April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 1

Fig. 1.

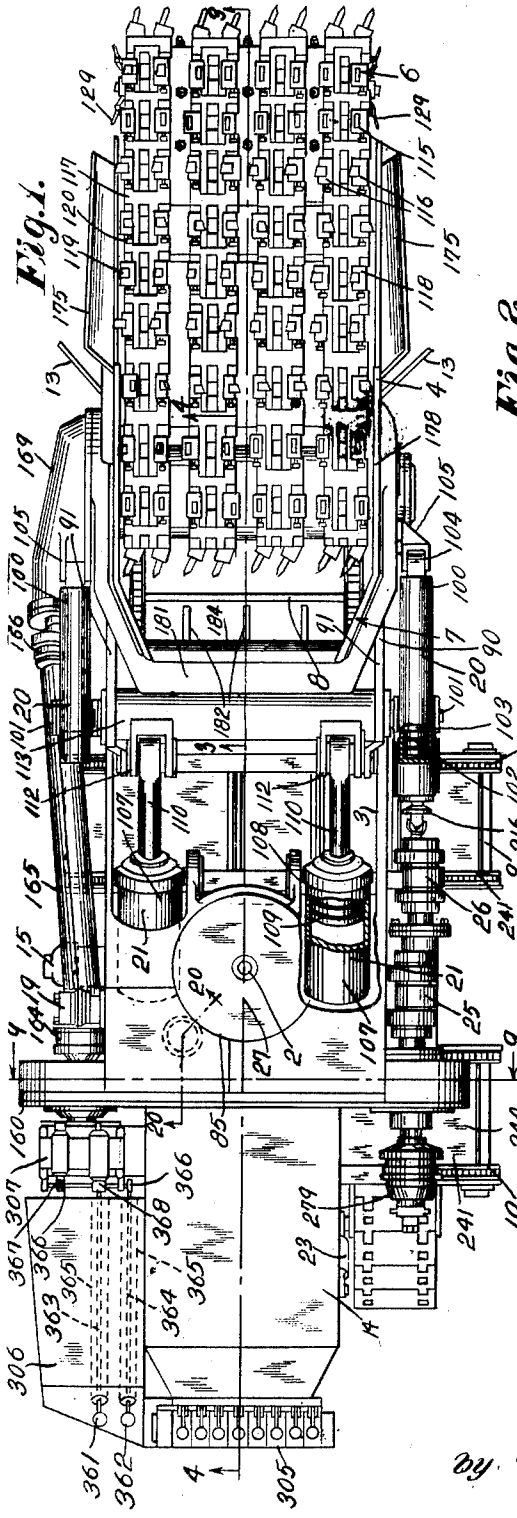
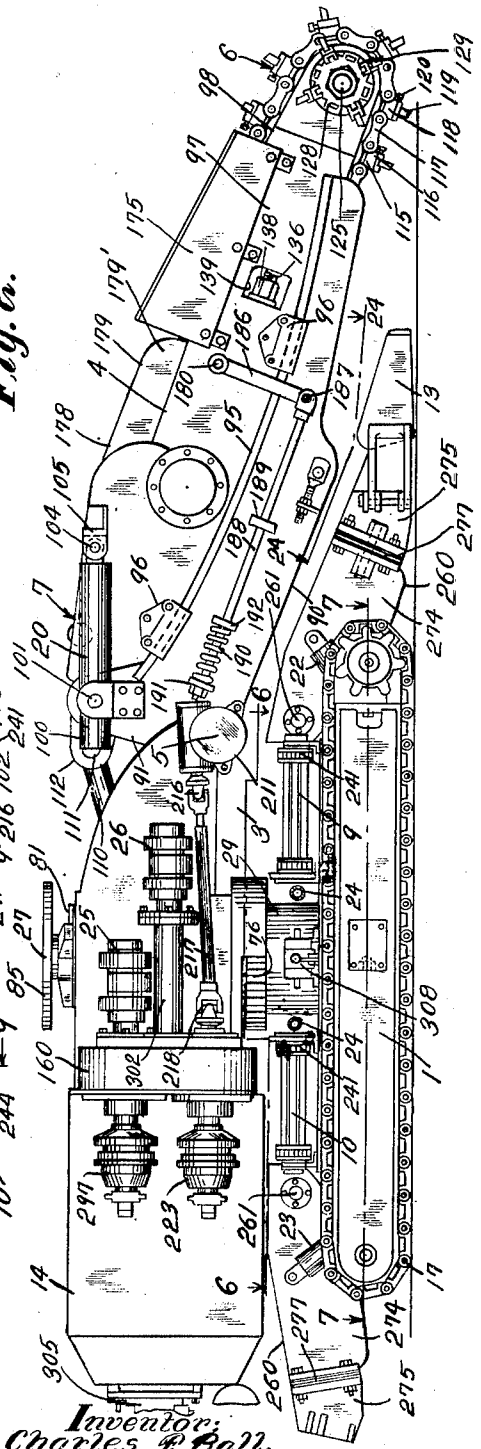


Fig. 2.



Inventor:
by Charles F. Ball.
Charles F. Ozwell Attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 2

