Feb. 4, 1947. C. F. OSGOOD 2,415,217

MINING APPARATUS

Filed Aug. 6, 1943 4 Sheets-Sheet 1

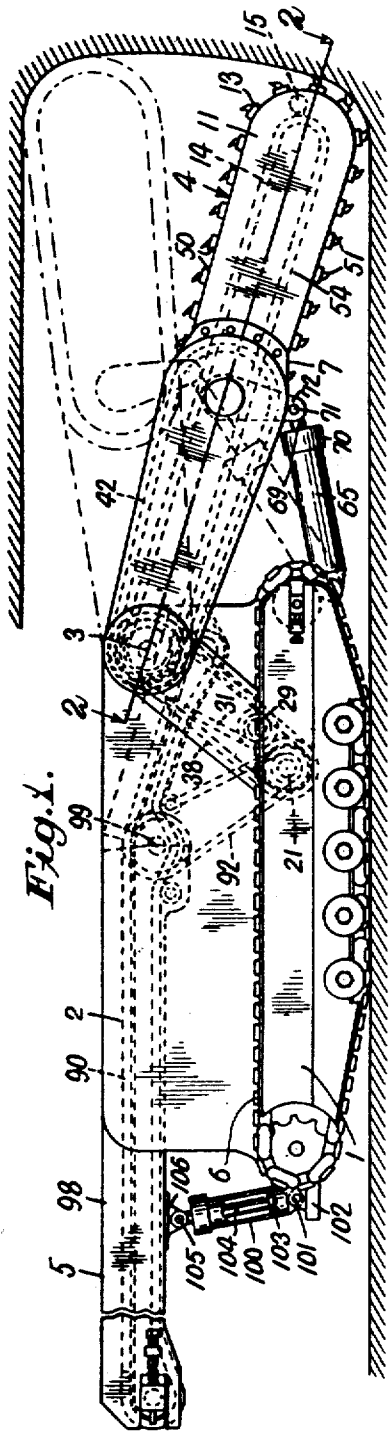


Fig. 1.

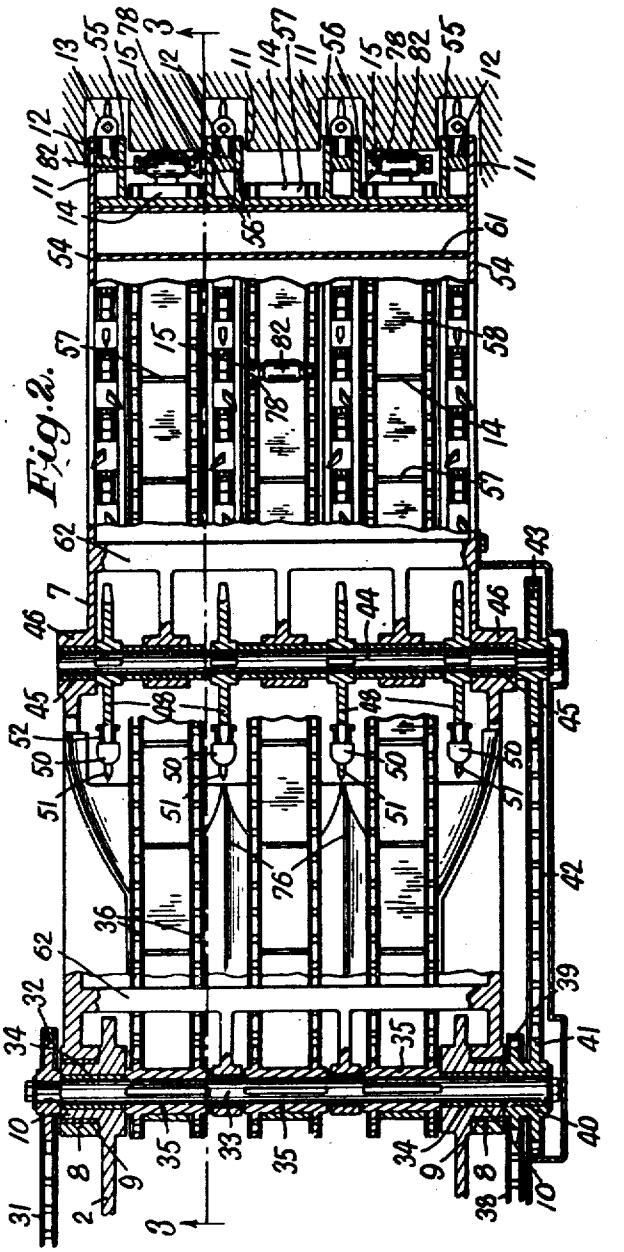


Fig. 2.

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MINING APPARATUS

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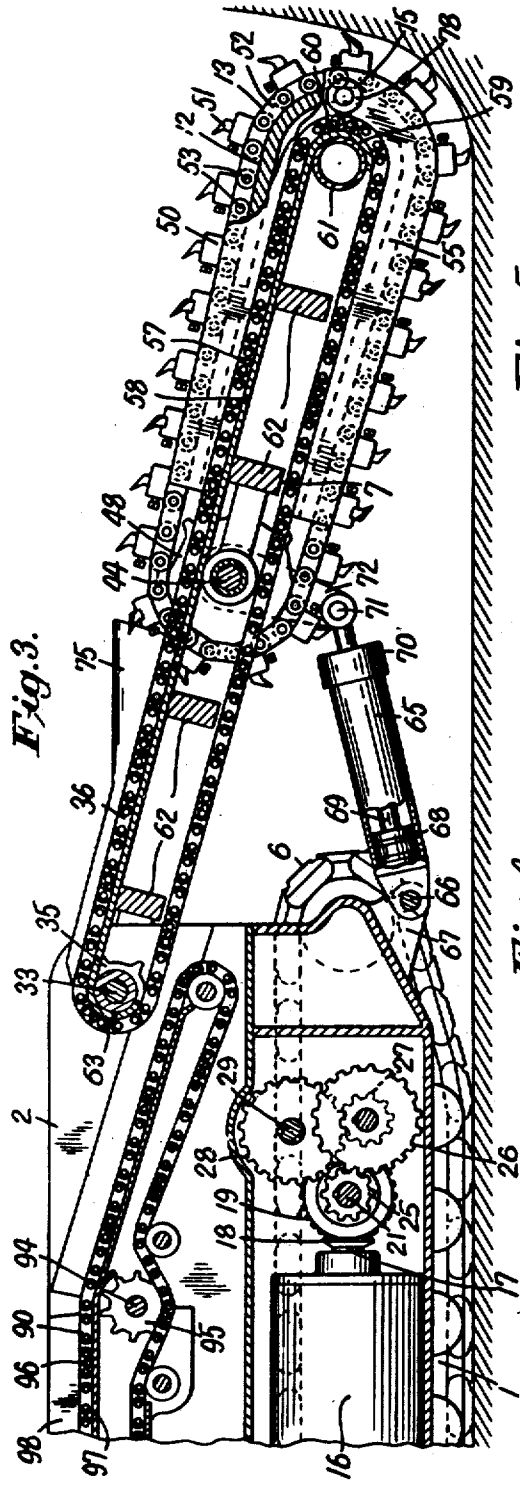


Fig. 3.

