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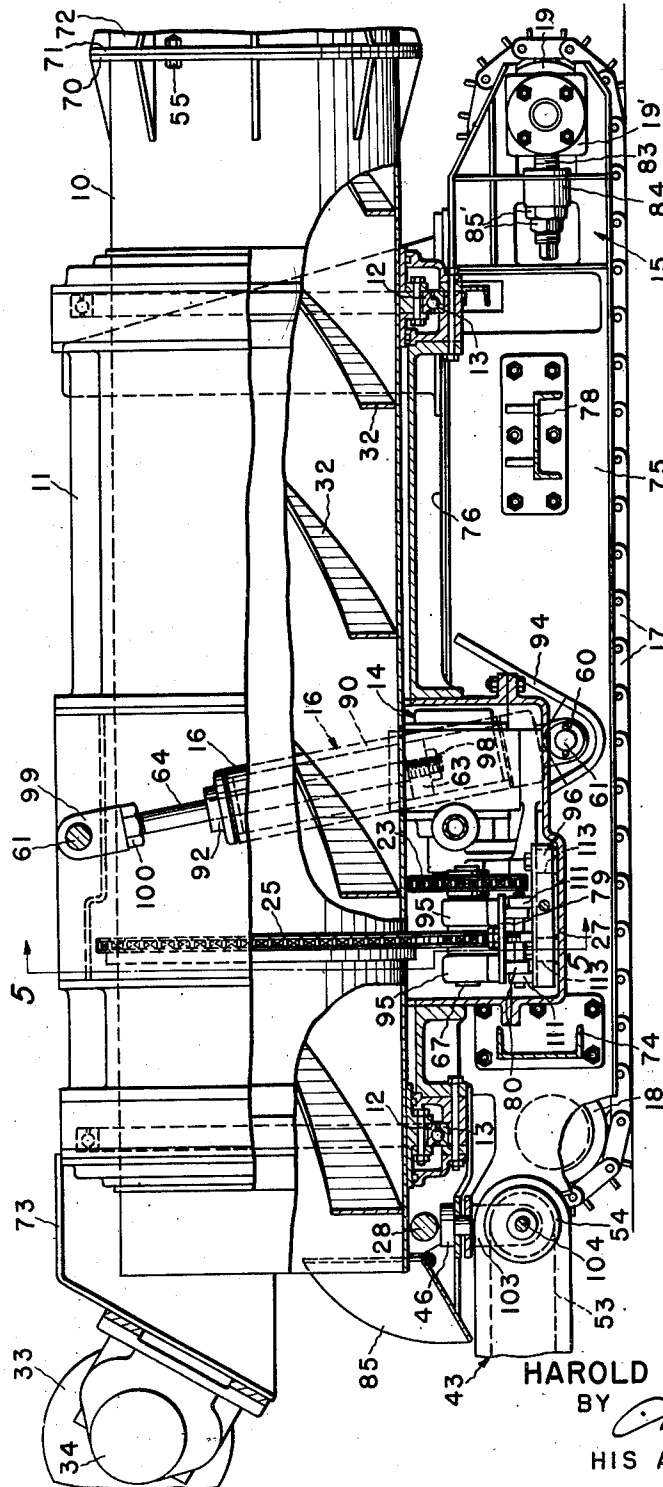
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2,821,374