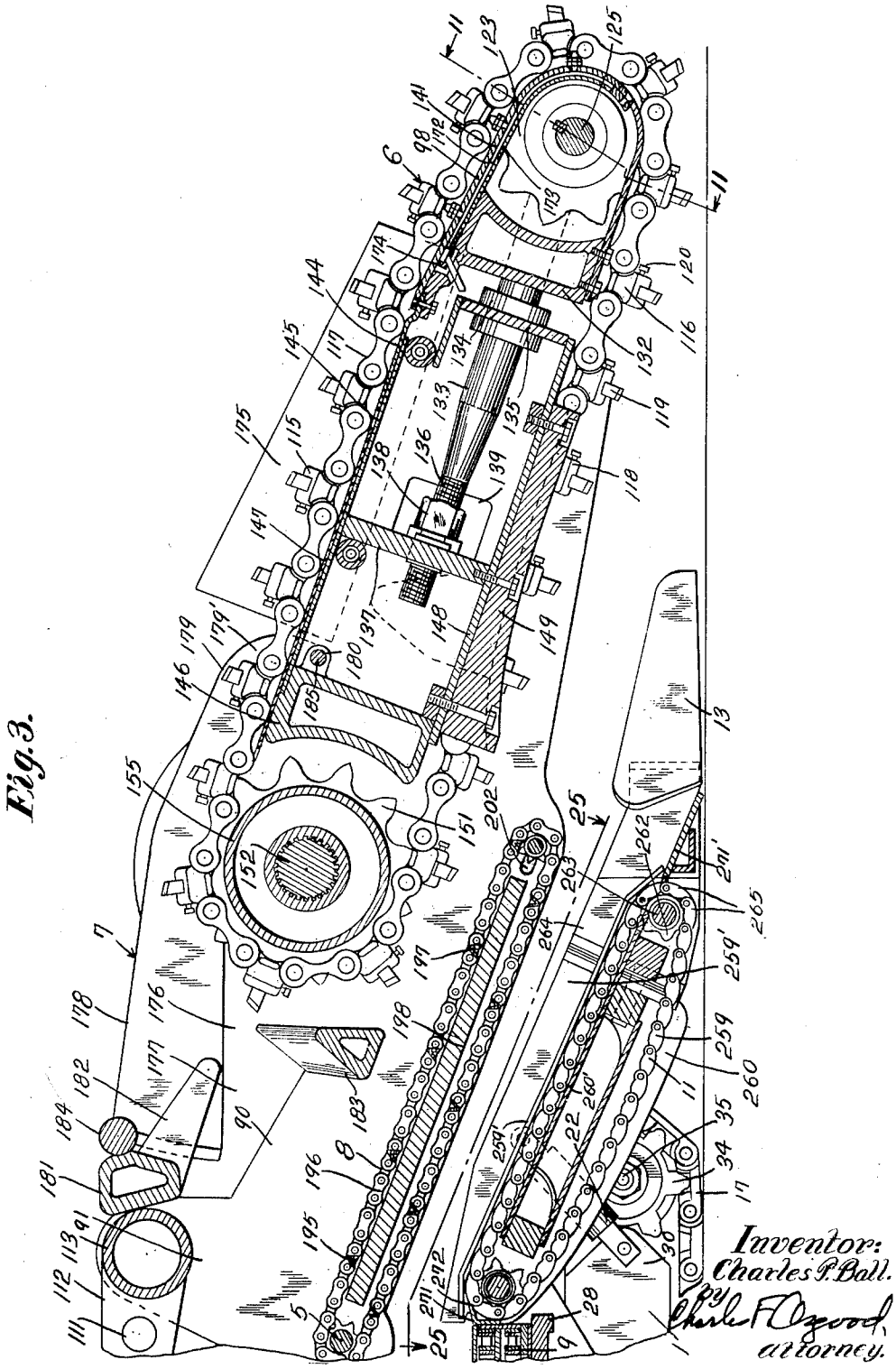


Fig. 3.

Inventor:
Charles P. Ball.
By Charles F. Osgood
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 3

Fig. 4.

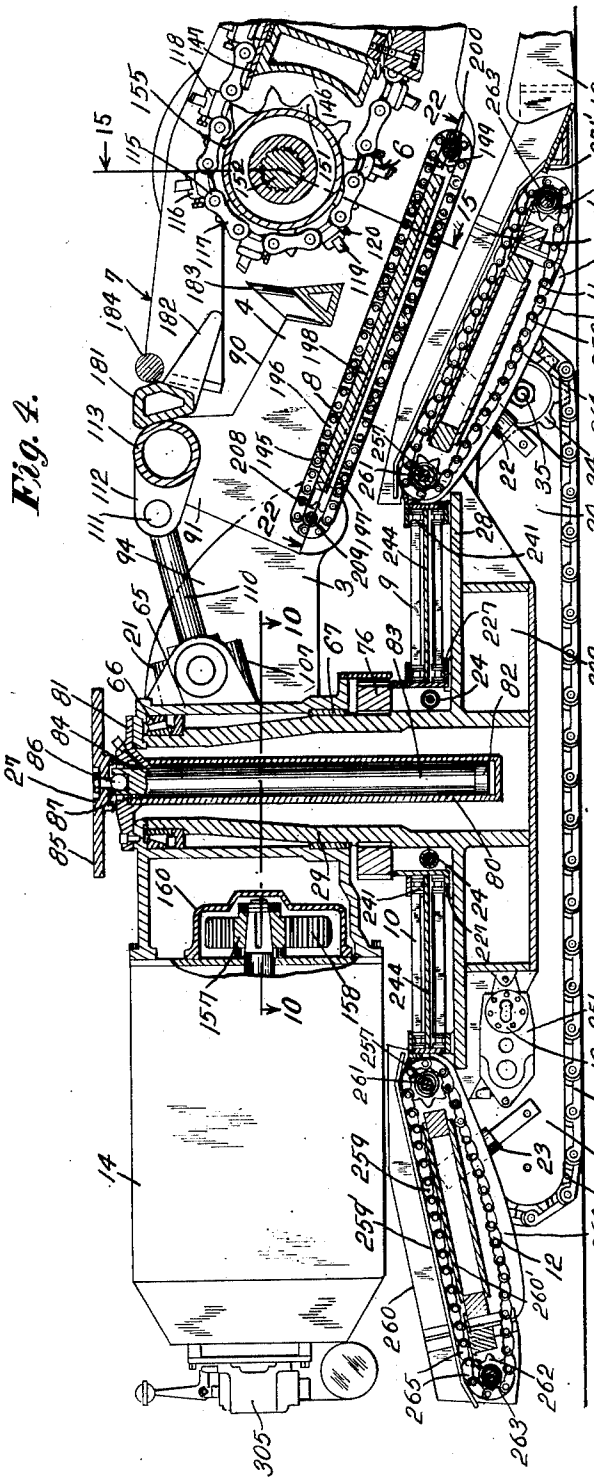
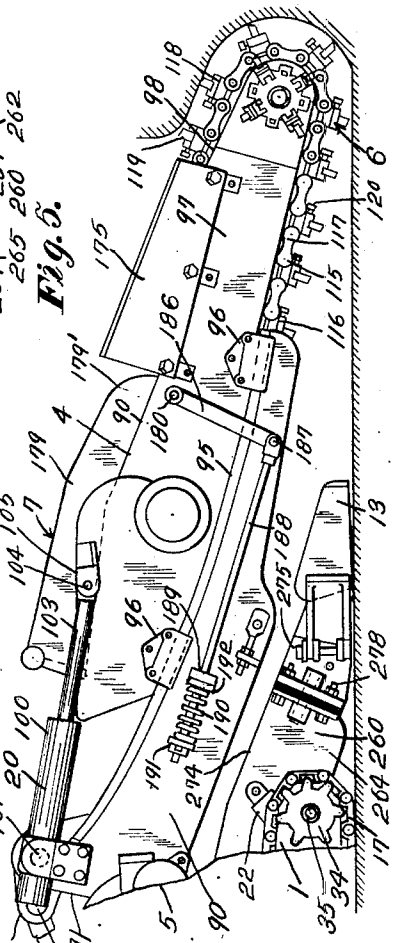


Fig. 5.