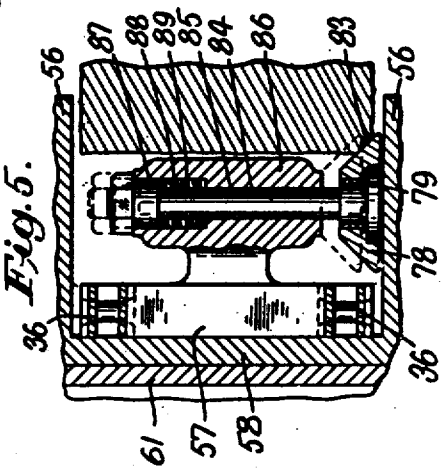


Fig. 5.

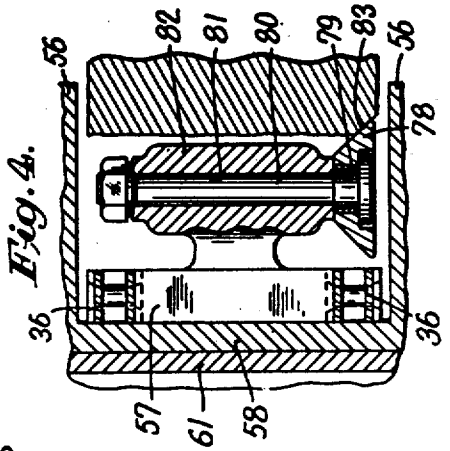


Fig. 4.

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Feb. 4, 1947. C. F. OSGOOD 2,415,217

MINING APPARATUS

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Fig. 6.

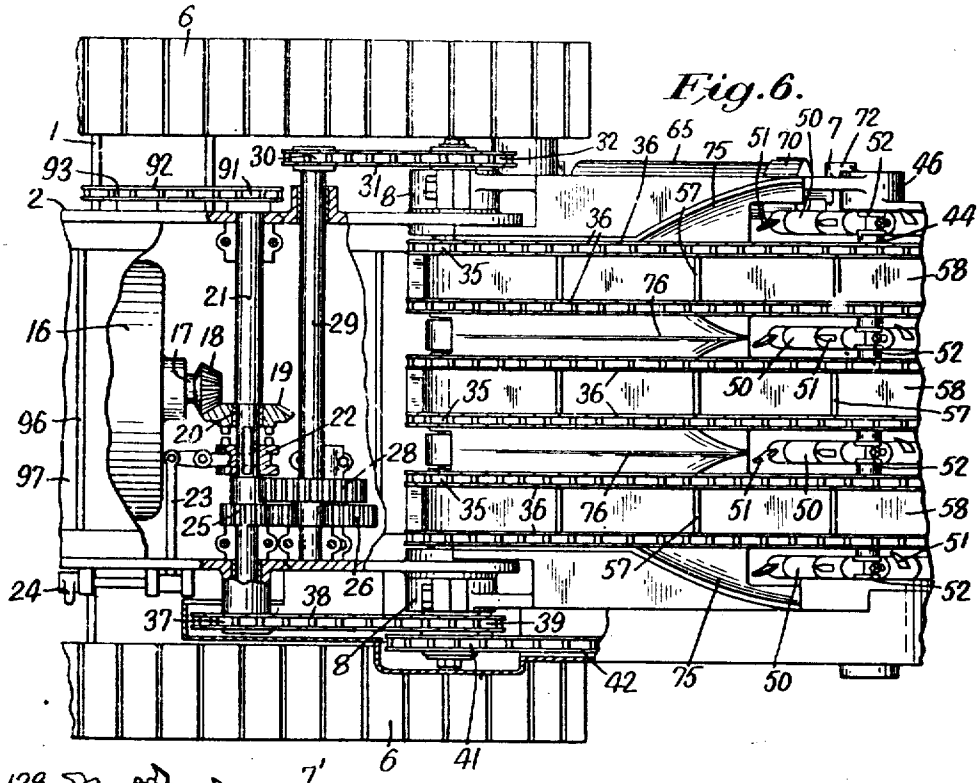
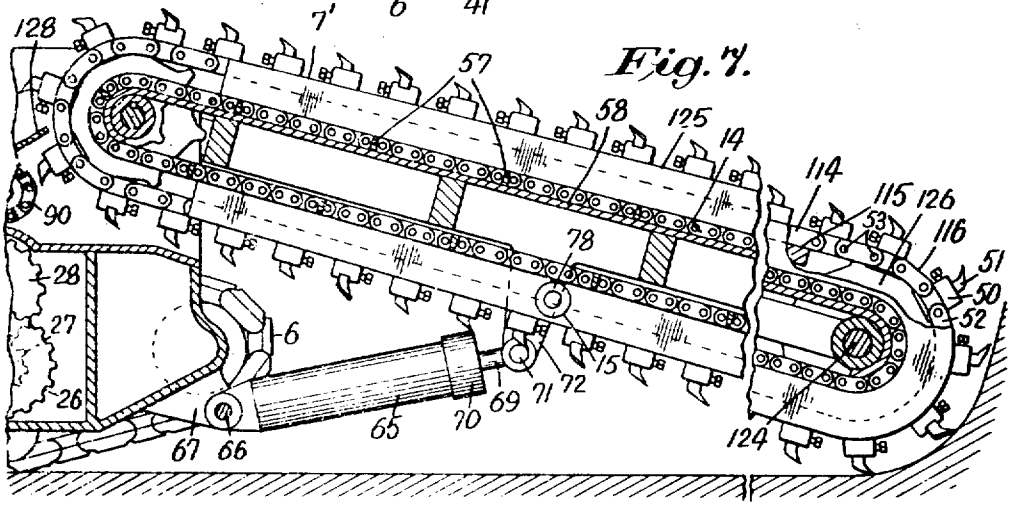


Fig. 7.



