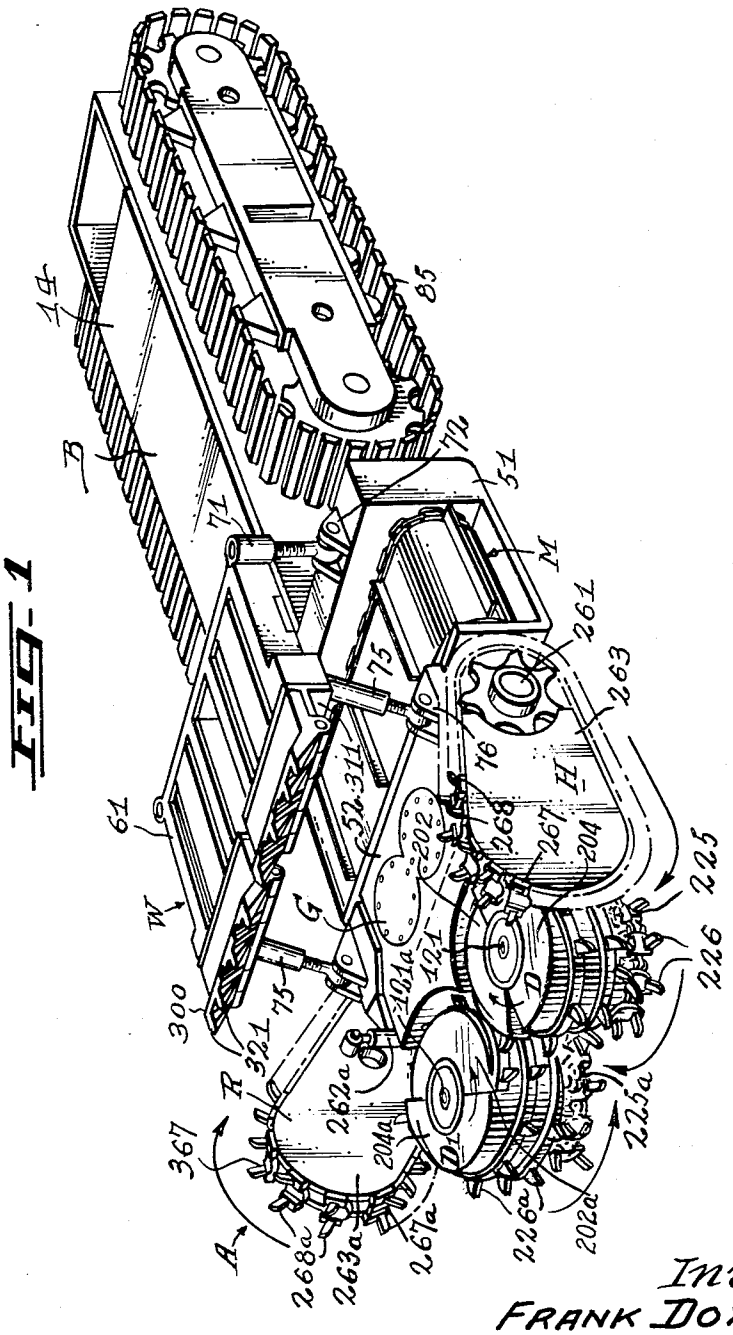
Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 1

FIG. 1



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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 2

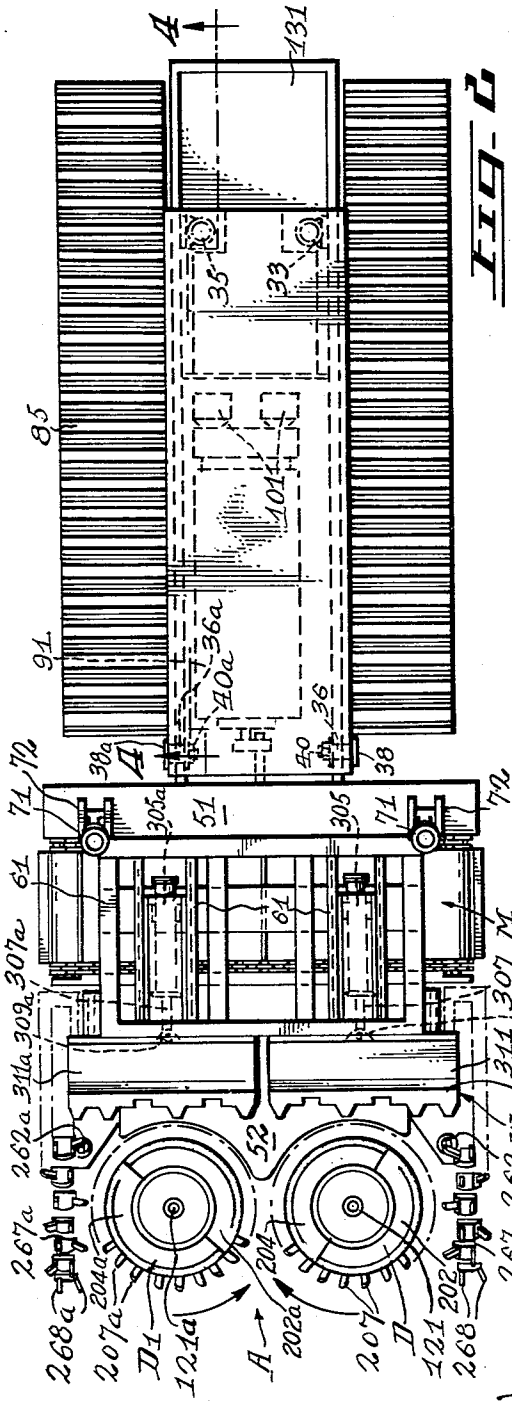


Fig. 2

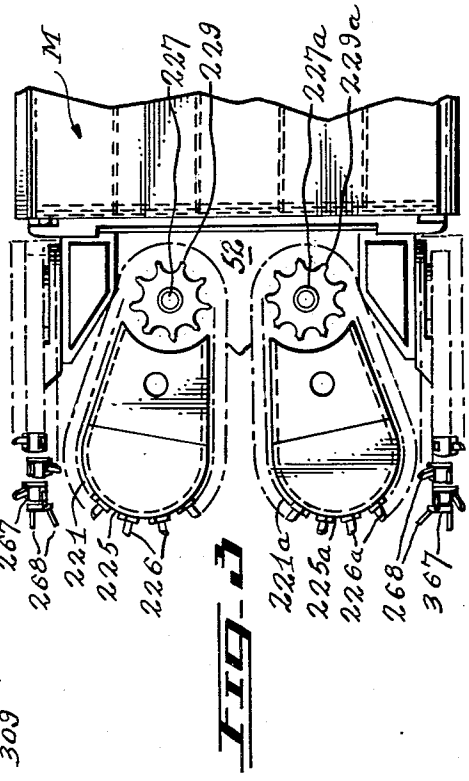


Fig. 3

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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 3