Inventor:
Charles F. Ball.
by
Charles F. Ozzard,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 4

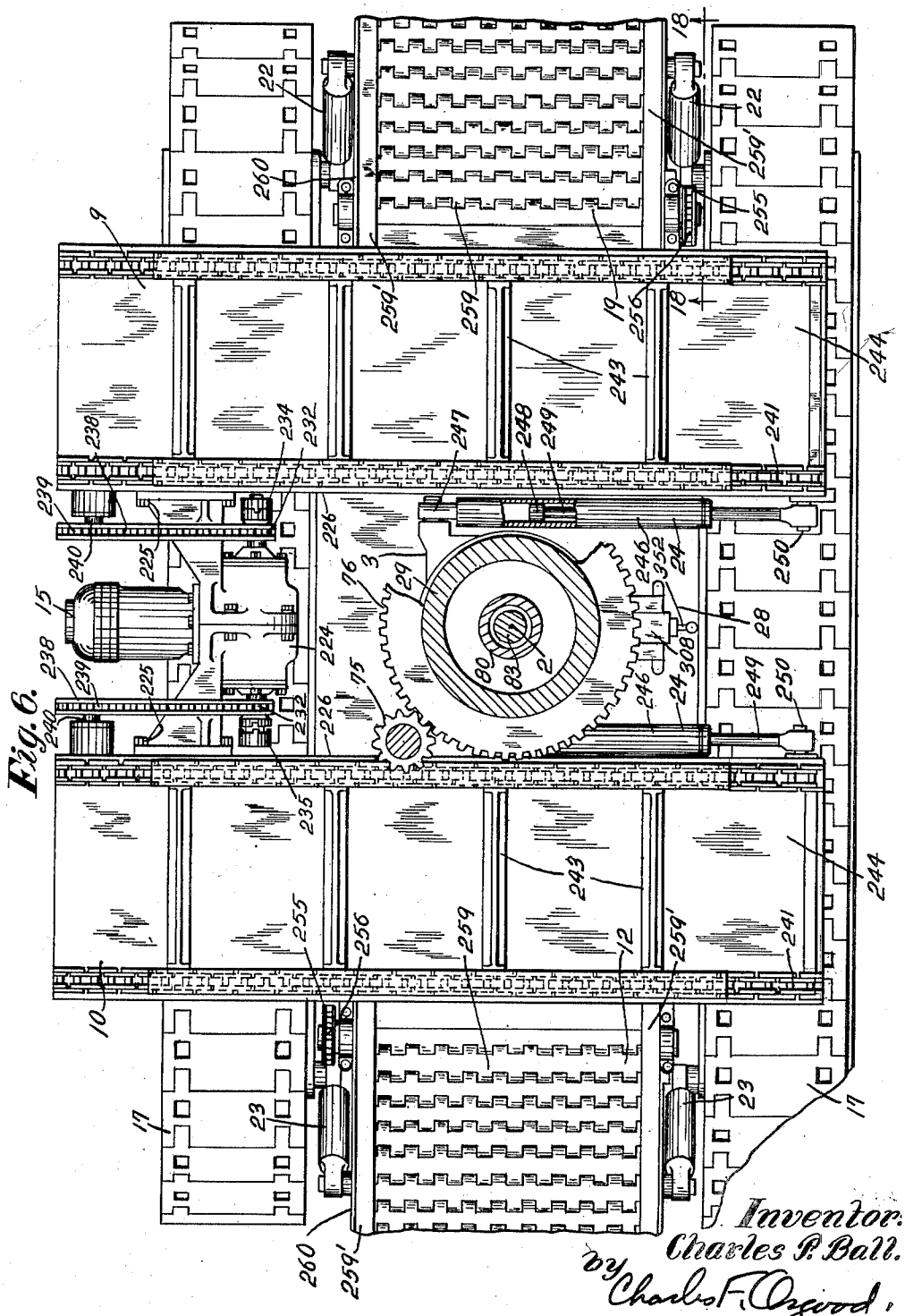


Fig. 6.

Inventor:
Charles P. Ball.
by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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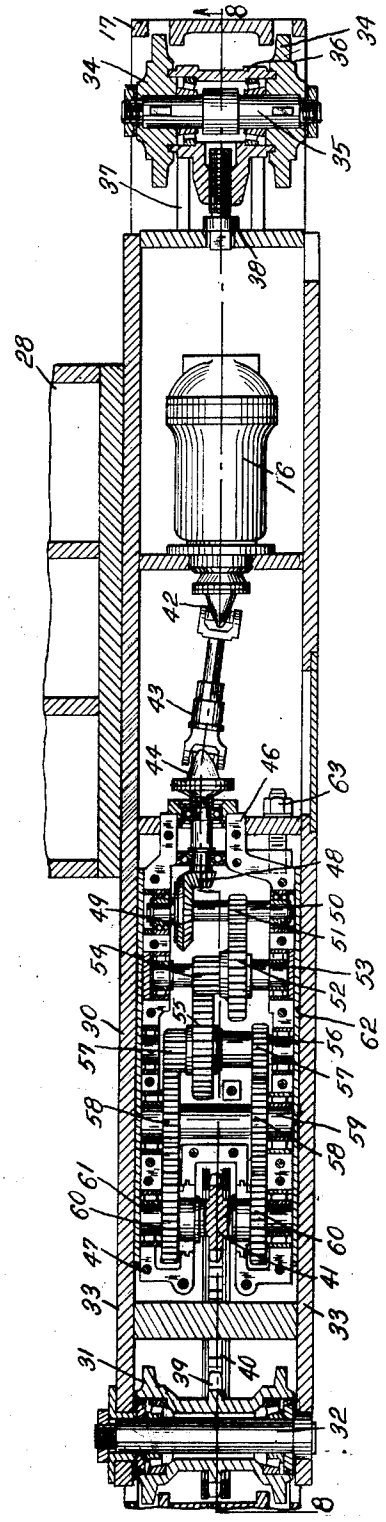

Fig. 7.

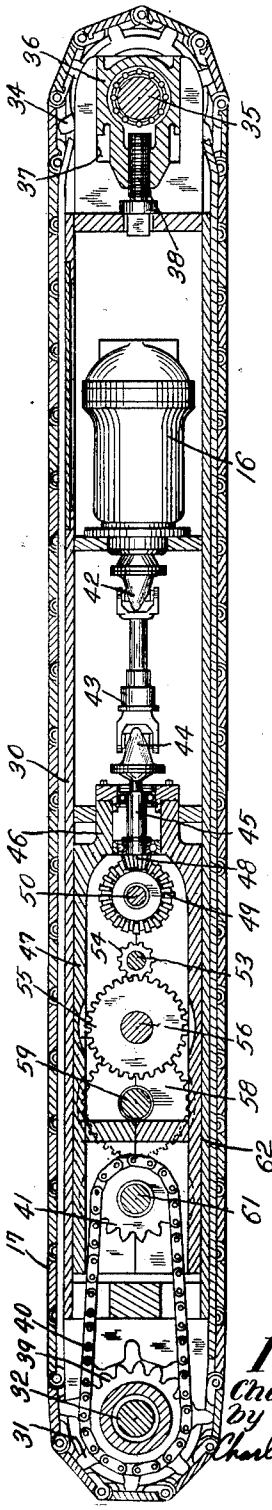

Fig. 8.