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Feb. 4, 1947. C. F. OSGOOD 2,415,217

MINING APPARATUS

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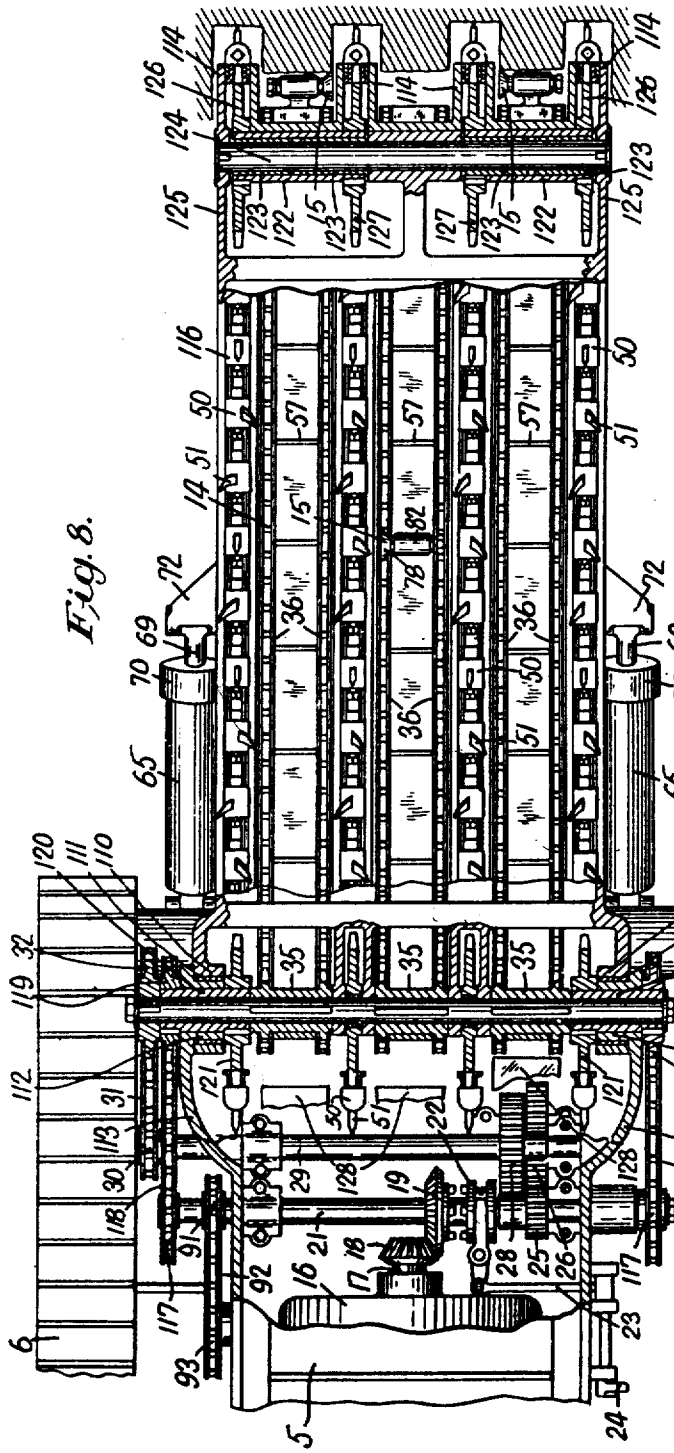


Fig. 8.

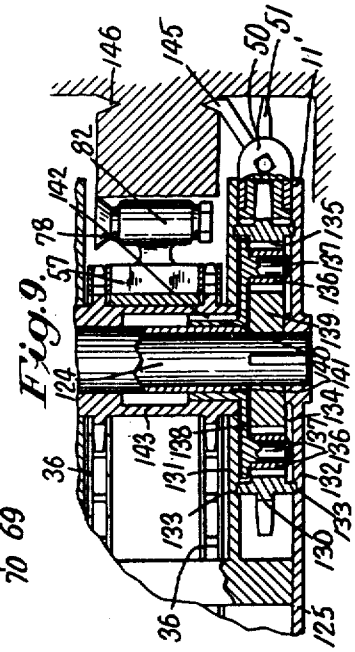


Fig. 9.

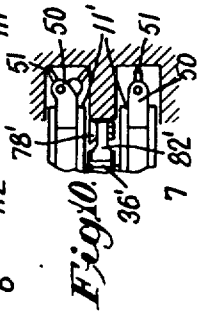


Fig. 10.

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Patented Feb. 4, 1947 2,415,217

UNITED STATES PATENT OFFICE

2,415,217

MINING APPARATUS

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Application August 6, 1943, Serial No. 497,698

16 Claims. (Cl. 262—28)

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This invention relates to mining apparatus and more particularly to improvements in a coal mining apparatus for cutting the solid coal, dislodging the cut coal from the solid and loading the dislodged coal, without the use of explosive or other blasting means.

In coal mining apparatus of the combined cutting, dislodging and loading type it has heretofore been proposed to cut parallel kerfs or slots in the solid coal to form parallel projections or cores of coal between the kerfs. The cores so formed were periodically dislodged as cutting progressed and the dislodged coal was conveyed away from the coal face and loaded into a suitable receptacle. In one known form of mining apparatus the parallel kerfs or slots were cut in the solid coal by endless cutter chains and the coal projections or cores were dislodged by means of core breakers mounted on the cutter chains for circulation therewith, for periodically delivering impact blows to the cores to dislodge the latter. In another known type of mining apparatus, an endless conveyor was arranged to move with the endless cutter chains at the same speed as the cutter chains, and this conveyor carried core breakers for dislodging the cores of coal. In such mining apparatus the core breakers moved at a speed at least as great as the speed of the endless cutter chains so that dislodging blows were struck against the cores before the latter had any substantial projection from the solid coal, thereby greatly reducing efficiency and increasing the consumption of power. Moreover, the conveyor circulating at the same high speed as the endless cutter chains moved too rapidly for the desired purpose, and if the conveyor were operated at the proper speed the endless cutter chains would move too slowly for efficient cutting.