COAL MINING MACHINE HAVING A PIVOTALLY MOUNTED CUTTER TUBE

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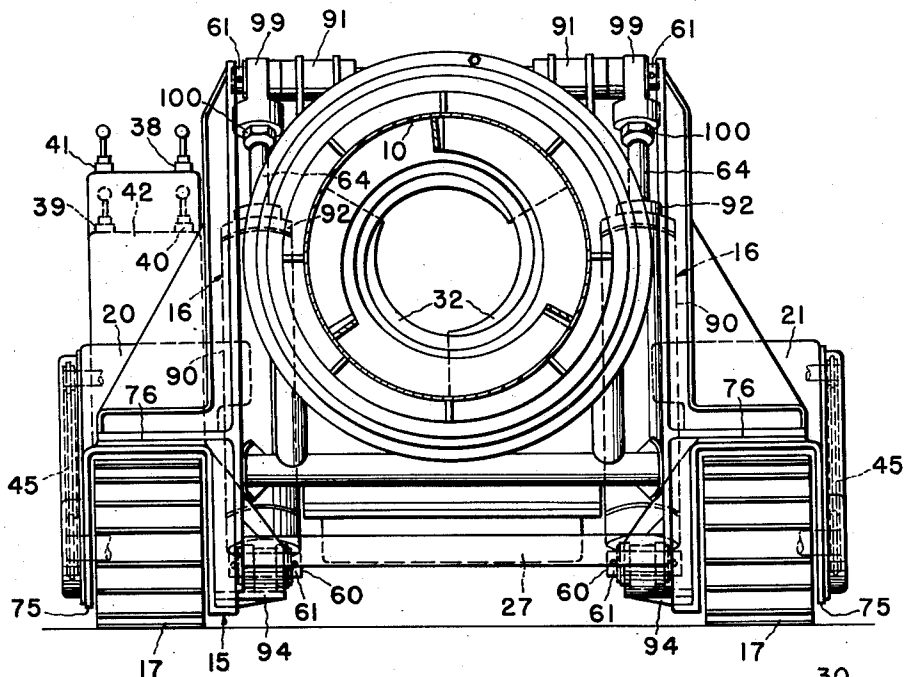
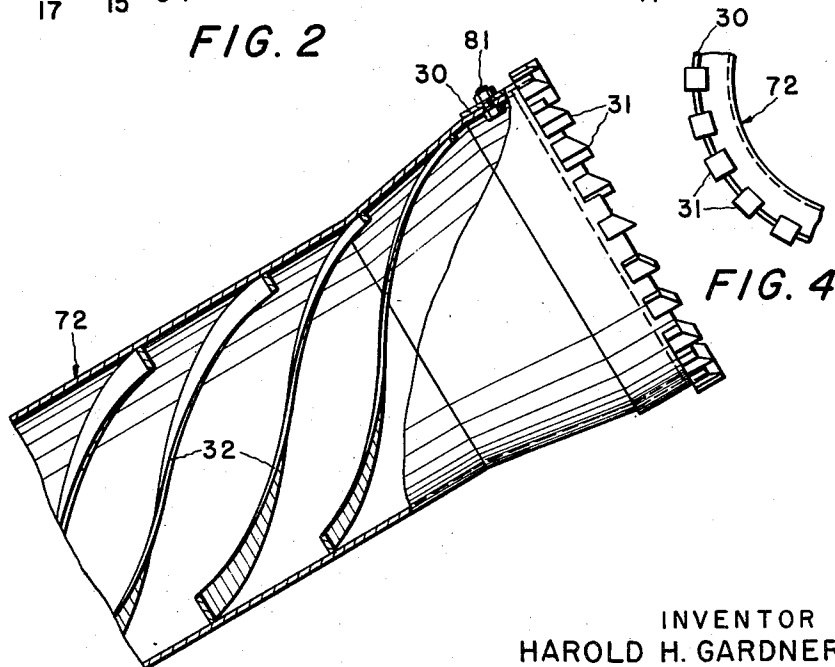
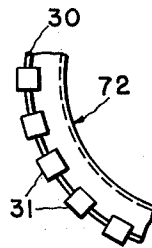
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4 Sheets-Sheet 2