Inventor:
Charles P. Ball.
by
Charles F. Ozard
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 9.

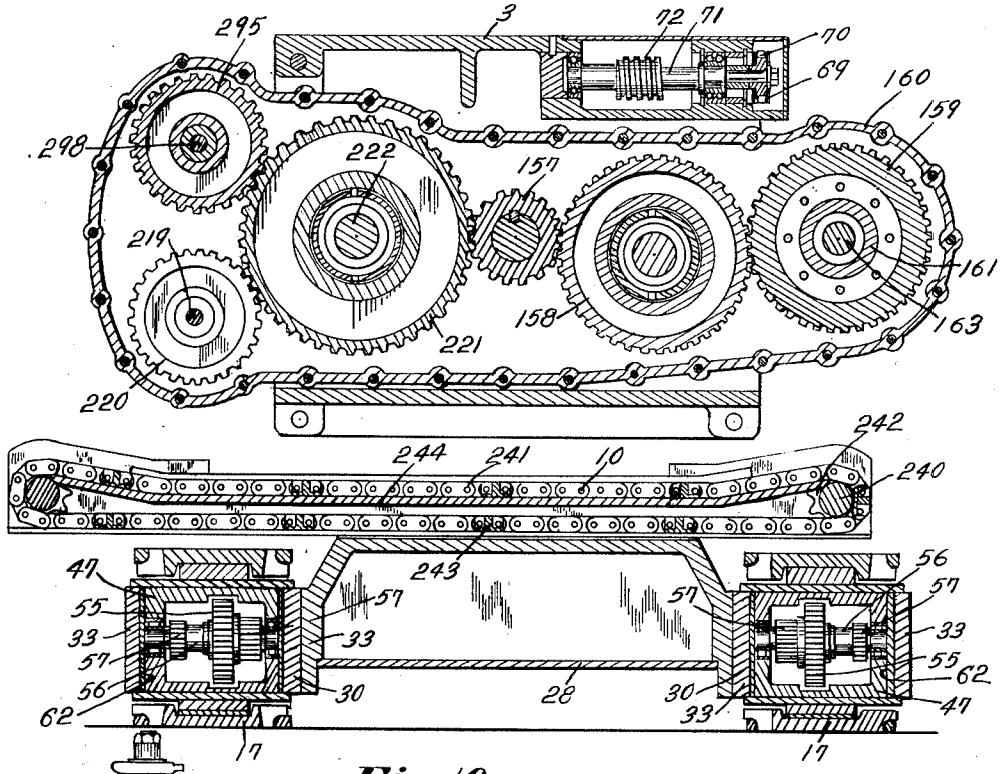
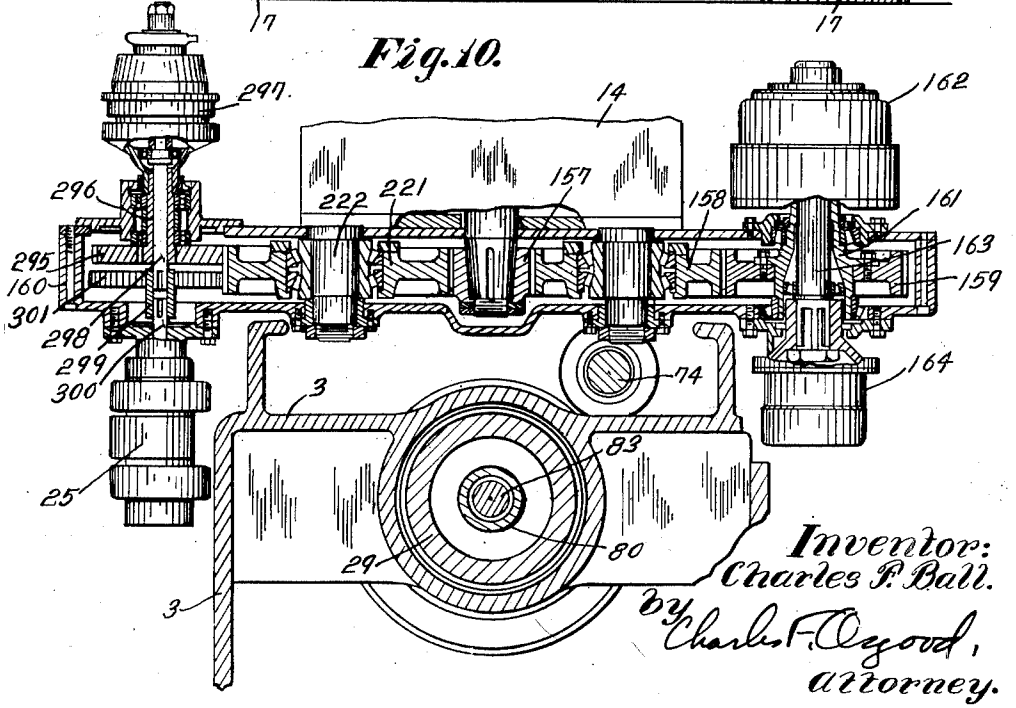


Fig. 10.



Inventor:
Charles F. Ball.
by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 11.

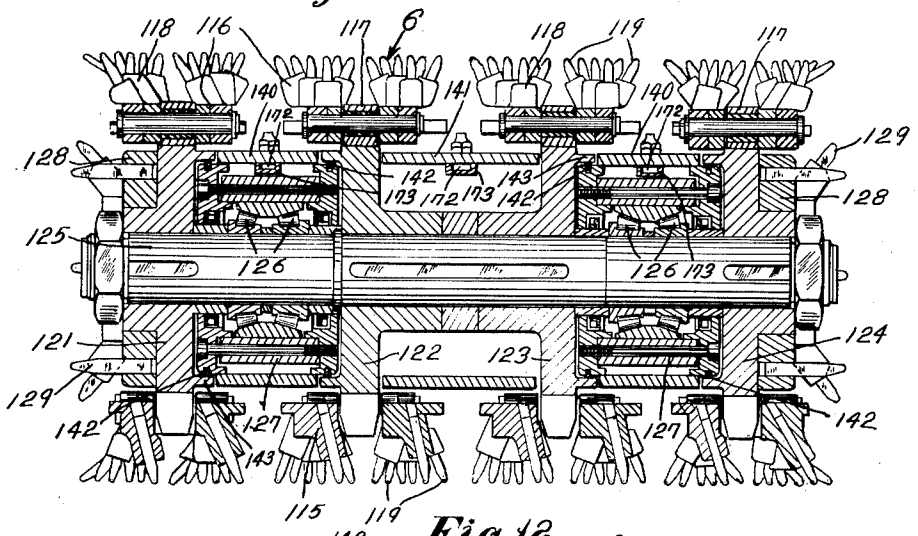


Fig. 12.