It is the primary object of the present invention to provide an improved coal mining apparatus of the combined cutting, dislodging and loading type having core breakers circulating at a speed substantially slower than the rate of orbital movement of the endless cutter chains so that cores having substantial projection from the solid are formed prior to the dislodging of the cores, thereby increasing efficiency and reducing power consumption over previous known apparatus. It is also an object to provide endless conveyors arranged between a series of parallel endless cutter chains and circulating at a speed substantially slower than the rate of orbital movement of the cutter chains so that the coal loading function is improved and a relatively high cutting speed is maintained. Still another object

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is to provide core breakers which are carried by the relatively slowly moving conveyors so that dislodging blows are struck against the cores only when the latter project a substantial distance from their points of attachment with the solid coal. A further object is to provide a cutting and conveying mechanism wherein by reducing the speed of the dislodging and loading cycle with respect to the cutting cycle, improved dislodging and loading of the coal are attained. A further object is to provide a conveyor which is driven by one of the endless chain cutters so that the conveyor and cutter circulate at substantially different speeds, there being provided reduction gearing between the cutter and the conveyor. A still further object is to provide an improved endless conveyor means arranged between series of parallel endless cutter chains and circulating at an orbital speed substantially slower than the rate of orbital movement of the cutter chains. Yet another object is to provide improved core breaking devices carried by the conveyor means and moving with the conveyor means at a speed substantially slower than the rate of orbital movement of the cutter chains. Still another object is to provide an improved coal dislodging means. A further object is to provide a coal mining apparatus having novel arrangements and combinations of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear in the course of the ensuing description.

In the accompanying drawings there are shown for purposes of illustration several forms and modifications which the invention may assume in practice.

In these drawings:

Fig. 1 is a side elevational view of a coal mining apparatus constructed in accordance with an illustrative embodiment of the invention.

Fig. 2 is an enlarged sectional view, with parts shown in plan, taken longitudinally through the cutting, dislodging and loading mechanism substantially on line 2—2 of Fig. 1.

Fig. 3 is a view in longitudinal vertical section taken substantially on line 3—3 of Fig. 2, and showing a portion of the tractor base.

Fig. 4 is an enlarged detail sectional view showing one of the roller core breakers.

Fig. 5 is a view similar to Fig. 4 showing a modified form of core breaker.

Fig. 6 is an enlarged fragmentary top plan view of the apparatus shown in Fig. 1, with parts shown in horizontal section to illustrate structural details.

Fig. 7 is a view similar to Fig. 3 illustrating another illustrative embodiment of the invention.

Fig. 8 is a top plan view of the cutting, dislodging and conveying mechanism shown in Fig. 7, with parts shown in section to illustrate details of construction.

Fig. 9 is an enlarged fragmentary sectional view illustrating a modified form of the conveyor drive.

Fig. 10 is a fragmentary sectional view showing a further modified construction.

In the illustrative embodiments of the invention, there is shown a self-propelled base 1 having a frame 2 mounted thereon. Pivotally mounted at the forward end of the base frame at 3 is a cutting, dislodging and conveying mechanism, generally designated 4. Mounted on the base frame 2 and projecting rearwardly therefrom is a discharge conveyor 5. The cutting, dislodging and conveying mechanism 4 is operative to cut parallel kerfs or slots in the solid coal to form parallel projections or cores of coal between the slots, and the dislodging mechanism breaks down or dislodges fragments of the cores as cutting progresses. The dislodged coal is conveyed rearwardly to discharge onto the discharge conveyor 5. The discharge conveyor receives the dislodged coal and moves the dislodged coal rearwardly of the apparatus to discharge into a suitable receptacle, such as a mine car. In these illustrative embodiments, the self-propelled base is in the form of a tractor, and endless track-laying treads 6 are provided for propelling the apparatus both during movement of the apparatus about the mine and during the cutting, dislodging and loading operations. It will be evident that the improved cutting, dislodging and loading mechanism may be incorporated in mining apparatus of various types other than that disclosed without departing from the spirit of the invention.

In the illustrative embodiment of the invention shown in Figs. 1 to 6 inclusive, the improved cutting, dislodging and loading mechanism 4 may comprise a forwardly projecting frame or boom 7 pivotally mounted at 3 on the tractor base to swing in a vertical direction with respect thereto, the swingable frame or boom having bearing hubs 8 at its rear end pivotally journaled on bearings 9 supported by trunnions 10 projecting from the sides of the frame 2 of the tractor base. Mounted at the outer portion of the vertically swinging boom is a series of parallel vertical cutter bars 11 having guideways 12 in which are mounted endless chain cutters 13. These endless chain cutters are guided in the cutter bar guideways for circulation in orbital paths about the margins of the cutter bars. Also guided for circulation on the vertically swinging boom and arranged intermediate the endless cutter chains are endless conveyors 14 which carry core breaker devices 15.

The means for driving the endless cutter chains and the endless conveyors at substantially different speeds may assume various forms, but herein such driving means may include a motor 16 which may also drive the tractor treads to propel and steer the apparatus in a well known manner. The motor 16 is mounted in a relatively low position on the tractor base between the tractor-laying treads 6 and has its power shaft 17 horizontally disposed and extending longitudinally of the base. Fixed to the forward end of the motor power shaft is a beveled pinion 18 meshing with a bevel gear 19 journaled on a bearing 20 supported by a shaft 21. The shaft 21 is horizontally disposed and extends transversely of the tractor base and is suitably journaled within bearings supported in the frame of the tractor base. The bevel gear 19 is connectible to the shaft 21 by a sliding jaw clutch 22 having suitable operating means 23 including a conveniently located operating handle 24. Fixed to and driven by the shaft 21 is a spur pinion 25 meshing with and driving a large spur gear 26 supported on a horizontal shaft suitably journaled in the frame of the tractor base. Rotatable with the gear 26 is a spur pinion 27 which meshes with and drives a large spur gear 28 keyed to a horizontal shaft 29. The shaft 29 is arranged parallel with the shaft 21 and is likewise suitably journaled within bearings supported within the tractor base frame. Keyed to the shaft 29 is a chain sprocket 30 connected by an endless drive chain 31 to a chain sprocket 32 keyed to a horizontal shaft 33. The shaft 33 is arranged with its axis coincident with the pivotal axis 3 of the cutting, dislodging and loading mechanism 4, and is suitably journaled in bearings 34 supported within the trunnions 10 of the base frame. Keyed to and driven by the shaft 33 are double chain sprockets 35 which engage and drive the endless side chains 36 of the conveyors 14. It will thus be seen that when the jaw clutch 22 is connected the endless conveyors 14 may be driven from the motor 16 at a relatively slow speed through the bevel gearing 18 and 19, spur reduction gearing 25, 26, 27, 28 and the chain and sprocket connections 30, 31 and 32. Keyed to one end of the shaft 21 at the outer side of the base frame is a chain sprocket 37 which is connected through an endless drive chain 38 to a chain sprocket 39 journaled on a bearing 40 supported by the shaft 33. Rotatable with and driven by the sprocket 39 is a chain sprocket 41 connected by an endless drive chain 42 to a chain sprocket 43 keyed to a horizontal shaft 44. The shaft 44 is suitably journaled in bearings 45 supported within bearing bosses 46 integral with the swingable frame or boom 7, and keyed to and driven by the shaft 44 are chain sprockets 48 which engage and drive the endless cutter chains 13. It is accordingly evident that the endless cutter chains may be driven from the motor 16 through the bevel gearing 18, 19, chain and sprocket connection 37, 38 and 39, and chain and sprocket connection 41, 42 and 43 at a speed substantially greater than the rate of orbital movement of the endless conveyors.