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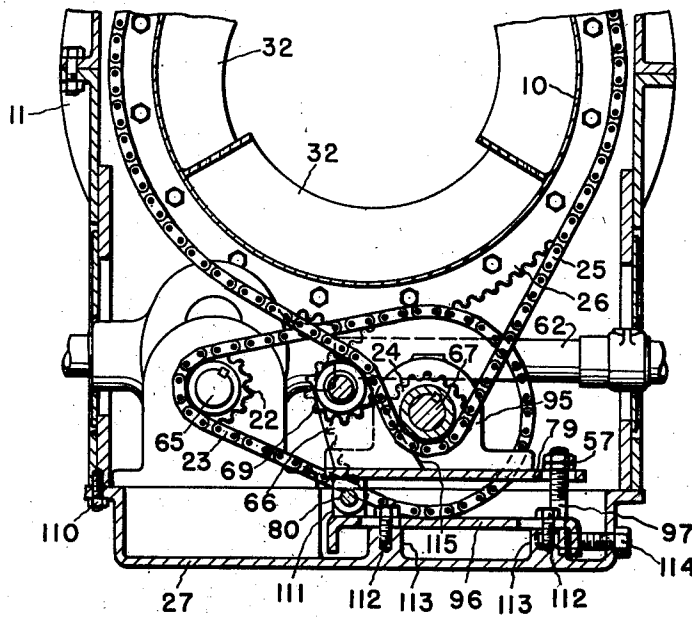


FIG. 5

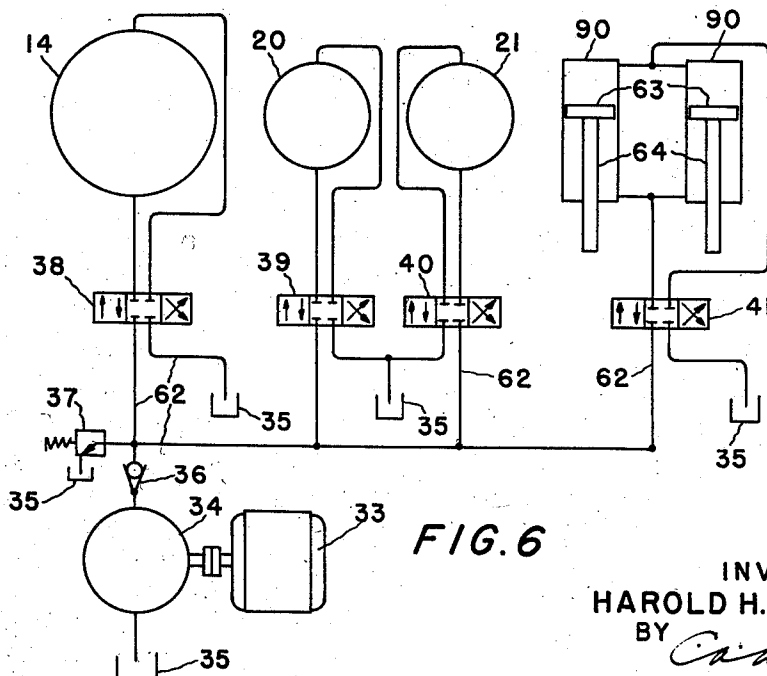


FIG. 6

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COAL MINING MACHINE HAVING A PIVOTALLY MOUNTED CUTTER TUBE

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3 Claims. (Cl. 262—26)

This invention relates to a mining machine, and more particularly to a coal mining machine which is a combination coal loader and cutter of the continuously operating type.

One object of this invention is to provide an improved coal mining machine which cuts and transports coal from the seam continuously and simultaneously.

Another object is to provide a self-propelled, easily maneuverable machine that will load and carry away coal continuously.

Still another object is to provide easy means to reach, cut and remove coal from hard-to-get-to places, such as the overhang in a seam.

Other objects will become obvious in the following specification and accompanying drawings.