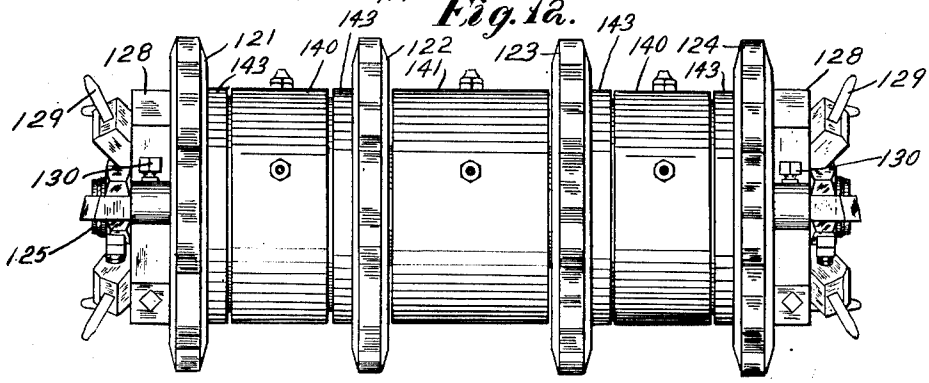


Fig. 13.

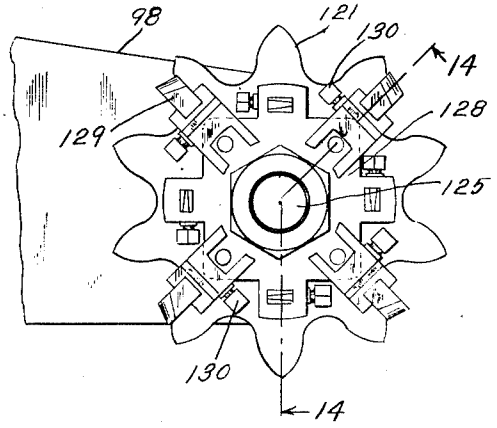
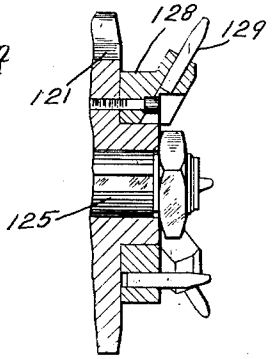


Fig. 14



Inventor:
Charles P. Ball.
by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 15.

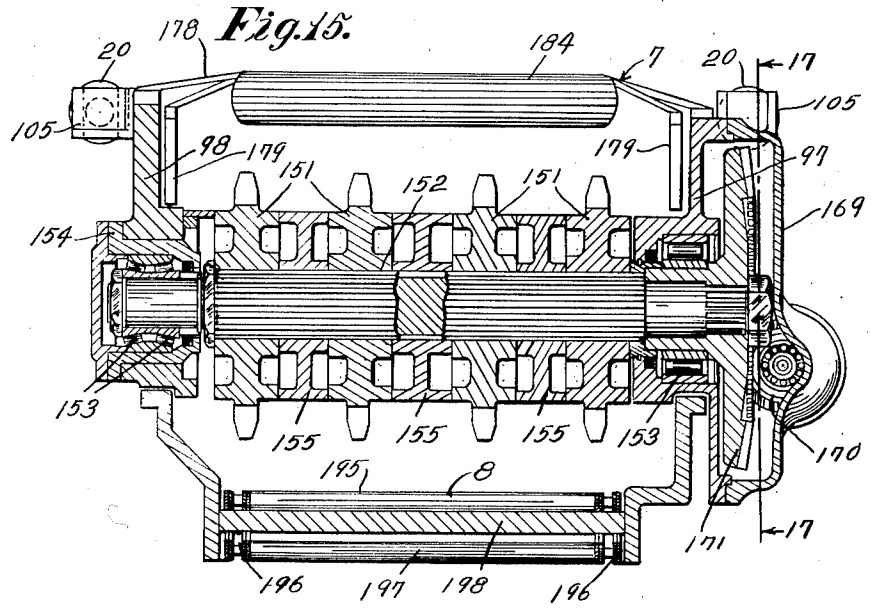
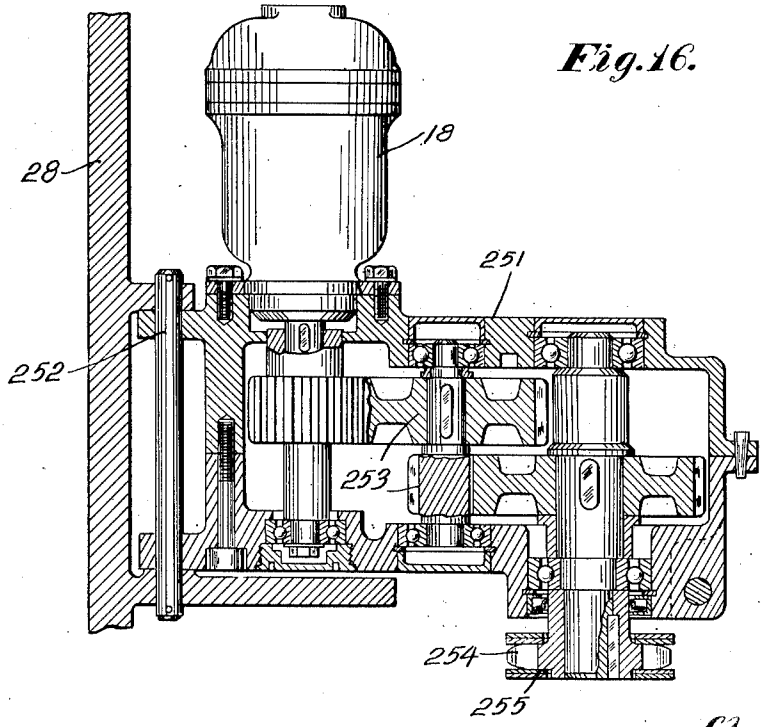


Fig. 16.