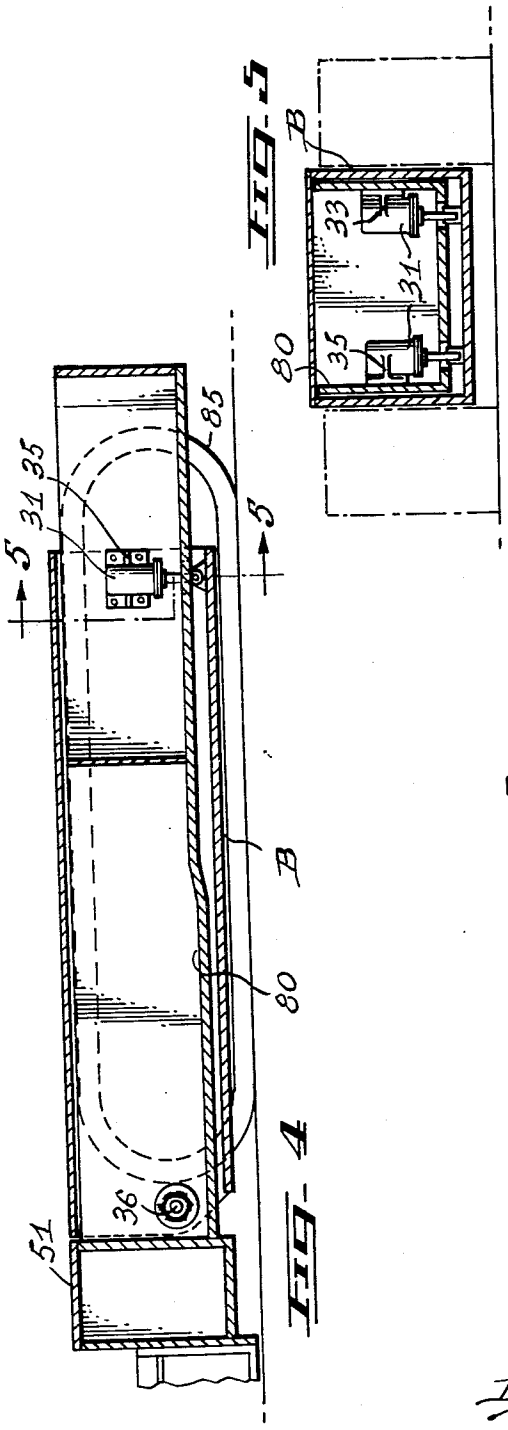


Fig. 4

Fig. 5

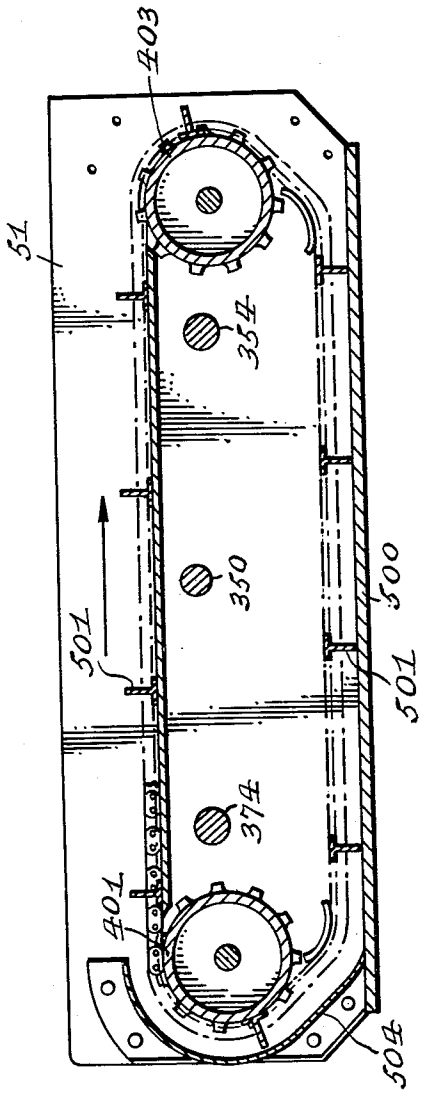


Fig. 6

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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 4

Fig. 7

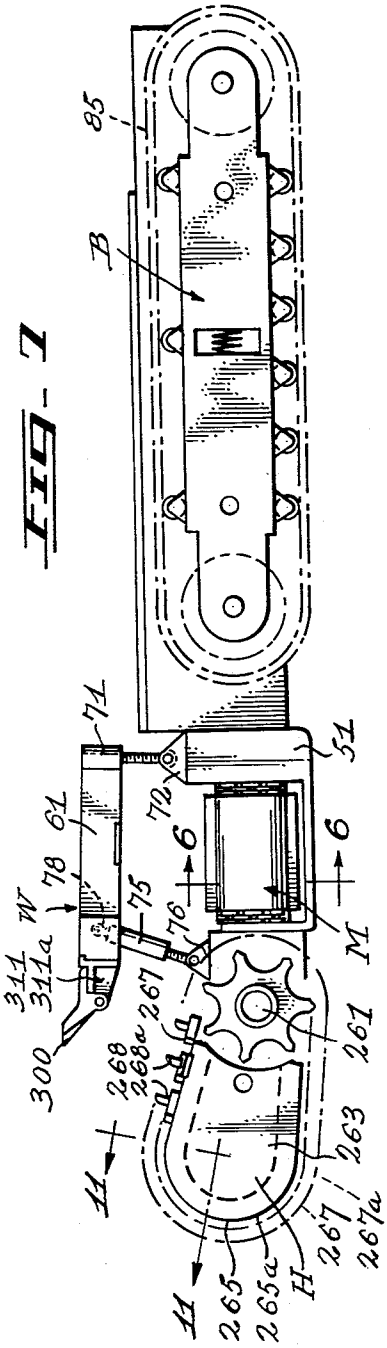
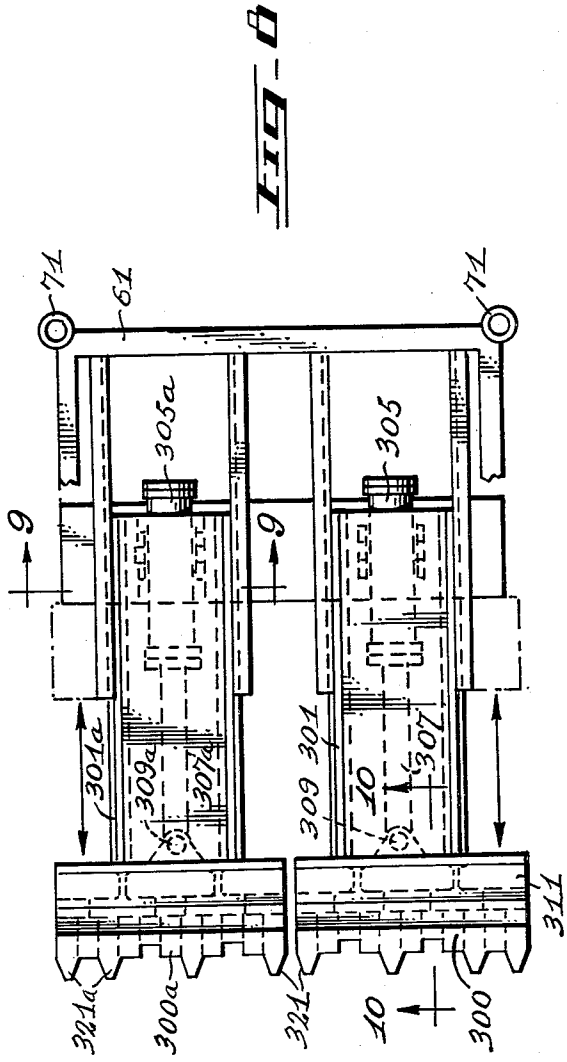


Fig. 8



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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 5

Fig. 11

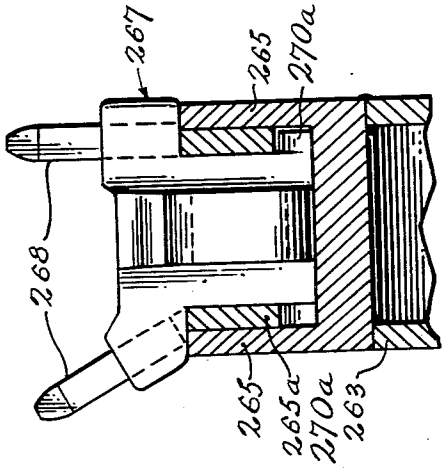


Fig. 10

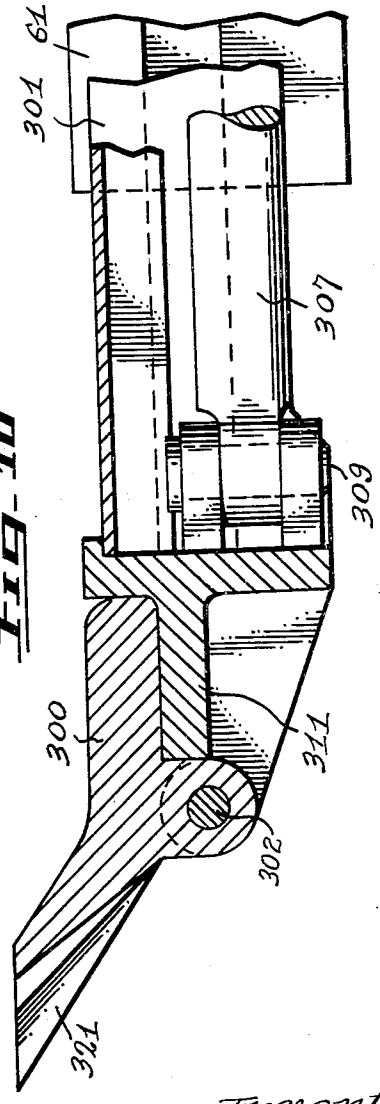
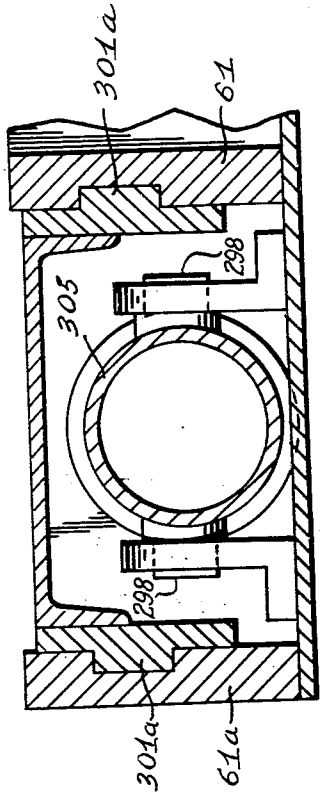