Fig. 1 is a side view partly broken away, and partly in section, of a completed machine constructed in accordance with the practice of the invention; the forward part of the cutter cylinder is not shown in this view;

Fig. 2 is a front view of the machine showing the cylinder pointing directly ahead; the forward section of the cutter cylinder being removed;

Fig. 3 is a side view partly in section of part of the forward end section of the cylinder;

Fig. 4 is a partial front view of the cutter cylinder, partly in section, showing the cutting teeth along the periphery;

Fig. 5 is a transverse view taken along line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 is a diagrammatic plan showing the hydraulic circuit of the machine in its preferred form;

Fig. 7 is a plan view of the preferred form of the machine showing more particularly the conveyor system;

Fig. 8 is a diagrammatic view of mining operations illustrating the use of the machine in removing the portion of the overhang;

Fig. 9 is a diagrammatic view of mining operations showing the use of the machine as a loader.

Referring to Fig. 1, the machine consists of a rotatable cutter cylinder 10 having internal conveyor flights 32 to carry the core and cuttings to the rear where they are dumped onto the tail conveyor 43 or other receiving device, the cylinder 10 being mounted pivotally at one end on a self-propelled chassis 15.

The cutting unit is seen to comprise the cylinder 10 which is rotatably mounted on the frame 11. The frame 11 may be formed as a sleeve concentric with the cylinder 10 and has anti-friction bearings comprising an inner race 12 on the cylinder 10 and an outer race 13 on the circumference of frame 11. Frame 11 is mounted on the chassis 15 by a pivot 28 which allows the frame 11 and with it the cylinder 10 to swing vertically.

Referring to Fig. 2, the chassis 15 has two side track housings 75 of inverted U form, the legs of each U extending downward to protect tracks 17 and the bases of the U's form platforms 76 on which the operator may stand and also a support for parts referred to herein-

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after. The housing 75 are rigidly connected by cross braces, one of which is shown at 74, Fig. 1, and another at 78.

Chassis 15 is supported and propelled by well-known track-laying type treads having the rear drive wheels 18, front running wheels 19 and tracks 17. The tracks 17 are powered by motors 20 and 21, indicated in Fig. 2, conveniently mounted on chassis housings 75, which rotate the drive wheels 18 by means of the chain drive 45. By independently controlling motors 20 and 21 the machine may be steered in the well-known manner. Screw 83, Fig. 1, exerts a longitudinal force against the bearing box 19' of front running wheel 19 to take up any slack in track 17. Screw 83 is threaded through sleeve 84 which is secured to chassis housing 75 and is provided with lock-nuts 85' screwed on screw 83 against sleeve 84.

In the preferred arrangement extensible means such as hydraulic rams 16 are used to raise cylinder 10 on pivot 28, which extends horizontally across the rear of the chassis 15. The hydraulic rams 16 are mounted on chassis 15 by means of the pivots 60 (Fig. 2), and on a shaft 61 supported at either side of frame 11 by brackets 91. Each hydraulic ram 16 has a cylinder 90 and a corresponding piston 63 having a rod 64 extending through gland 92 to bearing block 99. Nut 100 on rods 64 locks rod 64 to bearing block 99.

The cylinder 10 is rotated by motor 14 (Fig. 1), having a shaft 65 (Fig. 5), on which is keyed sprocket 22. A larger sprocket 66 is driven from sprocket 22 by a chain 23. Sprocket 66 and a smaller sprocket 24 are both keyed to a shaft 67 which in turn drives the cylinder 10 by a chain 25 engaging peripheral sprocket 26 mounted on the outer circumference of cylinder 10.

Motor 14 is suitably mounted on base 27 which suspends from frame 11 being bolted thereto as at 110. Slack in chain 25 is taken up by the means for mounting the lay shaft 67 in cooperation with an idler sprocket 69. To this end, the bearing blocks 95 of shaft 67 are mounted on a plate 79 hinged at one end on a pivot 80 mounted on a base plate 96 having suitable lugs 111. The base plate 96 is bolted to the base by cap screws 112 passing through slotted holes in plate 96 into bosses 113 extending upwardly from the base 27. An adjusting screw 114 passing through the side of the base 27 and threaded into the flanged side of plate 96 regulates the position of the shaft 67 with respect to the motor shaft 65 to take up slack in chain. Idler sprocket 69 is mounted on bearing plates 115 (only one of which is shown) extending upwardly from plate 79 to position the sprocket 69 between peripheral sprocket 26 and sprocket 24 and engage chain 25. The weight of mechanism supported by plate 79 tends to depress the plate and tighten chain 25. The plate 79 is kept in the depressed position by means of a stud 97 passing through plate 79 and provided with locking nuts 57.