Inventor:
Charles F. Ball.
by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949

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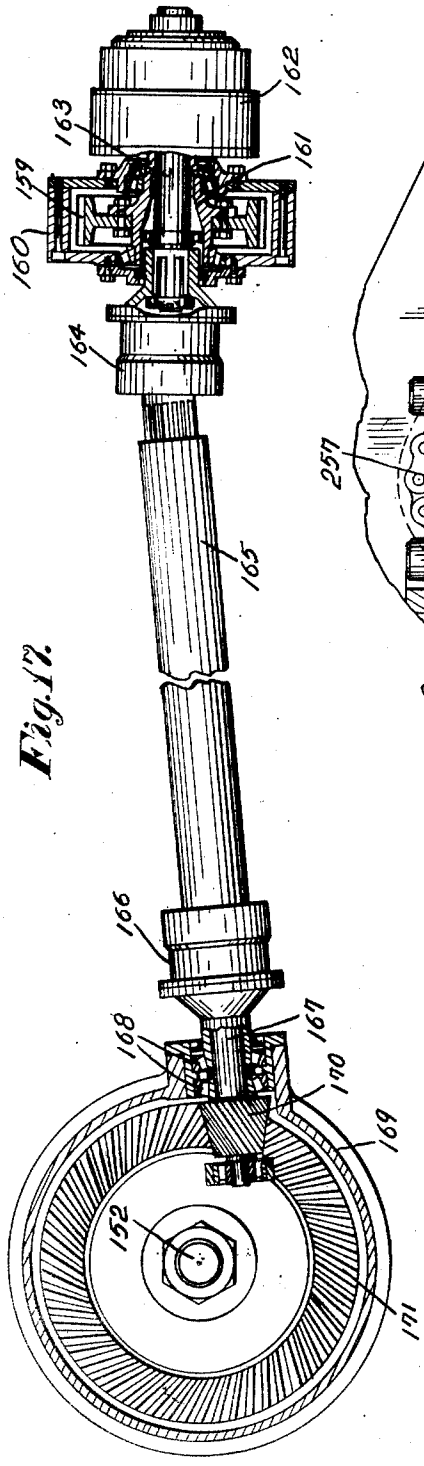

Fig. 17.

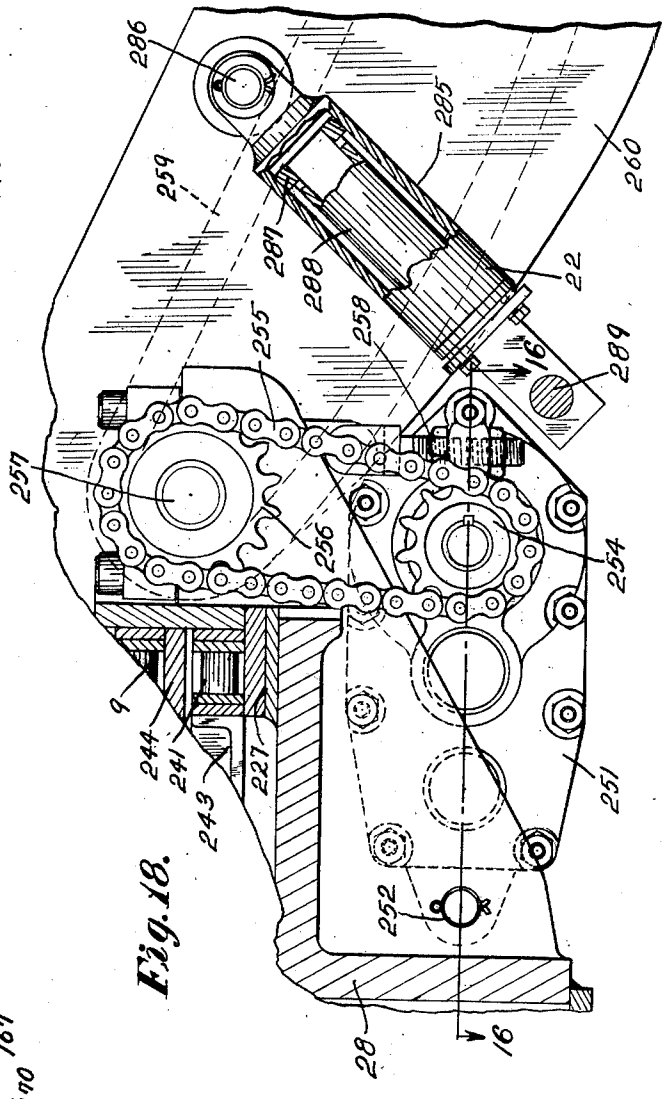

Fig. 18.

Inventor:
Charles P. Ball.
by Charles F. Oxford,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949

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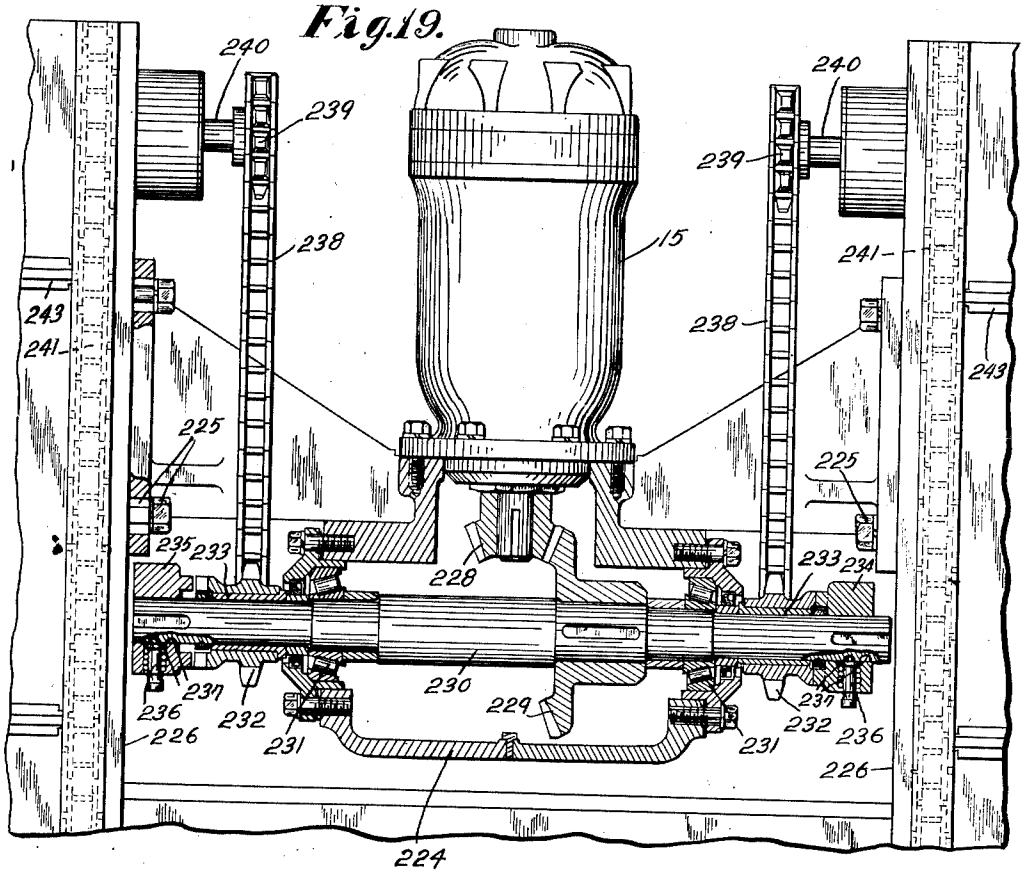
Fig. 19.