Fig. 9



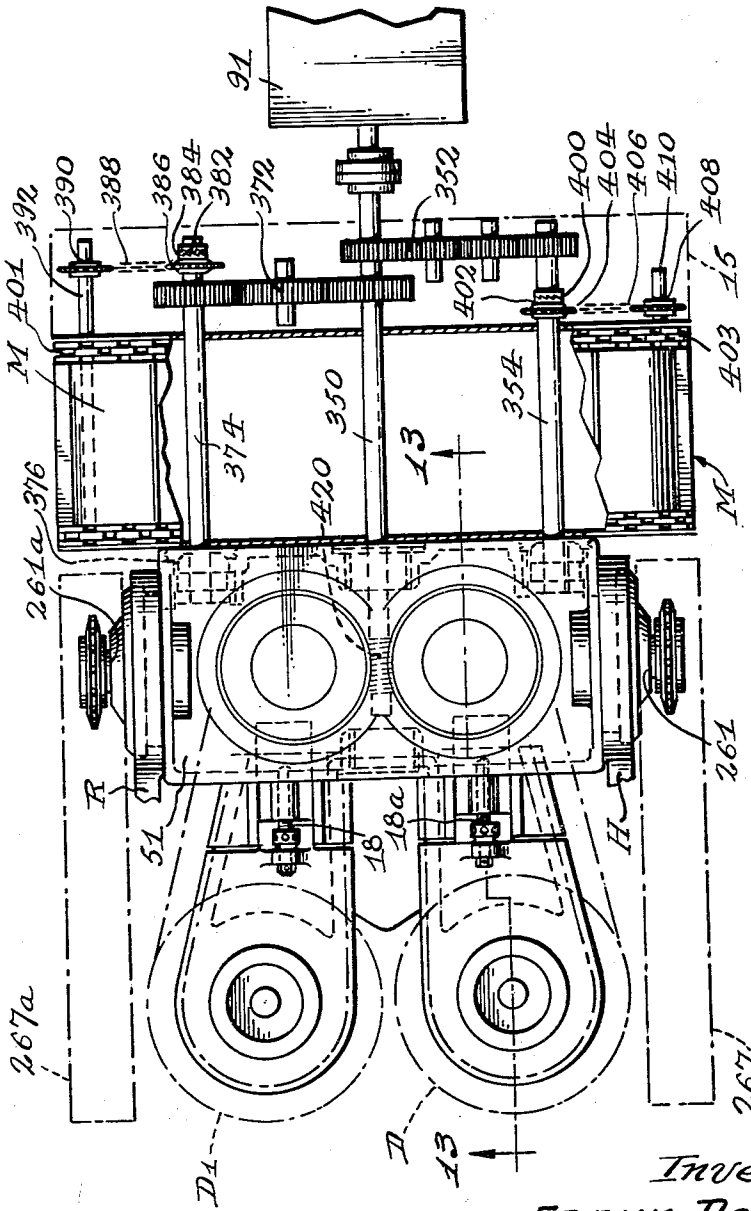
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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 6

FIG. 12



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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 7

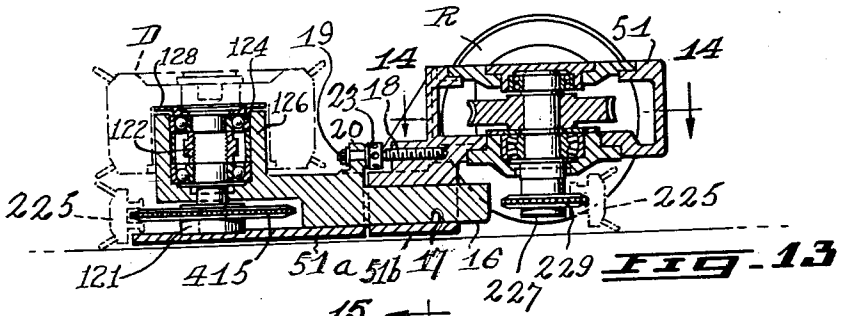


FIG. 13

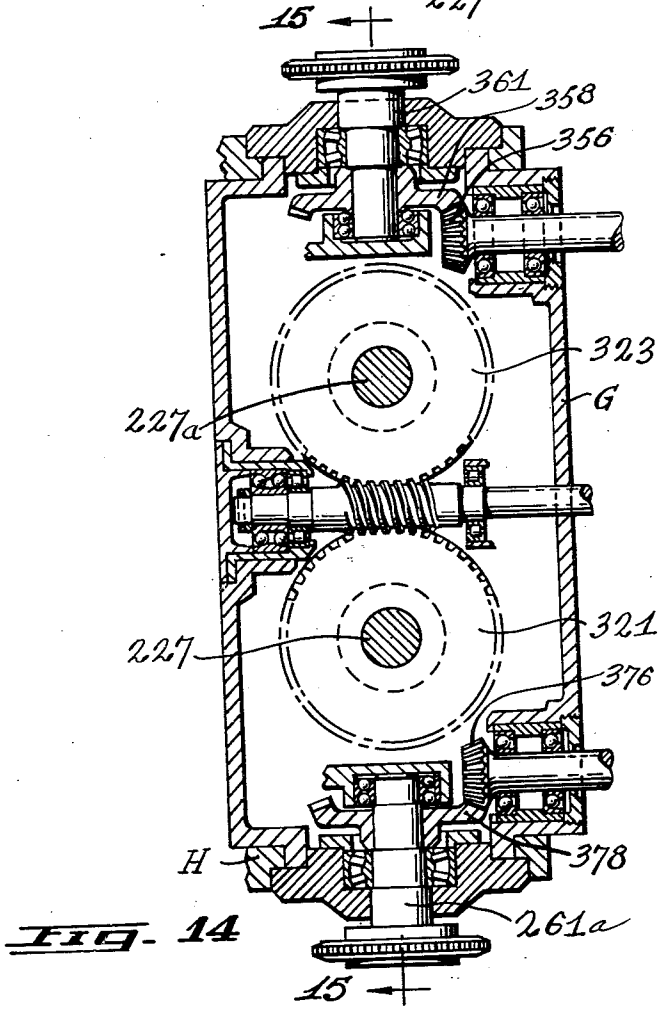


FIG. 14

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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 8