Cylinder 10, Fig. 1, constitutes the base of the cutter assembly there being provided a forward cylinder section 72 mounted upon the forward end of cylinder 10. For this purpose there is provided a flange 70 extending radially outward from the forward end of cylinder 10 and bolts 55 to engage flange 71 extending radially outward from the rear end of cylinder section 72. A ring 30, Figs. 3 and 4, is provided at the forward end of cylinder section 72 to cut into the coal face by means of a series of teeth 31 in the ring 30 facing forward. The ring 30 is bolted to the forward periphery of cylinder section 72 by bolts 81.

To carry the core and cuttings from the forward end of cylinder section 72 to the rear, means is provided consisting of flights 32 which extend, from front to rear, spirally along the inner periphery of cylinder section

72. Cylinder 10, Fig. 1, is also equipped with similar spiral flights, extending from the front to the rear, which join those of cylinder section 72 when attached to cylinder 10, thus forming a continuous series of spiral flights extending from the forward end of cylinder section 72 to the rear of cylinder 10. The spiral flights vary in height continuously from about zero at the forward end of cylinder section 72 to about 25 percent of the diameter of cylinder 10 at the rear end thereof, and also increase in pitch from the front of cylinder section 72 to the rear of the cylinder 10. Upwardly disposed U-shaped trough 85 is mounted on the rear of frame 11 directly under the rear of cylinder 10 to dump the material onto a suitable conveyor 43.

In the preferred arrangement the machine may be used in conjunction with a conveyor 43 as seen in Fig. 7. Tail conveyor 43 may be of the belt type, having a plurality of idler and stretcher wheels 54, Fig. 1, one only being shown, the actual number depending upon the length of the system. A bracket 103 for supporting the conveyor 43 is attached to the underside of pivot 46. Horizontally disposed pin 104 is mounted on supporting bracket 103, on which vertically disposed stretcher wheels 54 are mounted. Belt 53 of conveyor 43 passes around stretcher wheel 54. Belt 53 is so located that it passes directly beneath the rear end of cylinder 10. Upwardly disposed flanges 47, Fig. 7, are mounted on either side of tail conveyor 43, adjacent to the machine.

The other end of tail conveyor 43 has a coupler 48 consisting of a frame formed by the side plates 87 and cross members 88. The side plates support flange wheels 51 which are guided on tracks 52, mounted on the room conveyor 44. These flange wheels 51 permit the coupler 48 to move longitudinally along room conveyor 44. The upper portions of coupler 48 are equipped with trunnions 49 to permit vertical movement of tail conveyor 43. The tail end of conveyor 43 is rotatable horizontally on swivel 108, which rests on the top surface of cross plate 109, which is attached to side plates 87. The center portion of swivel 108 consists of the circular opening of open hopper 50 which is directly above room conveyor 44. Room conveyor 44 may be also of the well-known endless belt type. Its endless belt 107 may reverse direction at anchor platform 56, which is located in a relatively permanent position. Anchor platform 56 consists of cross members 131 and side members 130 between which is mounted horizontal pin 140. Belt 107 passes around vertically disposed stretcher wheels 86 which rotate on pin 140.

Power for all units of the machine is supplied by hydraulic pump 34, Fig. 1, which utilizes a liquid such as oil. Hydraulic pump 34 is mounted on base plate 73 which is attached to the rear of frame 11. Electric motor 33 is mounted also on base plate 73 and is coupled to pump 34 by means of shaft coupling 132, Fig. 7. Control housing 42, Fig. 2, mounted on platform 76 on the side of frame 11, houses the control valves 38, 39, 40 and 41 which operate the power units of the machine.