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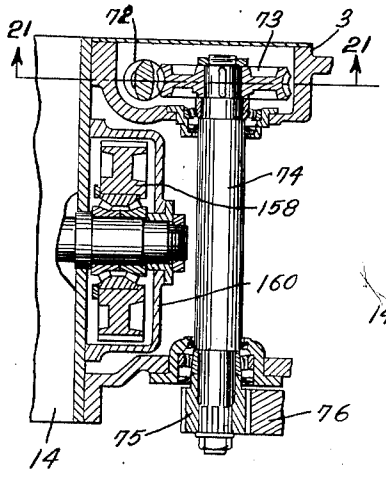
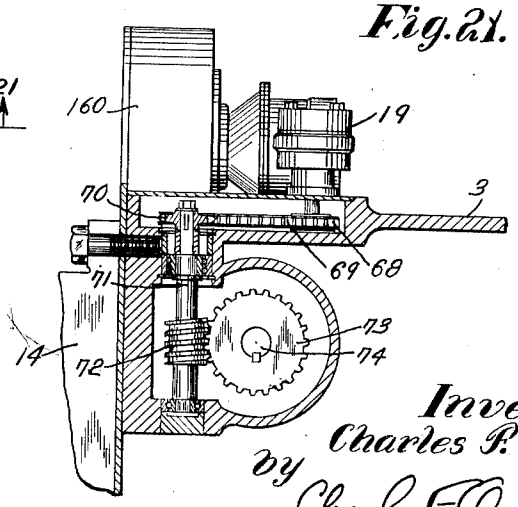


Fig. 21.



Inventor:
Charles F. Ball.
by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 22.

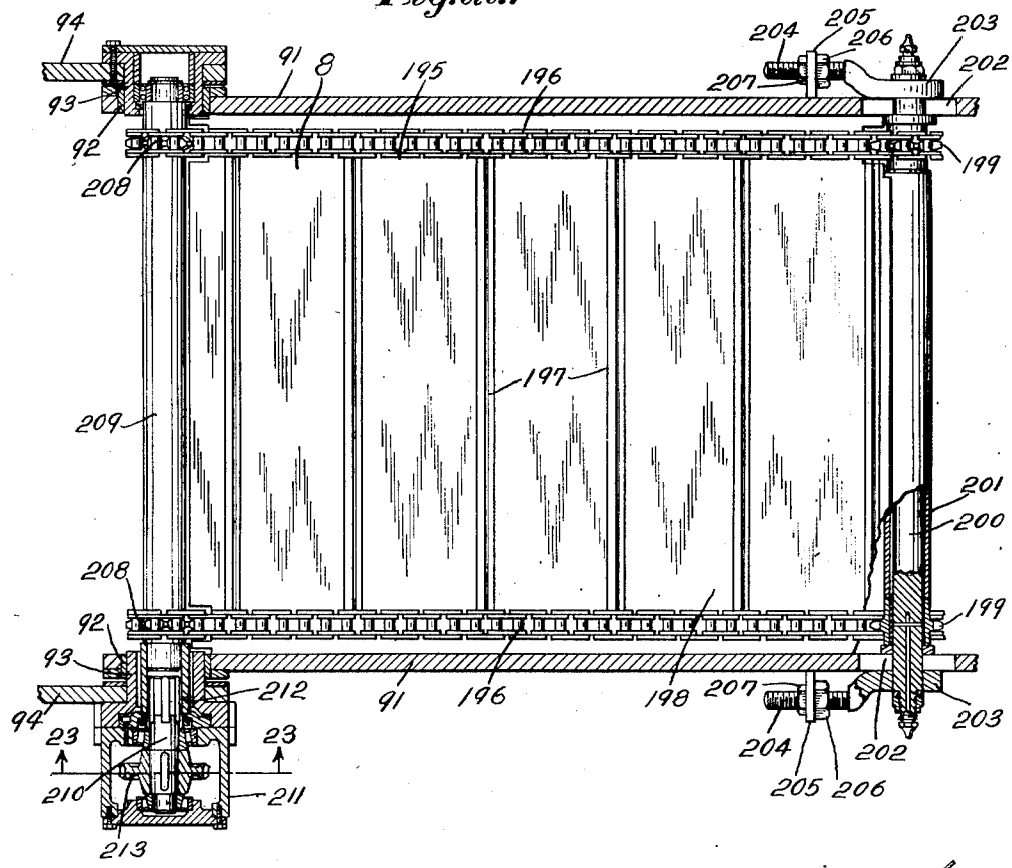


Fig. 23.

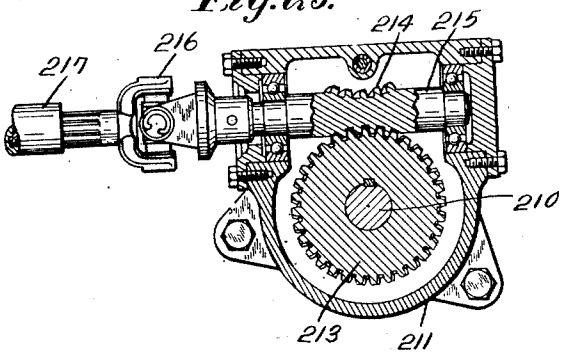
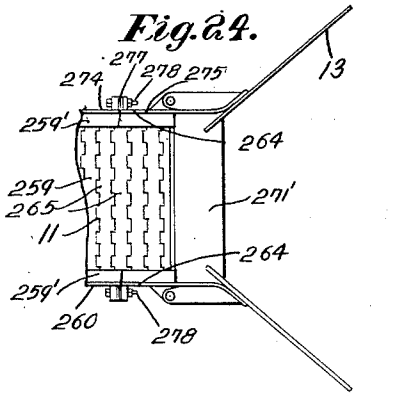


Fig. 24.



Inventor:
Charles F. Ball.
by Charles F. Lyon,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 25.