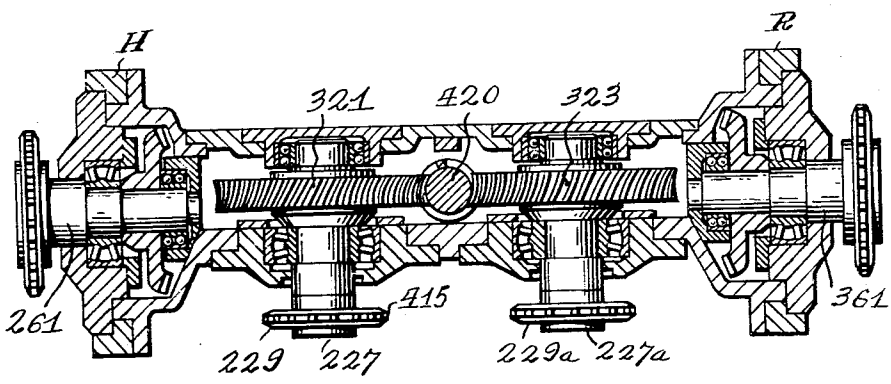


Fig. 15

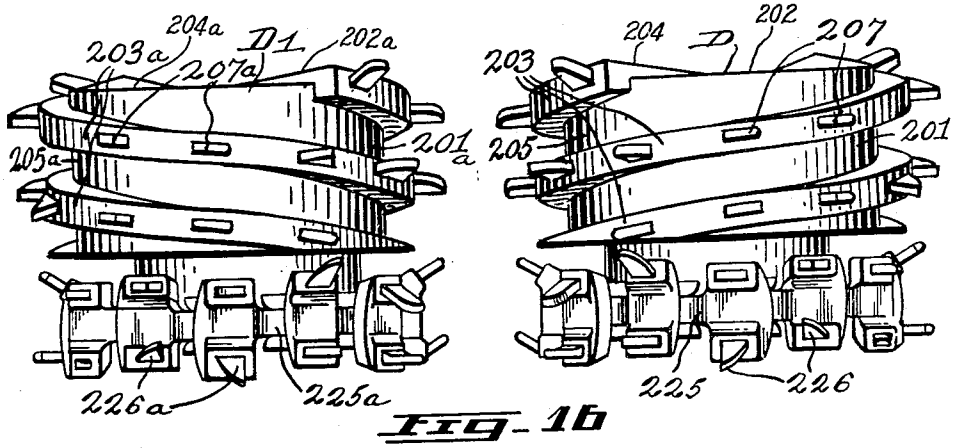


Fig. 16

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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 9

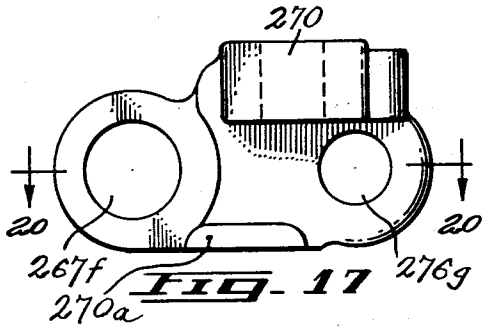


Fig. 17

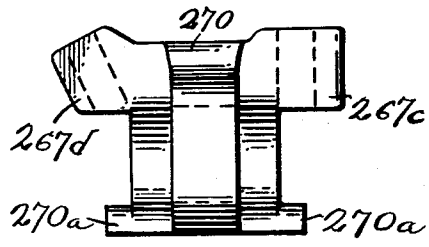


Fig. 19

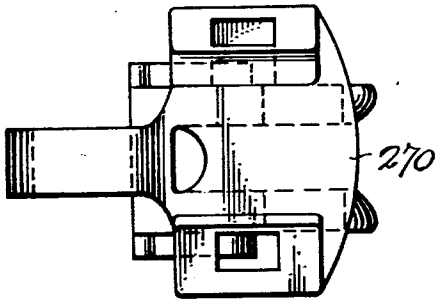


Fig. 18

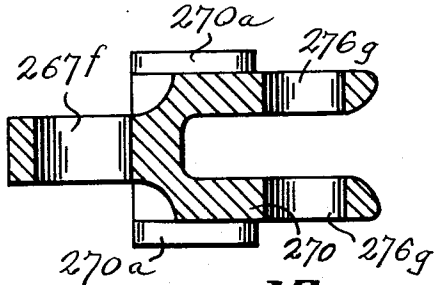


Fig. 20

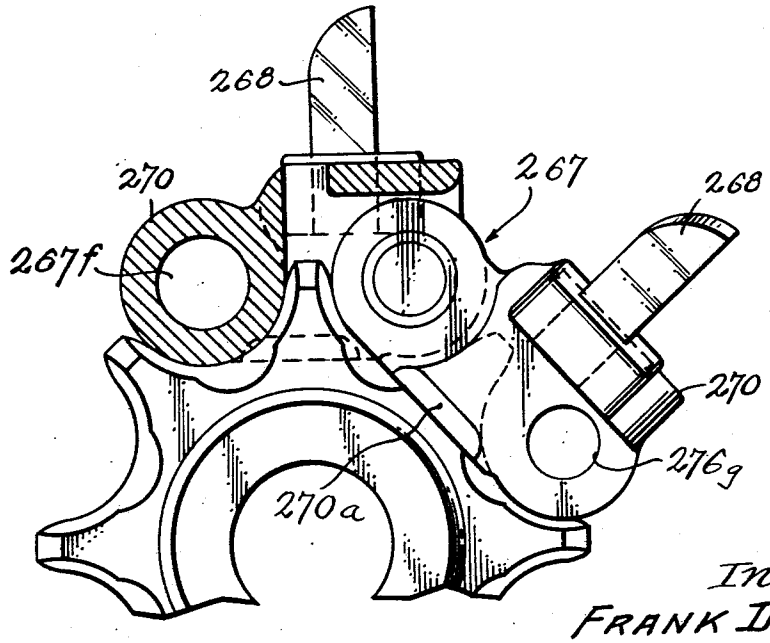


Fig. 21

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Oct. 31, 1961 F. DOXEY 3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 10

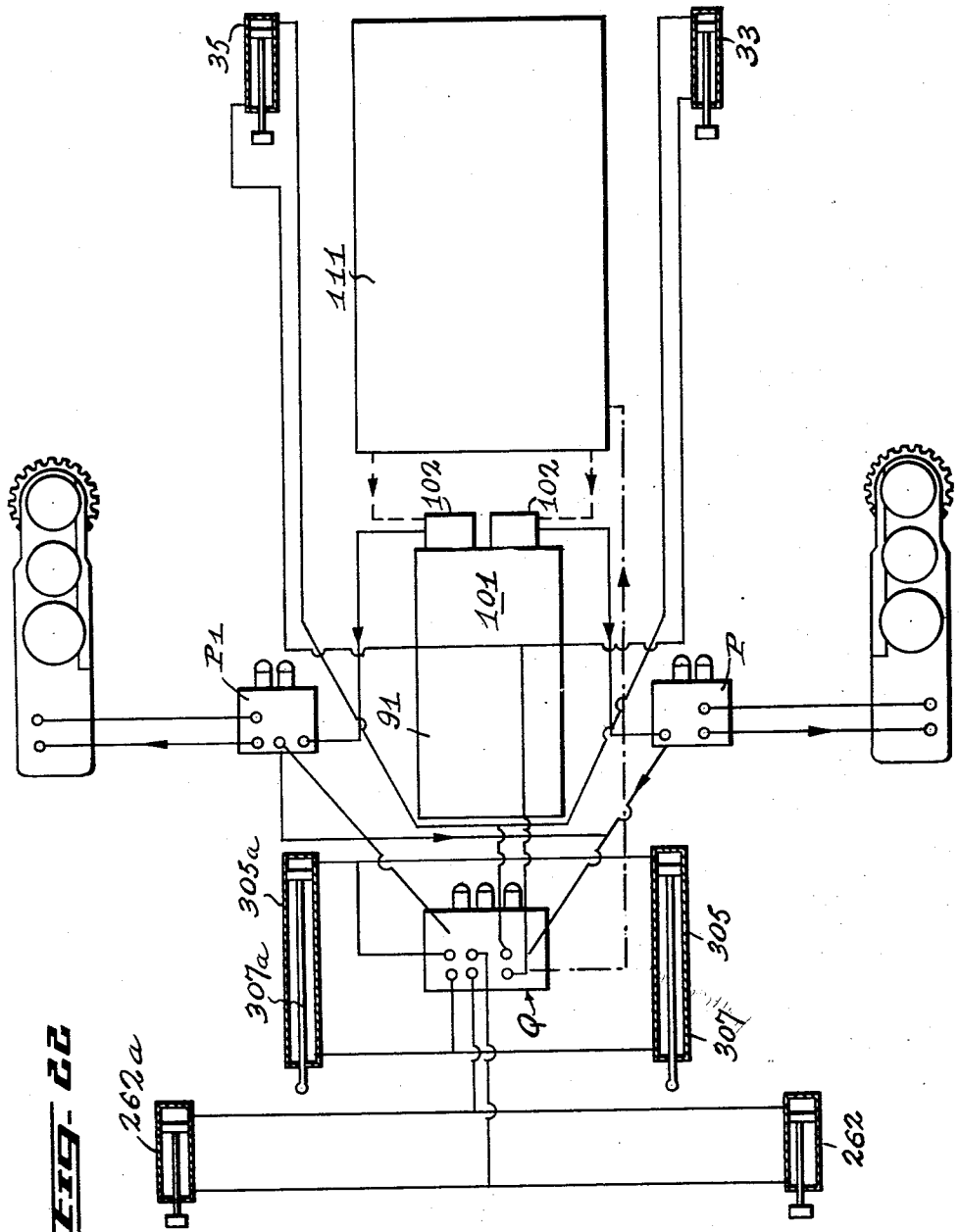


Fig. 22

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CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Filed April 15, 1958 11 Sheets-Sheet 11