The preferred hydraulic circuit for the machine is diagrammatically represented in Fig. 6. Hydraulic pump 34 driven by electric motor 33 draws oil from oil sump 35 and forces it through check valve 36. Oil sump 35 diagrammatically represented in conventional symbols contains sufficient hydraulic liquid to supply all the motor units of the machine while in operation. When oil is exhausted from the power units it drains back into oil sump 35 and is reused. Any excess oil supplied by pump 34 and not used by the power units of the machine will pass to the oil sump 35 through spring loaded bypass valve 37 which is set to a predetermined oil pressure. Thus a constant oil pressure is maintained in the system regardless of how many power units are operating. The oil under pressure is conveyed to the various power units of the machine through hydraulic pipes 62.

Boxes 38, 39, 40 and 41 are conventional symbols to

represent hydraulic valves to control the fluid supply from the main pump 34 to cylinder rotating motor 14, track propelling motors 20 and 21 and ram cylinders 90, respectively. The arrows in these boxes indicate the direction of flow of the hydraulic liquid when the control valve is thrown in forward and reverse directions. These control valves are manually operated and of the reversing type, all of them except 38 being adapted to return to neutral position when they are released. Thus if control valve 38 is thrown forward, oil would flow in the direction of the arrows, through the hydraulic pipes 62 (as indicated by the arrows at the left hand side), and continue into cylinder motor 14, thus actuating it. The oil would emerge from motor 14, flow through the hydraulic pipes 62 through control valve 38 returning to oil sump 35. If control valve 38 is thrown in the reverse direction, the direction of the oil flowing through motor 14 would be reversed (as indicated by the arrows at the left), thus reversing the direction of rotation of motor 14. In a neutral position of control valve 38 no oil will flow, and motor 14 will stop.

Motors 20 and 21 which power the tracks 17 are operated by control valves 39 and 40 similarly to previously described control valve 38. When control valves 39 and 40 are thrown in one direction, pressurized oil is admitted through the hydraulic pipe 62 through control valves 39 and 40, in the direction of the arrows. The oil continues through motors 20 and 21 thus actuating them, returns through control valves 39 and 40 in the direction of the arrow, and then flows into oil sump 35. As can be seen motors 20 and 21 are individually controlled by control valves 39 and 40 and are reversible.

Control valve 41 actuates the hydraulic rams 16. When control valve 41 is thrown in forward direction, oil will be forced under pressure in the direction of the arrows at the right through hydraulic pipes 62 into cylinder 90 and exert force against the forward side of piston 63, thus forcing piston 63 and rods 64 outwards. While this is occurring, oil on the reverse side of piston 63 in cylinder 90 will pass through the hydraulic pipe 62 through the control valve 41, in the direction of the arrows, and back into oil sump 35. When control valve 41 is thrown in the opposite direction, that is as indicated by the parallel arrows at the left, pressurized oil will flow in the direction of the arrows through hydraulic pipe 62 into cylinder 90 to the reverse side of piston 63 thus exerting force against it. Piston 63 is thus forced inwardly. The oil on the forward side of piston 63 is forced again through hydraulic pipes 62 into control valve 41, in the direction of the arrow, and into oil sump 35.

During operation the operator is seated facing forward on a seat 89 mounted on platform 76 to the rear of control housing 42, Figs. 8 and 9, so that he may easily reach control housing 42. By manipulating control valve 41, Fig. 2, forward and backward, the operator may raise or lower frame 11 by means of hydraulic rams 16. By throwing control valve 41 in a forward direction, oil under pressure from hydraulic pump 34, Fig. 1, flows through control valve 41, Fig. 2, into cylinder 90 by hydraulic pipes 62, Fig. 5, and exerts pressure on the forward side of piston 63, Fig. 1, causing piston 63 to rise in cylinder 90. Force is transmitted from piston 63 through rod 64 to pivot 60 and guide frames 94, Fig. 2, which are attached to frame 11, causing frame 11 to rise about pivot 28, Fig. 1. If control valve 41 is thrown to the rear, the reverse result is obtained and frame 11 will swing down.