Now referring to the specific structure of the cutter chains and conveyors, it will be noted that the cutter chains 13 each comprise a series of chain blocks 50 having usual sockets for the reception of cutter bits 51. The chain blocks are pivotally connected together by usual strap links 52 joined to the chain blocks by hinge pins 53. The chain blocks and strap links have inner guide surfaces which engage the inner surfaces of the cutter bar guideways 12. The outer cutter bars 11 have outer side plates 54 integral with the outer sides of the boom frame and inner plates 55 preferably secured by welding to the boom frame, as clearly shown in Fig. 2. The two inner cutter bars 11 preferably have both their inner and outer plates 56 welded to the boom frame. If desired the cutter bars may be of a fabricated construction having the parts thereof secured together and to the boom frame by rivets or bolts, in an obvious manner. The endless conveyors 14 arranged between the cutter bars have transverse scraper bars 57 secured to certain

links of the endless side chains 38 of the conveyors. These scraper bars move along the upper surface of a transverse plate 58 extending between the outer bar plates 54 on the boom frame and welded to the bars. This plate is preferably arcuately formed or curved at 59 at its forward end to provide a curved outer guide 60 for the conveyor chains, as they move about the outer end of the boom frame. The curved outer end 59 of the conveyor plate extends partly about a tubular member 61 arranged coaxial with the pivotal point about which the cutter chains and conveyors turn at the outer end of the boom frame. This tubular member 61 extends completely across the boom frame and is rigidly secured to the outer bar plates 54 in the manner shown. If desired, suitable guide members may be journaled on the tubular member 61 to guide the conveyor chains, in lieu of the curved guide plate 59. Extending transversely between the sides of the boom frame at points spaced longitudinally of the boom are transverse brace members 62. The conveyor chains are similarly guided at their rearward portions by a curved rear end portion 63 of the transverse plate 58, as shown in Fig. 3. The cutting, dislodging and loading mechanism 4 is swingable in a vertical direction about its pivot 3 with respect to the tractor base, and the means for effecting vertical swinging thereof comprises hydraulic cylinders 65 pivotally mounted at 66 at their lower ends within brackets 67 integral with the frame of the tractor base. Reciprocable within the cylinders are pistons 68 having their piston rods 69 extending upwardly through the packed top heads 70 of the cylinders and pivotally connected at 71 within brackets 72 integral with the boom frame. It will thus be seen that when fluid under pressure is supplied to these cylinders, the cutting, dislodging and loading mechanism 4 may be swung either upwardly or downwardly as desired, or locked in adjusted position. Attached to the outer sides of the boom frame are suitably shaped deflector plates 75 for retaining the dislodged coal on the boom and for directing the coal toward the outer conveyors. Formed on the boom frame intermediate the endless conveyors are upstanding deflector frames 76 for directing the coal brought back by the two intermediate cutter chains, toward the conveyors. The core breaker devices 15 on the endless conveyors 14 are arranged periodically to strike dislodging blows on the sides of the cores of coal to break down the cores as cutting progresses. Since the conveyors circulate in their orbits at a speed substantially slower than the rate of orbital movement of the cutter chains, cores of substantial projection from the solid are formed before the dislodging blows are struck thereon, thereby to facilitate dislodgment of the coal. Under certain conditions, the endless cutter chains may circulate at a speed eight or ten times as fast as the conveyors, although these relative speeds may be varied as desired. The core breaker devices 15 on the conveyors may assume various forms and herein for illustrative purposes comprise roller wedges 78 journaled on bearings 79 supported by boltlike shafts 80 mounted in transverse bores 81 in bearing brackets 82 secured to the side chains 36 of the conveyors. These rollers have tapered or frustoconical wedge surfaces 83 which are adapted to engage the sides of the cores to apply lateral dislodging pressures to the cores.

In the modification shown in Fig. 5, the wedging rollers are mounted for axial movement and are yieldingly held inwardly. As illustrated, the boltlike shaft 84 on which the wedging rollers are journaled are slidingly mounted in transverse bores 85 in bearing brackets 86. The bolts have sleeve-like portions 87 slidable in enlarged bores 88 which contain coil springs 89, and these springs act on the portions 87 in a direction to move the wedging rollers inwardly into the position indicated in dotted lines in Fig. 5. When the cores of coal are engaged by the rollers, the latter spring outwardly against the adjacent side plates of the cutter bars into the position shown in full lines in Fig. 5 so that an extremely effective wedging action on the sides of the cores is attained. After the wedging rollers move out of contact with the cores of coal, they spring back into their inward positions. This spring mounting arrangement for the wedging rollers permits the latter to move into an effective wedging position and to move inwardly after they leave the coal so as to clear the cutter chains as they cross the paths of the latter. In the preferred form as shown in Fig. 4, the wedging rollers are permanently located inwardly so that they always clear the cutter chains. In another embodiment of the invention, as will later be described, the wedging rollers are arranged completely within the orbits of the chain cutters so that the provision of clearance between the rollers and the cutter chains is unnecessary. In this latter arrangement, it is possible permanently to locate the rollers in their most effective dislodging position on the conveyors in the manner shown.

As the endless cutter chains operate to cut parallel kerfs or slots in the solid coal to form parallel cores of coal, the core breaker devices periodically strike against the sides of the cores to dislodge the latter, and the endless conveyors 14 receive the dislodged coal and move the dislodged coal rearwardly along the boom frame to discharge on the rear discharge conveyor 5. This rear discharge conveyor comprises endless side conveyor chains 90 guided within suitable guideways on the frame of the tractor base, and the forward portion of the discharge conveyor slopes downwardly beneath the rear discharge ends of the conveyors 14, as shown in Fig. 3. The discharge conveyor may be driven from the motor 16 by a chain sprocket 91 keyed to the end of the shaft 21 opposite from the sprocket 37 (Fig. 6). This chain sprocket is connected by an endless drive chain 92 to a chain sprocket 93 keyed to a horizontal shaft 94 suitably journaled within bearings supported within the sides of the frame of the tractor base. Keyed to the shaft 94 are chain sprockets 95 which engage and drive the conveyor side chains 90. Extending transversely between the conveyor chains are scraper bars 96 which move along an upper plate 97 secured to a vertically tiltable rear portion 98 of the conveyor frame. This tiltable rear portion of the conveyor frame is pivotally mounted at 99 to swing in a vertical direction about an axis coincident with the axis of the drive shaft 94. Hydraulic cylinders 100 are pivotally mounted at 101 on brackets 102 secured to the rear end of the tractor base frame. These cylinders contain reciprocable pistons 103 having their piston rods 104 projecting upwardly through the top cylinder heads and pivotally connected at 105 to brackets 106 secured to the bottom of the frame 98. It will thus be seen that when fluid under pressure is supplied to these cylinders, the rear discharge end of the

discharge conveyor may be raised or lowered as desired.