Fig. 23

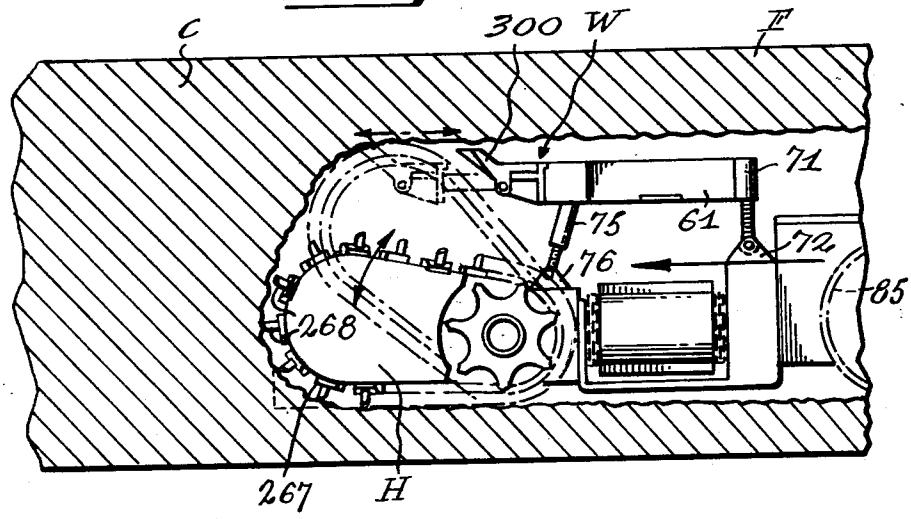


Fig. 24

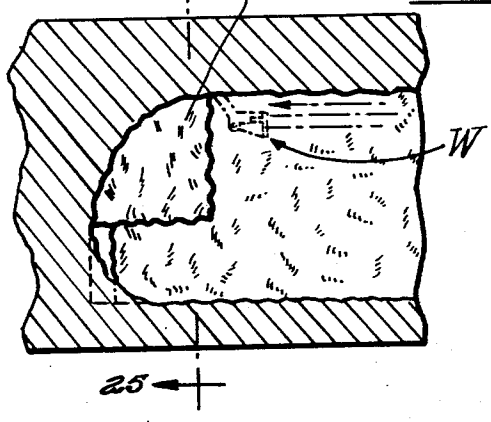
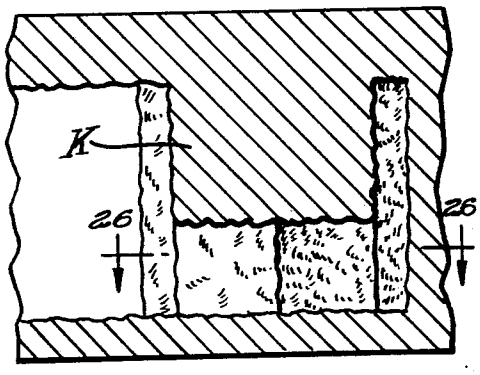


Fig. 25



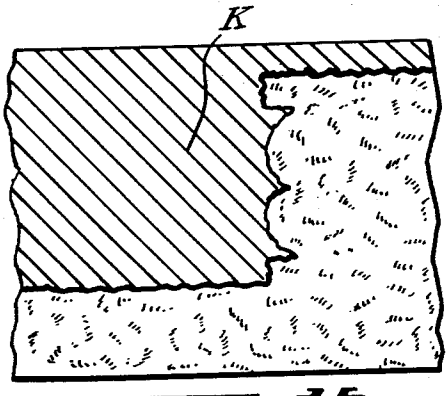


Fig. 26

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United States Patent Office 3,006,624 Patented Oct. 31, 1961

3,006,624

CONTINUOUS MINING MACHINE HAVING VERTICAL CUTTING ROTORS

Frank Doxey, Sydney, Nova Scotia, Canada, assignor to Dominion Coal Company, Limited, Sydney, Nova Scotia, Canada

Filed Apr. 15, 1958, Ser. No. 728,698
Claims priority, application Canada Feb. 25, 1958
6 Claims. (Cl. 262—9)

This invention relates to a machine for longwall mining.

It is particularly adaptable to mechanical longwall mining of minerals, for example coal, occurring in thin veins.

Mechanical longwall mining of minerals in narrow veins is fraught with problems. In the first place, the machine employed must be relatively small in size but yet must contain all the elements necessary to attack the vein and to remove the mineral extracted. The roof supports must be kept close to the working face and the operator must be under newly supported ground. The mined product should not contain too much fine material nor on the other hand, big blocks which are difficult to handle. The machine must also be capable of providing a false roof under which to work should soft contaminating material overlie the vein, and must be capable of negotiating relatively small undulations in the seam.

The applicant's method involves attacking the vein to undercut it and at the same time to shear at the side of and above the undercut to the desired height of the seam to form a block which is clear of the seam underneath, at the face and two sides, and is only held at the roof and front. Part of the block is then wedged free from the top. The wedging action causes the block to break up into pieces of a convenient size which can be readily conveyed out of the cutting area.

This method is preferably carried out by an apparatus according to the invention which includes a combination of undercutting means, side shearings means and separately operable power-operated top-wedging means. Conveyor means is arranged to act in conjunction with the attacking means for conveying the mineral attacked and disintegrated from the attacking zone. A driving unit is provided which contains all the essential driving mechanism for advancing the machine and at the same time for actuating the attacking and conveying mechanism.

In accordance with the invention an undercut is made high enough to allow access for conveying away the small coal from underneath the overhanging block but not high enough for the cutting to cause an overabundance of fines. At the same time the undercut is sufficiently deep to provide an overhang over the forward portion of the cutting area which cannot be wedged off, but at the same time providing sufficient overhang at the rear of the forward overhang which can be wedged off without dislodging the forward portion. In practice the applicant prefers that the undercut be between about 3 feet and about 4 feet. The height of the undercut, the applicant prefers not to be greater than one-half the height of the vein, but preferably at least one foot. The shearing kerf is at least as deep as the undercut and preferably goes in further than the undercut. Preferably the height of the shearing kerf is to the height of the block to be wedged off which should be a height which leaves the desired overhang on the roof. The wedging should be to a depth sufficient to knock off a chunk of the block which has been partly severed from the vein and to leave a remaining overhang still adhering to the vein to roof the cutting area. Wedging should be to a depth of 4 inches up to preferably about 2 feet

or about half the depth of the undercutting. The figures given are relatively critical to achieve the desired results in terms of production and of end product quality.

The nature of the invention has generally been described and will now be referred to in more detail by referring to a machine according to the invention, of preferred construction, and particularly adapted to mining coal which is illustrated in the accompanying drawings and in which:

FIGURE 1 is a perspective view of the preferred machine.

FIGURE 2 is a top plan view of the machine of FIGURE 1.

FIGURE 3 is a bottom plan view of the machine of FIGURE 1, showing particularly the driving mechanism for the rotors and chain cutters.

FIGURE 4 is a cross-section along the line **4—4** of FIGURE 2.

FIGURE 5 is a cross-section along the line **5—5** of FIGURE 4.

FIGURE 6 is a vertical cross-section along the line **6—6** of FIGURE 7.

FIGURE 7 is a side elevation of the machine of FIGURES 1 to 6.

FIGURE 8 is a top plan view of the attacking unit with the wedges extended.

FIGURE 9 is a vertical cross-section along the line **9—9** of FIGURE 8.