Valves 39 and 40, Fig. 2, control the oil supply to motors 20 and 21 which operate tracks 17 individually or together. Forward movement of the valves 39 and 40 will cause pressurized oil to flow from hydraulic pump 34 to motors 20 and 21 and actuate them. Motors 20 and 21 rotate rear track wheels 18 through drive chains 45, as seen in Figs. 1 and 2. Track wheels 18 drive tracks

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17 and cause the machine to move forward. Backward movement of valves 39 and 40 will cause the machine to move to the rear, while moving the valves 39 and 40 in opposite directions causes the machine to turn.

The control valve 38 controls the flow of oil to motor 14, which rotates cylinder 10, Fig. 1. A forward movement of the control valve 38, Fig. 2, will allow pressurized oil to enter motor 14 in a manner previously described, and actuate it. Motor 14 will then rotate sprocket 22 (Fig. 5), which through drive chain 23, will rotate sprockets 66 and 24, both mounted on shaft 67. Sprocket 24 through drive chain 25 will rotate peripheral sprocket 26, attached to cylinder 10, and cause cylinder 10 to rotate on inner and outer races 12 and 13, Fig. 1. The reduction drive allows cylinder 10 to be rotated at a much slower speed than motor 14 and with a consequent high torque. The direction of rotation of cylinder 10 may be reversed by throwing control valve 38 to the rear.

When it is desired to work in a seam, at the start cylinder 10 will preferably be raised to a horizontal position by means of control valve 41, Fig. 2. Cylinder section 72, attached to cylinder 10, may be rotated by operating control valve 38, and the machine driven straight into the coal face by tracks 17. Rotating teeth 31, Fig. 3, are thus forced against the coal face, cutting a circular section into the face. It will be seen that the frusto-conical shape of the forward end of cylinder section 72 is of advantage in allowing cylinder section 72 to advance into the coal face with considerable clearance. No great accuracy of aiming the machine at the face is needed.

Core and cuttings entering the forward portion of rotating cylinder section 72 are engaged by flights 32, often broken into smaller pieces and fed to the rear of cylinder section 72 as it rotates. At the rear of cylinder section 72 the coal is engaged by the flights of cylinder 10, Fig. 1, and further fed to the rear of cylinder 10 by said flights. The coal is then funneled by means of trough 85 on to tail conveyor 43. Upwardly disposed flanges 47, Fig. 7, on tail conveyor 43 prevent spillage. Tail conveyor 43 is free to rotate in a horizontal plane about pivot 46 and thereby accommodate itself to the travel of the whole machine as it is maneuvered. Belt 53 carries the coal from cylinder 10 to coupler 48. The coal upon reaching open hopper 50 on coupler 48, falls vertically to room conveyor 44, and is carried away on belt 107. Swivel 108 permits tail conveyor 43 to rotate horizontally in a circular direction while following the movements of the machine. Stretcher wheels 106 of trunnions 49, coupled with stretcher wheel 54, located directly below pivot 46, Fig. 1, permits tail conveyor 43 to swing in a vertical direction as when the machine travels over an uneven floor.

The versatility of the machine will now become apparent. It may be moved in a longitudinal and transverse direction without interrupting the constant flow of coal from cylinder section 72 to room conveyor 43, as may be seen in Fig. 7. Coupler 48 will roll longitudinally on tracks 52 as it is pulled by movements of the machine. When the machine is maneuvered in a transverse direction the flexible couplings of swivel 108 and pivot 46 will move accordingly, permitting an uninterrupted flow of coal to continue.

