pair of push and pull members operated by the power shaft on the frame, one connected to swing the vertically swingable arm and the other connected to swing the cutter and breaker head and operable to position said breaker means for operation with the seams in the material in all of the vertical positions of said head, a reversible driving connection between the power shaft on the frame and said push and pull members, and a reversible driving connection between the shaft on the breaker and cutter head and said breaker means.

10. In combination, a breaker and cutter head, a cutter on said head, a breaker on said head, means for raising and lowering the head, a carriage for the breaker, a rack adjacent said carriage, a pinion on the carriage cooperating with the rack to raise and lower the breaker and means for setting the breaker for operation with the generally horizontal seams in the material in all positions of the breaker.

11. In a device of the class described, the combination of a cutter frame, a plurality of cutter chains operatively mounted on said cutter frame and having generally triangular paths of movement, a breaker frame mounted on said cutter frame and adjustable at right angles to the direction of travel of the upper runs of said cutters, and breaker means operatively mounted on the breaker frame and reciprocable at right angles to the direction of adjustment thereof.

12. In combination, a reciprocable head having breaker means thereon, a support therefor, driving means for said breaker, means for adjusting the breaker at right angles to the direction of its reciprocable movement and means for setting the breaker for operation with the generally horizontal seams in the material in all operating positions of the breaker, said breaker means being adjustable to the inclination of seams in the material by the adjustment of the breaker head.

13. In a machine of the class described, the combination of a breaker and cutter head comprising a supporting frame, a plurality of cutter chains mounted upon said frame for operation in vertical planes spaced transversely with respect to said frame, a vertical row of breakers operatively arranged between each pair of cutters, a main cross shaft for driving the cutters, a vertical shaft drivingly connected thereto, reversible driving connections between said last shaft and said breakers, a carriage for each vertical row of breakers, reversible driving connections between said second vertical shaft and each of the breakers driven thereby, and means for raising and lowering the breaker carriage.

14. In a machine of the class described, a plurality of vertically operable transversely spaced cutter chains, a vertical row of breakers between each pair of cutter chains, means for reciprocating said breakers, means for moving the breakers and cutters into different vertical positions, and means for setting the paths of reciprocation of the breakers generally parallel with the seams in the material in all of the vertical positions of said breakers and cutters.

15. In a machine of the class described, the combination of a vertically swingable arm, a cutter and breaker head pivoted at the outer end of said arm for vertical swinging movement, a plurality of cutter chains mounted on said head for operation in generally vertical planes spaced transversely relative said head, a vertical row of breakers between each pair of cutter chains, means for driving the cutters and breakers, means for swinging said arm to lower and raise said head, and means for swinging said head about its pivotal mounting at the outer end of said arm to position the breakers for operation with the seams in the material in all positions of said arm.

16. In a machine of the class described, the combination of a vertically swingable arm, a cutter and breaker head pivoted at the outer end of said arm for vertical swinging movement, a plurality of cutter chains mounted

on said head for operation in generally vertical planes spaced transversely relative said head, a vertical row of breakers between each pair of cutter chains, means for driving the cutters and breakers, means for swinging said arm to lower and raise said head, means for swing said head about its pivotal mounting at the outer end of said arm to position the breakers for operation with the seams in the material in all positions of said arm, and means for adjusting the tiers of cutters rectilineally in a vertical direction.

17. In a machine of the class described, the combination of a breaker head having a plurality of reciprocable breaker devices, means for operating said breaker devices, means for moving the breaker head into different vertical positions, and means for adjusting the breaker head to collectively position the breaker devices for operation generally horizontally but with the seams in the material in all of the vertical operating positions of the breaker head, said breakers having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

18. In a machine of the class described, the combination of a breaker having a plurality of longitudinally reciprocable breaker devices, means for moving the breaker into different vertical positions, and means for collectively setting the breaker devices for operation generally horizontally but with the seams in the material in all of the vertical operating positions of the breaker, said breakers having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

19. In a machine of the class described, the combination of a breaker having a plurality of breaker devices, means for operating the breaker, means for adjusting the breaker vertically by motion of translation and means for positioning said breaker devices for operation parallel each other but with the seams in the material in all of the vertical operating positions of the breaker, said breakers having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

20. In a machine of the class described, the combination of a vertically adjustable breaker having a plurality of breaker devices and means for operating the breaker devices parallel with each other but with the seams in the material in all of the vertically adjustable positions of the breaker, said breaker devices having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

21. In a machine of the class described, the combination of a breaker, angularly operable means for moving the breaker into different vertical positions, and means for compensating for the angular operation of said last means for positioning the breaker for operation with the seams in the material in the different vertical positions thereof, said breaker means operating generally horizontally but with the seams in the material in all its vertical operating positions and to the top of the angularly operable means in its highest raised position, said breaker devices having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

22. In a machine of the class described, the combination of a breaker, a first angularly operable means for moving the breaker into different vertical positions, and a second angularly operable means for setting the breaker for operation with the seams in the material in the different vertical positions thereof, said breaker means operating generally horizontally but with the seams in the material in all of its vertical operating positions and to the top of said first angularly operable means in its highest raised position, said breaker devices having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

23. In a machine of the class described, the combination of a vertically swingable arm, breaker means pivoted to swing in a vertical plane at the outer end of said arm, means for swinging said arm vertically to lower and elevate the breaker means, and means for swinging the breaker means about its pivotal mounting upon said arm to set the breaker means for operation with the seams in the material in all of the angular positions of said arm, said breaker means operating generally horizontally but with the seams in the material in all of its vertical operating positions and to the top of the vertically swingable arm in its highest raised position, said breaker devices having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

24. In a machine of the class described, the combination of a vertically swingable support, a breaker pivoted at the outer end of said support, means for swinging the support to raise and lower the breaker, and means adapted for swinging the breaker in the opposite direction about its pivot at the outer end of the support to position the

breaker for operation with the seams in the material, said breaker means operating generally horizontally but with the seams in the material in all of its vertical operating positions and to the top of the vertically swingable support in its highest raised position, said breaker devices having ramming engagement with the material and the operation with the seams in the material imposing a splitting action upon the material in all positions of operation of the breakers.

25. In combination, a pivoted breaker and cutter head, having breaker and cutter means thereon a swingable support therefor, a push and pull member for operating said breaker and cutter head selectively about its pivot, and a second push and pull member for imparting swinging movement to said support, said first push and pull member setting said breaker means to operate generally horizontally but with the seams in the material throughout the operating range of the breaker and cutter head.

26. In a machine of the class described, the combination of a plurality of cutters for simultaneously forming a plurality of relatively closely spaced substantially parallel vertical kerfs to divide the material into a plurality of relatively narrow transversely separated slabs and breakers positioned between said cutters and operable upon all of said narrow slabs of material between said kerfs simultaneously with the cutting of said slabs and with the seams in the material in all of the operating positions of the breakers.

In witness whereof, I hereunto subscribe my name this 23 day of April, 1926.

JOHN H. BLAIR.

CERTIFICATE OF CORRECTION.

Patent No. 1,762,154. Granted June 10, 1930, to

JOHN H. BLAIR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 11, lines 95, 96 and 97, claim 13, strike out the words and comma "reversible driving connections between said second vertical shaft and each of the breakers driven thereby,"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 5th day of August, A. D. 1930.

(Seal)

Wm. A. Kinnan,
Acting Commissioner of Patents.