FIGURE 10 is a cross-section along the line **10—10** of FIGURE 8.

FIGURE 11 is a cross-section along the line **11—11** of FIGURE 7.

FIGURE 12 is a top plan view, partly in section, of the machine with certain of the superstructure mechanism removed.

FIGURE 13 is a vertical cross-section along the line **13—13** of FIGURE 12.

FIGURE 14 is a cross-section along the line **14—14** of FIGURE 13.

FIGURE 15 is a cross-section along the line **15—15** of FIGURE 14.

FIGURE 16 is a schematic front elevation of the rotors and chains in relative position omitting certain details for clarity.

FIGURE 17 is a side elevation of a chain link with teeth removed.

FIGURE 18 is a plan view of a chain link with teeth removed.

FIGURE 19 is a front elevation of a chain link.

FIGURE 20 is a cross-section along the line **20—20** of FIGURE 17.

FIGURE 21 is a side elevation, partly in section, showing relationship of a sprocket to the chain.

FIGURE 22 is a schematic diagram of the hydraulic system.

FIGURE 23 is a side elevation of the machine at work in longwall mining.

FIGURE 24 is a view of the cut with the machine removed.

FIGURE 25 is a vertical cross-section as along line **25—25** of FIGURE 24.

FIGURE 26 is a horizontal cross-section as along line **26—26** of FIGURE 25.

GENERAL ARRANGEMENT

More specific reference will now be made to the drawings. A preferred form of machine illustrated is made up generally of a cutting and conveying unit A and a driving unit B. The machine is shown in FIGURE 23 working on a vein C.

The unit A includes a front frame **51** which is cantilevered from the main housing **80** which is pivoted on

pivots **36** and **36***a* extending through the wall of the housing **80** and through the wall of the housing B one at each side of the machine. Thus, the housing **80** is pivotally mounted within the housing B. The pivots **36**, **36***a* have respective heads **38** and **38***a* and securing nuts **40** and **40***a*. Hydraulic jacks **31** permit the adjustment of the height of the rear end of the housing **80**. These jacks are connected at the bottom end to the endless track housing B and at the top end to the rear end of the housing **80** as at **33** and **35**. It is thus seen that the front frame **51** is cantilevered to the housing **80**, while the housing **80** is hinged to the housing B.

Mounted on top of the rear part of the front frame **51** is a wedge housing **61**. The rear of the wedge housing is mounted on a column and spacing pin arrangement **71** which is connected to the front frame **51** as at **72**. The front end of the housing **61** is carried by hydraulic jacks **75** connected at the bottom end to the front frame **51** as at **76** and at the top end to the underside of the wedge housing as at **78**.

The driving unit housing **80** is rigidly connected directly to the front frame **51**. The unit B is provided with endless tracks **85** which are driven to advance or to retract the unit.

The housing contains an electric motor **91**, hydraulic pumps **101**, a hydraulic fluid tank **111**, electric control equipment **122** and an operator's control platform **131**.

GENERAL OPERATION

The overall operation of the device is as follows:

The entire machine is advanced into the cut by the endless track mechanism B. The cutting unit A both undercuts the vein with the chains **225** and **225***a* and rotors D, D_1 and shears it vertically with the chains **267** and **267***a* of the jibs H and R to form a block K partially severed from the vein, as shown in FIGURES 24, 25 and 26. The small coal resulting from the cutting and shearing operation is carried rearwardly by the chains **225** and **225***a* and is delivered to the lower run of the chain conveyor M. Then the power wedging mechanism W comes into play and wedges free the part K of the block which has been partly divided from the vein by undercutting and shearing. The wedging action also breaks up the block which falls down in pieces on top of the driving gear box and on to the conveyor M, joining there the small coal brought on to this conveyor as described. Then laterally on the conveyor M from the machine to means of transportation from the mine.

SPECIFIC FEATURES

The undercutting mechanism includes a pair of cutting rotors D and D_1, each mounted side by side on a vertical shaft **121**, **121***a* respectively.

The rotor D is made up of a body **201** which may be a casting, of a generally cylindrical form. The peripheral face of the body **201** is provided with a number of spiral lands **203** and intervening flutes **205**. These lands are each provided with a number of spaced-apart bits **207**. The top of the rotor D is formed with special faces **202** and **204** respectively which tends to give the coal an upward and rearward throw, flinging it into the path of the conveying mechanism M as shown in FIGURES 1, 2 and 16, the top faces **202** and **204** of the rotor D and **202***a* and **204***a* of the rotor D_1 are inclined in the same sense as the lands relative to a plane perpendicular to the axis of the rotor D and are so adapted to fling the material in the upward and rearward direction as they rotate. These faces **202***a* and **204***a* continually act on successive loads of the material as they rotate beneath it.

The rotor D_1 is of the same construction as the rotor D. Its parts are referred to by the same numbers as those of the rotor D qualified by the subscript "*a*." The spiral lands and intervening grooves spiral in the opposite direction to those of the rotor D.

Each shaft **121**, **121***a* is driven by the driving mechanism as will be described.

Around the side of the frame and co-operating with the cutting rotor D is a chain cutter including a track **221** on which runs an endless chain **225** provided with spaced cutting bits **226**. The chain **225** is driven from a vertical shaft **227** having a sprocket **229** which meshes with the chain. The chain **225** runs from a position close to a lateral conveyor M to beneath the cutting rotor D and back again. The chain **225** also drives the cutting rotor D in addition to co-operating with the rotor in disintegrating the vein. To this end the shaft **121** is connected to the sprocket **415** which carries the chain **225**, and mounted on the top of the shaft **121** is a sleeve **122** which runs on a bearing **124** housed in an upward cylindrical extension **126** of the front frame **51**. The sleeve **122** has a driving connection with the drive plate **128** forming a part of the rotor D. Thus the drive imparted to the shaft **121** by the chain **225** is transmitted to the rotor D. Through a similar mechanism the chain **225***a* drives the rotor D_1.

Likewise, there is an endless chain **225***a* which bears the same relationship to the cutting rotor D_1 as does the chain **225** to the rotor D. Similar numbers have been given to the chain **225***a* as to the chain **225** qualified with the subscript "*a*."

Mounted on shafts **261** and **261***a* are shearing jibs H and R respectively. The jib H is made up of a frame **263** carrying a track **265** on which runs a chain **267** carrying spaced cutter bits **268**. A hydraulic cylinder **262** acts between the frame **263** and the front frame **51** whereby the jib may be moved up and down. The parts of the shearing jib R have been identified by the same numbers as the shearing jib H but have been qualified by the subscript "*a*."

The construction of the wedge mechanism W is as follows:

A pair of wedge heads **311**, **311***a* are mounted pivotally, as at **298**, **298***a*, on a pair of wedge guides **301**, **301***a* for forward and backward movement on the wedge frame **61**. On the wedge guide **301** is an hydraulic cylinder **305**. An hydraulic piston **307** works in the cylinder and is pivotally connected at **309** to the wedge head **311**. On the wedge head **311** is pivotally mounted through a pivot **302** the wedge **300**. Each wedge is provided with teeth **321** and the preferred wedge is of substantially the overall shape shown on drawings. The wedge parts have been described in terms of the wedge head **311** at one side of the machine. The parts of the other wedge have been identified by the same numbers qualified by the subscript "*a*."

Mounted on the carriage **51** is a chain conveyor M which is carried by roller sprockets **401** and **403**, driven as will be described.

DRIVE

G is the gear box. **350** is the main shaft driven from the electric motor **91**. A chain of gears **352** connects the shaft **350** with the shaft **354**, which in turn drives a bevel gear **356**, which drives another bevel gear **358** on a shaft **261** which drives the jib chain **267**. Likewise, a gear **372** drivably connects the shaft **350** with the shaft **374**, which, in turn, is connected with a bevel gear **376** driving a bevel gear **378** on the shaft **261***a*, which drives the jib chain **267***a*.

The shaft **374** is provided with a clutch member **382**, which co-operates with the clutch member **384**, connected to a sprocket **386**, driving a chain **388**. The chain **388** connects with a sprocket **390**, which is mounted on a shaft **392** which drives the carrying chain of the conveyor M. The shaft **354** is provided with a clutch member **400** which co-operates with the companion clutch element **402**, connected with a sprocket **404**, which drives a chain **406**, which in turn drives a sprocket **408** mounted on the shaft **410**, which drives the carrying chain of the con-

veyor M in the opposite direction to the drive imparted by the sprocket **390**. The gears **352** are arranged to change the direction of the shaft **354** as compared with the shaft **374**.