In mining operations the machine may be used to attack a coal face by driving cylinder section 72 more or less horizontally into the coal face, as previously described, thus removing a cylindrical section of coal as indicated in Fig. 8 by section A. By maneuvering the machine, parallel series of such sections as indicated at A in Fig. 8 may be removed across the coal face. Cylinder section 72 may then be swung upward by means of hydraulic rams 16 and rotating cylinder section 72 can be driven into the coal face to remove a section of coal from the face as is indicated by section B, Fig. 8. A similar series of parallel sections such as shown at B may be removed

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across the coal face. This process may be continued to remove further sections C and D as in Fig. 8. By tipping rotating cylinder section 72 toward the floor, the lower portion of the coal face may be removed as indicated by section E, Fig. 8.

During these mining operations a quantity of coal may fall to the floor from cave-ins or the spillage of coal from the mouth of cylinder section 72. Such coal may be picked up by lowering cylinder section 72 to the floor and driving it into the loose coal, as shown in Fig. 9. Such loose coal is scooped into the forward end of rotating cylinder section 72, engaged by the flights 32, and carried to the rear in the manner previously described. Throughout the mining and loading operations, the coal is continuously conveyed through tail conveyor 43 at room conveyor 44 with very little interruption.

The advantages of the machine are apparent from the above. It may be used as a continuous miner to remove the entire face of coal without resorting to blasting.

In addition, the machine may be easily maneuvered in a pitching seam where other machines are not effective on account of sloping roofs. Attached to the conveyor system, the machine has great latitude of movement while still continuously delivering coal to the conveyor system. There are few delays in operation or idle time, for after the mining phase of the operation is completed, the machine may immediately be used as a loader, to scoop up that coal which has fallen to the floor.

Furthermore, workmen can do close supporting work while the machine is in operation. Thus this machine will do more efficiently, work which previously required several machines.

It is understood that the details of construction are described by way of illustration and that if preferred, other well known types of driving mechanism can be utilized with no departure from the scope of the invention as indicated by the appended claims.

I claim:

1. A mining machine comprising a self-propelled carriage provided with means for steering the course thereof, a cutter tube in front and rear sections, the rear section overlying the carriage, and the front section extending beyond the carriage and flaring conically at its outer end, cutting elements mounted on the outer end of said front section, a frame mounted on the carriage means for rotatably supporting said cutter tube within said frame with the ends of the tube projecting therefrom, horizontal pivot means on the lower side of said frame below said tube and on the rear end of said carriage about which said pivot means said frame is adapted to swing in the vertical plane, a motor for rotating said tube mounted on the frame below said tube, and flights within said tube to propel cut material therethrough upon rotation of said tube.

2. A mining machine comprising a self-propelled carriage provided with means for steering the course thereof, a cutter tube in front and rear sections, the rear section overlying the carriage, and the front section detachably mounted on the rear section and coaxial therewith extending beyond the carriage and flaring conically at its outer end, cutting elements mounted on the outer end of said front section, a frame mounted on the carriage means for rotatably supporting said cutter tube within said frame with the ends of the tube projecting therefrom, horizontal pivot means on the lower side of said frame below said tube and on the rear end of said carriage about which pivot means said frame is adapted to swing in a vertical plane, a motor for rotating said tube mounted on the frame below said tube, and flights within said tube to propel cut material therethrough upon rotation of said tube.

3. A mining machine comprising a self-propelled carriage provided with means for steering the course thereof, a cutter tube in front and rear sections, the rear section

being cylindrical throughout overlying the carriage, and the front section detachably mounted coaxially with said rear section extending beyond the carriage and flaring conically at its outer end, cutting elements mounted on the outer end thereof, a frame mounted on the carriage means 5 for rotatably supporting said cutter tube within said frame with the ends of the tube projecting therefrom, horizontal pivot means on the lower side of said frame below said tube and on the rear end of said carriage 10 about which pivot means a said frame is adapted to swing in a vertical plane, a motor for rotating said tube mounted on the frame below said tube and flights within said tube to propel cut material therethrough upon rotation of said tube.

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