In the illustrative embodiment of the invention shown in Figs. 7 and 8, the endless conveyors 14 are arranged entirely within the projections of the orbits of the endless cutter chains. In this construction the vertically swingable boom frame 7' has at its rear end bearing hubs 110 journaled in bearings 111 supported within inwardly directed trunnions 112 formed on the outwardly projecting side portions 113 of the frame of the tractor base. Extending longitudinally in parallelism along substantially the full length of the boom frame are elongated cutter bars 114 having guideways 115 about their margins in which endless cutter chains 116 are guided for circulation in orbital paths. The endless conveyors 14 are arranged between these cutter bars and are mounted in a manner similar to that above described in regard to the other embodiment of the invention. Also as described in the other embodiment, the conveyor chains carry core breaker devices 15. The endless conveyors 14 are driven from the motor 16 through the bevel gearing 18, 19, spur gearing 25, 26, 27, and 28 and the chain and sprocket connection 30, 31 and 32. The driving means for the cutter chains comprises chain sprockets 117 keyed to the opposite ends of the shaft 21 and these sprockets are connected by endless drive chains 118 to chain sprockets 119 keyed to tubular shafts 120 respectively. These tubular shafts are journaled within the trunnions 112 on the base frame and have secured thereto chain drive sprockets 121 which engage and drive the endless cutter chains on the outer cutter bars. At the outer end of the boom frame are tubular shafts 122 journaled on bearings 123 supported by a transverse shaft 124. The shaft 124 is nonrotatable and is fixed at its opposite ends to outer bar plates 125. The cutter chains of the outer cutter bars engage and drive chain sprockets 126 keyed to the shafts 122, and driven by the shafts are chain sprockets 127 which engage and drive the cutter chains on the inner cutter bars. It is accordingly evident that the inner cutter chains are driven through the outer cutter chains. As in the embodiment of the invention above described, the endless cutter chains cut parallel kerfs or slots in the solid coal to form parallel cores, and the core breaker devices 15 on the conveyors periodically dislodge the cores between the slots as cutting progresses, and the dislodged coal is conveyed rearwardly along the boom by the endless conveyors 14. The dislodged coal discharged by the conveyors 14 is received by the rear discharge conveyor 5 and conveyed rearwardly of the apparatus in the manner above described. Suitable deflector plates 128, direct the coal discharged from the conveyors 14 onto the rear discharge conveyor. Other than the novel manner of driving the cutter chains and the novel arrangement of the conveyors and breaker devices within the projections of the orbits of the cutter chains, this embodiment is similar to the other embodiment.

In Fig. 9 a modified form of the conveyor drive is shown. In this construction an endless cutter chain engages and drives a chain sprocket 130 suitably journaled within side plates 131, 132 of the cutter bar. This sprocket has an annular sleevelike portion or hub which is received at its outer sides within annular grooves at 133 in the inner sides of the bar plates to provide a sealed chamber 134 within the sprocket. Formed on the sprocket is an internal gear 135 which meshes

with planet gears 136 journaled on stub shafts 137 formed on a rotatable carrier 138. These planet gears mesh with the teeth of a stationary sun gear 139 keyed to the shaft 124, shown in Fig. 9. The hub 140 of the carrier 138 is journaled on a bearing 141 supported by the shaft 124, and keyed at 142 to the carrier hub is a double chain sprocket 143 which engages and drives the endless side chains 36 of the conveyor 14. It will thus be seen when the cutter chain is driven the conveyor is driven by the cutter chain at a relatively low speed through the planetary gearing. The other two conveyors may be driven from other cutter chains in this same manner. The endless cutter chains may carry on certain of the blocks thereof lateral cutters 145, as shown in Fig. 9; there being one or more lateral cutters at the sides of each cutter chain. These lateral cutters may serve to notch the sides of the cores as at 146 near the points of attachment of the cores with the solid coal, thereby to weaken the cores and facilitate dislodgement thereof by the core breaker devices 15.

While there are shown in both embodiments four parallel cutter bars and three endless conveyors between the cutter bars, it will be evident that more or less may be employed as desired. Under certain conditions the cutter bars and conveyors may extend clear across the front of the tractor base to provide an opening in the coal seam of sufficient width to receive the base. Also when the cutter bars 11' are arranged in closely spaced relation as shown in Fig. 10, the conveying function of the endless chains 36' may be omitted and these chains then may serve only as core breaker chains. With the conveying function omitted the cutter chains act to convey the dislodged coal away from the coal face. The wedging rollers of the chains 36' are designated 78' in Fig. 10, and the roller brackets are designated 82'.

The general mode of operation of the improved mining apparatus is as follows: The motor 16 may effect drive of the endless track-laying treads 6 of the tractor base in any well known manner, and the apparatus may be propelled about the mine at a relatively high speed by these track-laying treads. By regulating the relative speeds of the track-laying treads, the apparatus may be steered also in a well known manner. When the working face is reached and the cutting, dislodging and loading mechanism 4 is disposed in the position shown in full lines in Fig. 1, the cutter chains and conveyors may be rapidly circulated in their orbits on the boom frame through the connections driven by the motor 16. The apparatus may then be fed forwardly toward the coal face under the propulsion of the track-laying treads at a relatively slow speed suitable for cutting to effect sumping of the endless cutter chains within the solid coal to cut parallel vertical kerfs or slots in the coal to form parallel projections or cores of coal between the slots. When the sumping operation is completed, the tractor base may be held stationary and fluid under pressure may be supplied to the cylinders 65 to effect upward swinging of the boom about its pivot 8 with respect to the tractor base to move the cutter chains upwardly in an arcuate path, thereby to form vertical kerfs or slots extending upwardly to the top of the coal seam. When the swinging cut is completed the cutter bars are held rigidly in position with respect to the base by the hydraulic cylinders, and the apparatus may be moved rearwardly away from the coal face under

the propulsion of the track-laying treads to withdraw the cutter bars from the coal to complete the forming of the vertical kerfs or slots. As the cutter chains are sumped into the coal, swung upwardly in an arcuate path and withdrawn from the coal in the manner described, the core breakers 15 on relatively slowly moving conveyors periodically strike blows on the sides of the cores to dislodge the cores as cutting progresses. As the coal is dislodged it is received by the endless conveyors 14 and is conveyed rearwardly along the boom frame between the cutter bars to discharge at the rear end of the boom on the rear discharge conveyor 5. The rear discharge conveyor moves the dislodged coal in a direction rearwardly of the apparatus and discharges the coal into a suitable receptacle.