The main shaft **350** is provided with a worm **420**, which engages worm gears **321** and **323**, mounted on the shafts **227** and **227***a* respectively. The worm gear **321** is mounted on the shaft **227**, on which, in turn, is mounted a sprocket **229** which drives a chain **225** which connects with a sprocket **415**.

The shaft **392** drives the sprocket **401** and the shaft **410** drives a sprocket **403**. The shafts **374**, **350** and **354** are all mounted on ball bearings.

The front frame **51** (see FIGURE 13) is made up of two parts **51***a* and **51***b*. The part **51***a* has a post **16** which slides in a sleeve **17** of the part **51***b*. The sliding movement of the post **16** in the sleeve **17** ensures alignment, along the axis of the machine, of the parts **51***a* and **51***b*, but allows forward and backward movement between these parts. A pair of connecting screws **18**, one on each side of the machine engages threaded openings in the part **51***b*. Each of the screws **18**, **18***a* has a part extending forwardly through an opening in an upward extension **20** in the part **51***a*. Additional parts of the connecting screw **18** will be described, it being understood that corresponding parts of the screw **18***a* bear the same numbers qualified by the subscript *"a."* A nut **19** on the end of the screw **18** bears against the forward end of the upward extension **20** and thus limits the forward movement of the part **51***a* relevant to the part **51***b*. An adjusting nut **23** serves to set the forward position of the part **51***a*, the chains **225**, **225***a* tending to pull the part **51***a* towards the part **51***b*. So, the connecting arrangement between the parts **51***a* and **51***b* also acts as chain-tightening means.

The conveyor member M is provided with a base **500**. The scrapers **501** push the coal along in contact with the base **500**. A guide **504** forms a continuation of the base **500** so as to guide the coal up above the end of the conveyor M and deposit it on the top run of the conveyor M.

The chains **267** and **267***a* are made up of links **270**. Each link **270** is provided with lips **270***a* which slide under a guide **265** forming part of the frame **263**. Teeth **268** are mounted in the links which are also provided with projections **267***c* and **267***d* which have teeth-receiving openings to receive the teeth **268**. Each link **270** is also provided with openings **267***f* and **267***g* to receive connecting pins. It will be understood that the chains **267** and **267***a* are identical so that this description serves to describe the parts of these chains.

HYDRAULIC SYSTEM

FIGURE 22 illustrates diagrammatically the hydraulic system. **101** represents an electric motor which drives two pumps **102** which take the hydraulic fluid from the tank **111**. By manipulation of valves, the fluid is directed to the endless track engines separately through valves P and P1 or simultaneously through the valve box Q to jib-lifting cylinders **262** and **262***a*, through the valve box Q to wedging cylinders **305** and **305***a*, and through the valve box Q to tilting cylinders as at **33** and **35**.

The operation of the machine is as follows:

In accordance with normal practice, a longwall face F is established and appropriate means for conveying the mineral from the site of cutting is set up. The machine is brought into position at the end of the face to start a new cut.

The machine is started, to rotate the cutting rotors D and D1, to move the cutting chains **225** and **225**A and the chains **267** and **267***a* of the shearing jibs H and R and conveying mechanism M, described above. Then the entire machine is advanced by the thrust of the drive unit B against the vein.

The cutting rotors D and D1 and the chains **225** and **225***a* undercut the vein. At the same time one of the shearing jibs H or R shears the back of the cut. Coal coming from the cutting rotors D, D1, chains **225** and **225***a* and jibs H and R is projected rearwardly to the lateral conveyor M which delivers it to other means of transportation from the mine.

The machine is advanced until the wedge teeth **300**, **300***a* engage the vein. Then the power of the wedging unit W is brought into play and the wedges are forced forward to wedge between the overhanging block of coal and the roof. Sometimes the wedges will wedge between the coal and the roof, sometimes they will wedge into the coal itself to form a new roof should soft contaminating material overlie the vein. This has the effect of dislodging part of the block which has already been partially separated from the vein by undercutting and shearing. The block is dislodged and at the same time, because of the brittleness of the coal, disintegrated. It falls to pieces on to the conveyors. The pieces then fall rearwardly on to the lateral conveyor M which removes the coal from the machine.

The wedging action can be intermittent or continuous. In other words, the undercutting and shearing can be carried for a distance and the cutting mechanism stopped and the wedging takes place to remove partly severed block. Alternatively, the cutting mechanism can carry on continuously with the wedging action taking place either intermittently or continuously.

The cutting rotors serve not only to cut the vein through the operation of the bits **207**, **207***a* but the spiral lands **203** and **203***a* and flutes between them **205**, **205***a* act on the small coal produced by cutting and throw this rearwardly between the respective rotors D and D1. The spiral arrangement of the lands **203** and **203***a* and the flutes **205** and **205***a* causes raising of the small coal in an upward direction and tends to fling it upward and inward (towards the center of the machine). Then the material is thrown off the peripherical surface of the rotors D, D1 into the conveying area where it comes under the control of the lateral conveyor M. This action differs from that of previous machines. Generally, these machines operating with horizontal cutting elements merely churn the small coal about and drag it to the outside of the machine, so causing clogging of the machine or necessitating other equipment to remove the small coal from the pavement. The present apparatus, on the other hand, collects the small coal towards the center and deposits it on the conveyor M.

The machine can be used to operate in either direction along the cut.

One of the main problems that the present machine overcomes is that of roof stress relief. Attempts have been made to use a horizontal jib in cutting a horizontal kerf to release the block from the roof. However, when the block is released from the roof, stresses are immediately set up which cause the roof to settle imperceptibly. This has the effect of jamming the roof against the jib and bending the jib and causing it later to go out of line. This causes the jib to cut too low and leaves a downwardly sloping roof with consequent difficulties for starting the next cut. The applicant's machine eliminates this problem. The wedge being pivotally mounted will be depressed where the roof settles but when the wedge comes into contact with the solid vein ahead will rise to its normal position before it starts to push into the block to be disintegrated.

The height of undercutting is governed by the fact that the cut must be sufficiently deep to allow the cutting and conveying mechanism to go underneath the block. The maximum height of undercutting is governed by the height of the vein. The applicant prefers that the undercut should not exceed about 18 inches in height but is preferably at least 15 inches. The forward penetration of the shear kerf must be at least the maximum wedge stroke and is preferably more than this, for example, to the same depth as the undercut. This makes certain that

the shear is complete to the depth of the block to be wedged and moreover, with the preferred form of jib shown, the remaining block, remains held as shown in FIGURE 24.

The wedge stroke is preferably not more than about 18 inches. Quantitatively the depth of the undercut is governed by not penetrating so far that the remaining block after wedging will not remain connected to the vein, and yet going far enough that the wedge portion of the block will come off. In a thick seam, multi-wedges may be used rather than increasing the height of the undercut.

Preferably, the initial depth of the undercut is at least about 3 up to about 4 feet. The kerf at the side will preferably be about the same. The jibs H and R are urged upwards at the same time as the wedge W moves forward. The wedge preferably has a stroke of about one and one half feet. In other words, for the initial undercut, the machine will advance so that the undercut mechanism undercuts about 3 feet or 4 feet. Then, the wedge will advance one and one half feet and remove a one and one half foot chunk of the 3 or 4 foot block partly separated by undercutting and shearing.

The limits for the various cuts are as follows: The undercut would range up to about 4 feet and would never be less than about 3 feet. The same goes for the shearing. The wedge stroke may be continuous or intermittent and may vary from about 4 inches to not more than one and one half feet.

The rotors must always be kept covered by part of a block which has not been severed from the roof. Therefore, the stroke of the wedge must be of such length as to leave an unsevered block overhanging the rotors.

The machine can operate on seams having a varying pitch, for example, up to steep pitches of about 30%. On the steeper gradients it is usual to cut downhill and on the slighter gradients either up or downhill. Horizontal seams are cut both ways.

An auxiliary driving mechanism, for example, rope or cable haulage can be provided, for instance where the machine operates on a pavement of relatively soft material. Alternatively, the housing **80** may be forwardly movable by hydraulic means, with respect to the housing B so that the cutting mechanism may be advanced to attack the seam, while the housing B is locked in a stationary position.

The size of the elements of the machine are important to a point. It is preferable to undercut as little as possible yet to make room for the machine. The applicant prefers not to go over 18 inches in undercutting. This means that the undercut will be the sum of height of the chain and rotors. Generally, the chain is about 6 inches in height and rotors are about 9 inches. The diameter of a rotor will be approximately 2 feet.

The width of the kerf in the shear is approximately 6 inches so that the rotors and shear jibs combine to give a total undercut width of about 5 feet.

The material from which various parts will be made will be evident to anyone familiar in the art, the following being preferred for important parts.

The cutting parts are tungsten carbide-tipped and the other cutting and wearing parts are made from high grade steel or other suitable metals. The wedges **300** and **301***a* are preferably of high strength heat-treated steel.

The machine including the driving of the attacking and conveying mechanism is all powered by a 150 H.P. electric motor. The wedging mechanism is powered preferably by a hydraulic unit capable of delivering a pressure of 1500 pounds per square inch.

The present invention is particularly applicable to mining coal, especially bituminous coal, which occurs in relatively narrow veins, but it can also be applied to mining other friable materials, for example salt or potash.

The term "wedging" as used in this application defines the action of forcing a wedge member or members slowly into the coal across a substantial width of a block of coal. In accordance with the invention such wedging takes place after the block has been undercut and sheared. The speed of advance of the wedge is usually from about 9 feet to about 12 feet a minute relative to the coal.

Example I

This is a typical example of longwall mining of coal for relatively thin veins. The data is for a vein 4 feet in height.

The dimensions of the machine employed are approximately as follows. Driving unit A, 2 feet high. Width of driving unit 4 feet 6 inches. Width of cutting unit outside of jib H to the outside of jib R was 5 feet. The remainder of the apparatus is substantially proportionate as shown on the drawings.

The example is based on bituminous coal of a type found in the area of Sydney (Nova Scotia, Canada). It has 14 inches of soft contaminating material, mainly clay and shale, over the top of the vein and a pavement on which the machine is operated of fire clay, a relatively soft material.

The machine is operated as described in this specification to attack the vein. It advances at the rate of approximately 3 feet per minute for a distance of 500 feet to make one complete cut along the face. The wedging action is performed in such a manner as to leave 6 inches of roof coal underneath the soft contaminating shale. Props are placed under the roof immediately after the machine has passed under it.

The machine attacks the vein and disintegrates the coal and delivers a completely uncontaminated (contained no foreign matter) product from the conveyor and to auxiliary conveying means which takes it out of the mine. The yield from the 4 foot seam of mined coal is approximately 60 percent round and approximately 40 percent small. The round is plus 1¼ inches and the small below this figure. The total amount of coal mined in the cut is about 320 short tons. The round and small coal is brought out longitudinally of the machine by the conveyor system.

ADVANTAGES

Among the advantages of the invention are the following. It is particularly adaptable to mining with high efficiency in a thin seam. It provides a very high yield of rough product from the vein, in contrast to some prior methods which provide an over-abundance of fine material. The spiral action of the cutting rotors elevates the fine material cut from the seam and throws it clear of the site of cutting so that the tendency to clog is removed and the operation can be continued at a higher rate. It is capable of providing a false roof under which to work which is particularly advantageous if there is friable contaminating material immediately above the vein. The present method leaves a clean straight wall at the back of the cut. The wedging mechanism can be adjusted to any desired height to compensate for variation in seam thickness and the pivotal construction of the wedges takes care of roof stress relief.

The machine has been described in connection with coal mining. It will be understood, however, that it is applicable to mining other minerals occurring in similar deposits and having similar characteristics.

I claim:

1. A device for longwall mining of mineral, including an attacking unit, said attacking unit having a body including a gear box having a relatively flat top surface and a pair of arcuate front faces forming a housing, a pair of cutting rotors mounted on said body with vertical axes concentric with and adjacent to said arcuate front faces, said rotors extending substantially to the height of the body and having a bottom surface spaced from the bottom of the body, the rotors being provided with spiral lands and intervening channels, said lands being provided

with cutting elements, a pair of cutting chains being mounted beneath said rotors to operate one in the orbit of each rotor and extending rearwardly to within the body, means for driving said cutting chains and the rotors in opposite directions with the front surfaces of said rotors rotating inwardly of the machine, at least one kerf cutting mechanism mounted on the side of the body and including a frame and running on the frame a cutting chain oriented for operating in a vertical plane and means for driving said kerf cutting mechanism, the rear of said body being provided with a transversely extending trough, a conveyor mechanism mounted in said trough to convey laterally from the machine mineral pieces thrown by the attacking mechanism rearwardly on to the conveyor, a wedging mechanism mounted on top of the body for vertical adjustment, said wedging mechanism including wedging elements adapted for forward movement into a block of mineral formed from the vein by the cutting mechanism, and means for operating said wedging mechanism.

2. A longwall mining machine comprising in combination a vein attacking mechanism and a driving mechanism, said attacking mechanism being provided with a body having a base adapted to slide along the pavement; said driving mechanism including a chassis mounting propelling elements, said driving mechanism body being pivotally mounted within said chassis for relative up and down movement, said driving mechanism body being rigidly connected to said attacking mechanism body whereby the attacking mechanism may be inclined in an upward or downward direction by the upward or downward inclination of the driving mechanism body, means acting between the driving mechanism body and the chassis for inclining the driving mechanism body up or down in relation to the chassis; said attacking mechanism having mounted thereon means for undercutting including a pair of spaced apart rotors and including cutter elements to undercut the vein of mineral being attacked and a cutting chain beneath each rotor to operate in the orbit thereof, means to drive said chains and said rotors, at least one kerf cutting mechanism mounted on said attacking mechanism body and adapted to co-operate with said rotors and horizontal cutting chains to cut a substantially vertical kerf simultaneously with the undercutting operation, the rotors having a vertical axis, spiral lands and intervening flutes and top platforms inclined in the same sense as said lands to a plane horizontal to said axis to throw mineral in upward and rearward direction; a wedging mechanism also mounted on said cutting mechanism body including a pair of wedging elements adapted to advance into the block of mineral to wedge free and disintegrate the block and a conveyor mechanism mounted to the rear of the wedging and cutting elements and adapted to receive the cut and disintegrated mineral thrown rearwardly from the cutting mechanism and to convey it to one side of the machine, driving means in said driving mechanism body and drive connections between said driving means and the cutting and conveying mechanism, a hydraulic power unit mounted in the said driving mechanism body and having a driving connection with said wedging mechanism.

3. A longwall mining machine as defined in claim 2 wherein said drive means for said cutting chains and said spaced rotors includes a pair of driven sprockets operatively connected to said driving mechanism and rotated thereby and a pair of sprockets spaced from said rotors and operatively connected thereto, each of said cutting chains engaging one of each of said pairs of sprockets whereby upon rotation of said first pair of sprockets motion will be transmitted through said cutting chains to said second pair of sprockets to drive said spaced rotors.

4. A cutting apparatus of the type described having an attacking unit, said attacking unit including a pair of cutting rotors mounted with vertical axes in laterally spaced apart relationship, said cutting rotors having a peripheral face provided with spiral lands intervened by spiral grooves, means for driving said rotors in opposite directions whereby their forward surfaces are moving inwards, the lands being arranged to rise in the outwards direction thereby to fling the cut material in an upward and inward direction, the rotors being provided with top faces inclined in the same sense as said lands to a plane parallel to the said axes thereby being adapted to fling the material in the upward and rearward direction, and picks on the lands to cut the mineral being attacked.

5. A cutting rotor for mining machinery comprising a cylindrical body provided with spirally arranged lands intervened by flutes, said lands being provided with spaced-apart cutting-bits, said rotor having a vertical axis and a top face inclined in the same sense as said lands with respect to a plane perpendicular to said vertical axis thereby being adapted to fling material in an upward and rearward direction with the rotation of the rotor about said axis.

6. A cutting apparatus including a pair of cutting rotors, as defined in claim 5, said rotors being mounted on vertical parallel axial shafts to rotate in spaced-apart relationship in opposite directions, the rotors being adapted to pass the material cut between them and to throw it upward and rearwardly.

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