In each of the foregoing embodiments of the invention it will be observed that the linear speed at the pitch line of the orbits of the cutting devices is greater than the linear speed at the pitch line of the orbits of the dislodging devices.

As a result of this invention, it will be noted that an improved coal mining apparatus of the combined cutting, dislodging and loading type is provided, whereby the solid coal may be cut, the cut coal dislodged and the dislodged coal loaded in an improved manner without the use of explosives or other blasting means. It will further be noted that by the novel conveyor arrangement disclosed and by circulating the conveyors in their orbits at a speed substantially slower than the rate of orbital movement of the cutter chains, the coal is loaded in a more efficient manner. Further by mounting the core breaker devices on the relatively slowly moving conveyors, cores of substantial projection from the solid are formed prior to the engagement of the dislodging devices with the cores so that dislodgement of the cores is facilitated. Other advantages of the invention and other modes of use, will be clearly apparent to those skilled in the art.

While there are in this application specifically described several forms and modifications which the invention may assume in practice, it will be understood that these forms and modifications of the same are shown for purposes of illustration and that the invention may be further modified and further embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a cutting and loading apparatus, a series of parallel cutter devices movable orbitally to cut parallel spaced vertical kerfs in the material to be mined, conveyors arranged between and movable relative to said cutter devices for conveying away the material cut by said devices, and dislodging means carried by said conveyors for breaking down the material.

2. In a mining apparatus, an endless cutter chain, means for rapidly circulating said cutter chain in its orbit, a conveyor, and driving connections between the outer ends of said cutter chain and said conveyor for driving the latter directly by the former at a speed substantially slower than the speed of said cutter chain.

3. In a mining apparatus, a pair of endless chain cutters arranged in parallel relation to move in non-circular orbits, an endless conveyor arranged between said cutters within the projections of the orbits of the latter, means for rapidly circulating said cutters in their orbits including a driving connection between said cutters whereby one cutter drives the other, and means for driving said conveyor at a speed substantially slower than the speed of said cutters.

4. In a mining apparatus, a pair of endless chain cutters arranged in parallel relation, an endless conveyor arranged within said cutters and within the projections of the orbits of the latter, said cutters and said conveyor being pivotally mounted to swing in unison about a common pivotal point, means for rapidly circulating said cutters in their orbits, and means for driving said conveyor at a speed substantially slower than the speed of said cutters, said cutter circulating means and said conveyor driving means including cutter circulating and conveyor driving elements arranged in coaxial relation with said pivotal point.

5. In an apparatus for continuously cutting solid coal and dislodging the cut coal from the solid, means moving in an orbit continuously advanced relative to the coal face for forming a plurality of spaced, relatively narrow and deep slots in the solid coal to form elongated cores of coal between the slots, means moving in an orbit at a speed substantially slower than the rate of orbital movement of said slot-forming means for moving the dislodged coal away from the coal face, and means movable orbitally with said coal-moving means for periodically exerting laterally directed dislodging pressures on said cores only when the cores have attained substantial projections from the solid.

6. In an apparatus for continuously cutting solid coal and dislodging the cut coal from the solid, means moving in an orbit continuously advanced relative to the coal face for forming a plurality of spaced, relatively narrow and deep, parallel slots in the solid coal to form elongated cores of coal between the slots, means moving in an orbit with respect to said slot-forming means for periodically exerting laterally directed dislodging pressures on the cores only when said cores have attained a substantial projection from the solid, and conveyor means movable relative to said slot-forming means for moving the dislodged coal away from the coal face, said conveyor means including endless continuously moving carrier-means in adjacency to the cutters, and said pressure-exerting-means including core dislodging devices carried by said carrier-means.

7. In a mining and loading apparatus, a series of parallel endless chain cutters for cutting parallel slots in the solid coal to form parallel cores of coal between the slots, guides for guiding said cutters for orbital movement in non-circular paths, endless conveyors arranged intermediate said chain cutters for moving the dislodged coal away from the coal face, guides extending between and projecting a substantial distance rearwardly of said cutter guides for guiding said conveyors for orbital movement in non-circular paths, and core breakers carried by said conveyors and movable orbitally therewith for periodically dislodging said cores as cutting progresses.

8. In a mining and loading apparatus, a series of parallel endless chain cutters for cutting parallel slots in the solid coal to form parallel cores of coal between the slots, means for guiding said chain cutters in non-circular orbital paths, conveyor means arranged intermediate said chain cutters for moving the dislodged coal away from the coal face, means for guiding said conveyor means in elongated non-circular orbital paths of substantially greater extent than the orbital paths of said chain cutters, and core breakers carried

by said conveyor means for periodically dislodging fragments of the cores as cutting progresses.

9. In a cutting and loading apparatus, parallel cutter devices movable in elongated non-circular orbits disposed in parallel spaced apart vertical planes for cutting parallel kerfs in the material to be mined to form projections of material between the kerfs, conveyors arranged intermediate said cutter devices and movable orbitally with respect thereto at a speed substantially slower than the speed of said cutter devices for conveying away the dislodged material cut by said devices, and means on said conveyors and movable orbitally therewith for exerting breaking down pressures on said projections to break down fragments thereof as cutting progresses.

10. In an apparatus for continuously cutting solid coal and dislodging the cut coal from the solid, means moving continuously in an orbit continuously advanced relative to the coal face for forming a plurality of spaced, relatively narrow and deep slots in the solid coal to form elongated cores of coal between the slots, means moving continuously in an orbit at a speed substantially slower than the speed of said slot-forming means for periodically exerting laterally directed dislodging pressures on said cores only when said cores have attained a substantial projection from the solid, each of said orbits having portions in which the movement of the means moving therein is substantially translational except for changes of direction produced by bodily advance of the orbit as aforesaid, and the linear speeds of said moving means along such portions of their respective orbits being substantially different so that cores of substantial projection shall be formed before they are subjected to dislodging forces by said dislodging pressure exerting means, and means extending along said slot-forming means and moving in an orbit at a speed substantially slower than the rate of orbital movement of said slot-forming means for conveying the dislodged coal away from the coal face.

11. In a cutting and dislodging apparatus, a series of parallel cutter devices movable continuously in elongated, non-circular orbital paths for cutting spaced parallel kerfs in the working face of the material to be mined to form projections of material between the kerfs, and dislodging devices arranged intermediate said parallel cutter devices and movable continuously in elongated non-circular orbital paths with respect thereto at a speed substantially slower than the speed of said cutter devices for periodically applying at predetermined intervals lateral dislodging pressures to the sides of said projections to dislodge fragments thereof as cutting progresses, said cutter devices and said dislodging devices having driving means so constructed and arranged that the linear speed at the pitch lines of said first mentioned orbital paths is greater than the linear speed at the pitch lines of said second mentioned orbital paths, and said orbital paths being of such relative forms and dimensions that said cutter devices traverse the complete circuits of their orbits while the dislodging devices traverse less than the entire circuits of their orbits.

12. In a cutting and dislodging apparatus, a series of parallel cutter devices, including cutting elements traversing orbital paths as they cut, for cutting spaced parallel kerfs in the working face of the material to be mined to form projections of material between the kerfs, dislodging devices including orbitally moving dislodging elements and arranged intermediate said parallel cutter devices and having said dislodging elements movable continuously with respect to said cutting elements at a speed substantially slower than the speed of said cutter devices for periodically applying at predetermined intervals lateral dislodging pressures to the sides of said projections to dislodge fragments thereof as cutting progresses, said cutting elements being more numerous than said dislodging elements and said cutting elements and said dislodging elements having respectively such orbital paths of movement and such velocities in said orbital paths that the unit time required by each of said cutting elements completely to traverse its path is substantially less than the unit time required by the dislodging elements to traverse their paths, whereby said cutting elements may form projections of substantial depth before such projections are subjected to dislodging forces, and means arranged intermediate and extending along said parallel cutter devices and movable continuously relative thereto at a speed substantially slower than the speed of said cutter devices for moving the dislodged material rearwardly between said cutter devices away from the working face.

13. In an apparatus for continuously cutting solid coal and dislodging the cut coal from the solid, means moving continuously in a non-circular orbit continuously advanced relative to the coal face for forming a plurality of spaced, relatively narrow and deep slots in the solid coal to form elongated cores of coal between the slots, and means moving continuously in a non-circular orbit relative to said slot-forming means at a speed substantially slower than the speed of said slot-forming means for automatically periodically exerting at predetermined intervals laterally directed dislodging pressures on the sides of said cores only when said cores have attained a substantial projection from the solid, the linear speed at the pitch line of said first mentioned orbit being greater than the linear speed at the pitch line of the second mentioned orbit and the angular velocity during curvilinear movement in said orbits also being greater in the case of said slot-forming means than in the case of said dislodging-pressure-exerting means, whereby cores of substantial depth are formed before they are subjected to dislodging pressures by said dislodging-pressure-exerting means.

14. In an apparatus for continuously cutting solid coal and dislodging the cut coal from the solid, means moving continuously in a non-circular orbit continuously advanced relative to the coal face for forming a plurality of spaced, relatively narrow and deep slots in the solid coal to form elongated cores of coal between the slots, means moving continuously in an orbit for periodically notching the sides of the cores to weaken their points of attachment with the solid coal, and constantly effective means moving in a non-circular orbit relative to said slot-forming means at a speed substantially less than the rate of orbital movement of said slot-forming means for automatically periodically exerting at predetermined intervals laterally directed dislodging pressures on the sides of the notched cores to break off the cores as cutting progresses, said several means having driving means for causing the orbital movements aforesaid and said driving means for said slot-forming means and for said dislodging-pressure-exerting means being constructed and arranged to cause said slot-forming means completely to transverse its orbit while

said dislodging-pressure-exerting means only partially traverses its orbit so that the notched cores are of substantial size before they are broken off.

15. In a mining apparatus, parallel cutter devices including cutting elements moving continuously in elongated non-circular orbits for cutting parallel slots in the solid coal to form cores of coal between the slots, and breaker devices movable continuously relative to said cutter devices for periodically engaging at predetermined intervals the sides of the cores to dislodge the cores as cutting progresses, and means for automatically operating said cutting devices and breaker devices causing the cutting elements to move in their orbits at speeds, both linear and angular, substantially greater than the speeds of movement, both linear and angular, of said breaker devices, to cut substantial cores before said breaker devices come into action.

16. In a mining apparatus, cutter devices movable continuously in non-circular orbits for cutting parallel slots in the solid coal to form a core of coal between the slots, and a breaker movable continuously in a non-circular orbit relative to said cutter devices for periodically exerting, at predetermined intervals, dislodging pressures upon the core to dislodge fragments of the core as cutting progresses, and means for automatically moving said devices and said breaker in their orbits so that the former operate to linear and angular speeds both substantially higher than the corresponding speeds of the latter, to cut cores of substantial projection from the solid coal between the times when said breaker comes into action.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,116,355	Morgan	Nov. 3, 1914
970,725	Kuhn	Sept. 20, 1910
1,650,027	Morgan	Nov. 22, 1927
1,762,154	Blair	June 10, 1930
1,588,563	Wilson	June 15, 1926
2,269,781	Osgood	Jan. 13, 1942
2,287,230	Cartlidge	June 23, 1942
1,414,568	Russell	May 2, 1922

FOREIGN PATENTS

Number	Country	Date
566,777	German	Dec. 21, 1932

Certificate of Correction

Patent No. 2,415,217. February 4, 1947.

CHARLES F. OSGOOD

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 1, line 5, for "explosive" read *explosives*; column 14, line 4, claim 16, for "to" before "linear" read *at*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of July, A. D. 1947.

[SEAL]

LESLIE FRAZER,
First Assistant Commissioner of Patents.

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16. In a mining apparatus, cutter devices movable continuously in non-circular orbits for cutting parallel slots in the solid coal to form a core of coal between the slots, and a breaker movable continuously in a non-circular orbit relative to said cutter devices for periodically exerting, at predetermined intervals, dislodging pressures upon the core to dislodge fragments of the core as cutting progresses, and means for automatically moving said devices and said breaker in their orbits so that the former operate to linear and angular speeds both substantially higher than the corresponding speeds of the latter, to cut cores of substantial projection from the solid coal between the times when said breaker comes into action.

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