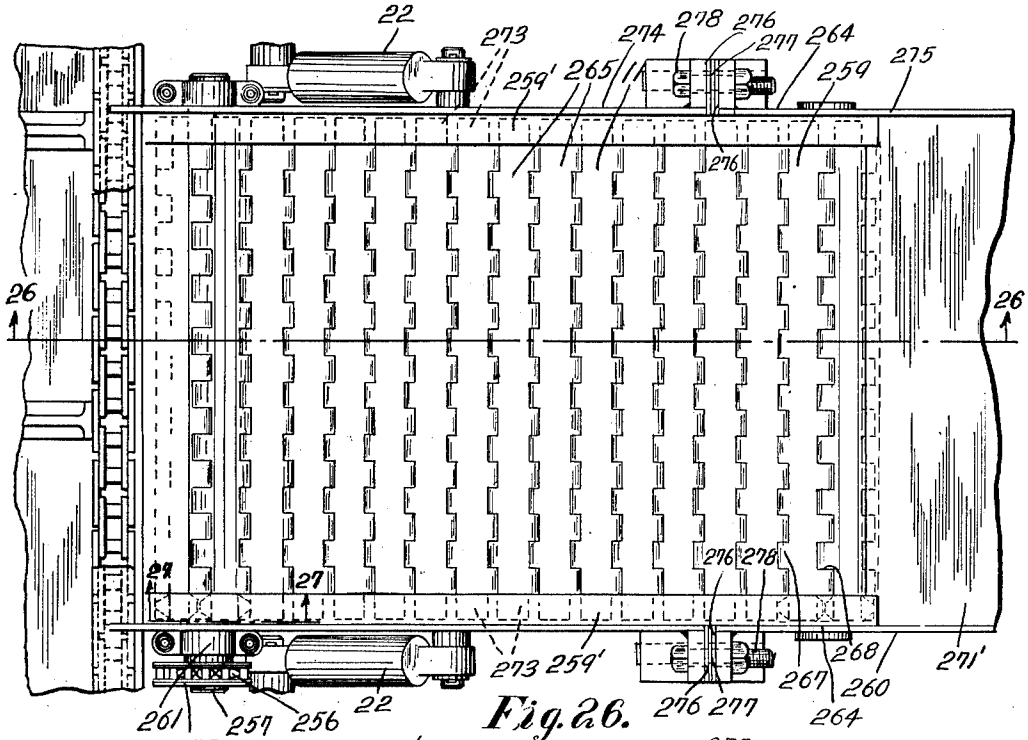


Fig. 26.

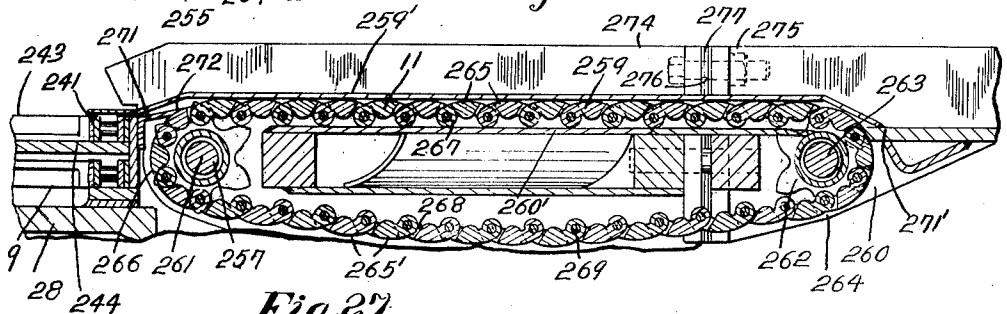
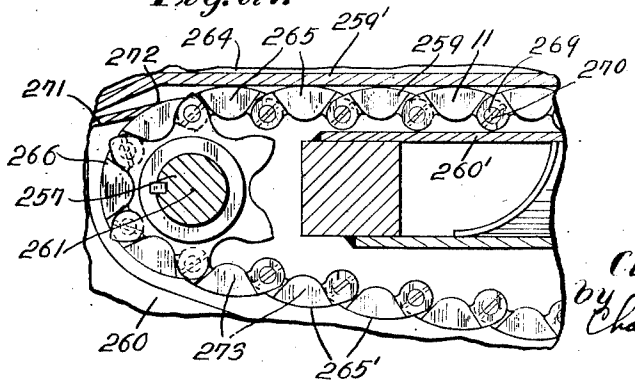


Fig. 27.



Inventor:
Charles F. Ball.
by Charles F. Osgood,
Attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig.28.

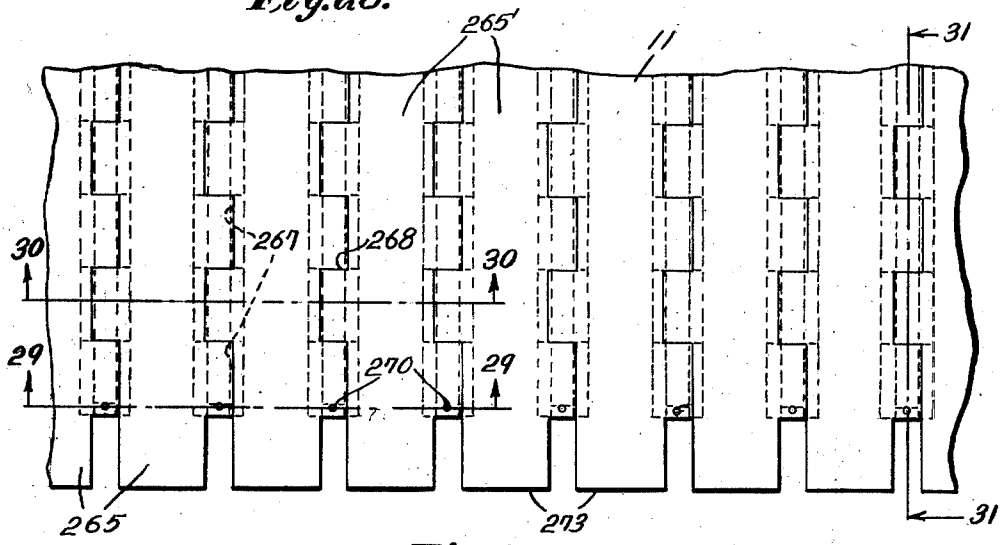

Fig.29

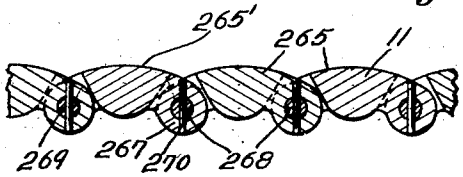

Fig.30

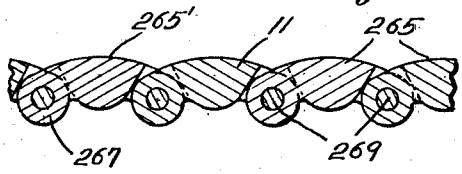

Fig.31.

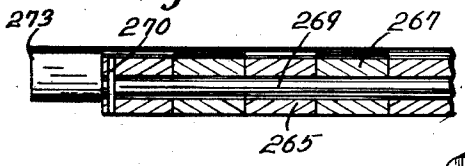

Fig.32.

Inventor:
Charles F. Ball.
by Charles F. Osgood,
Attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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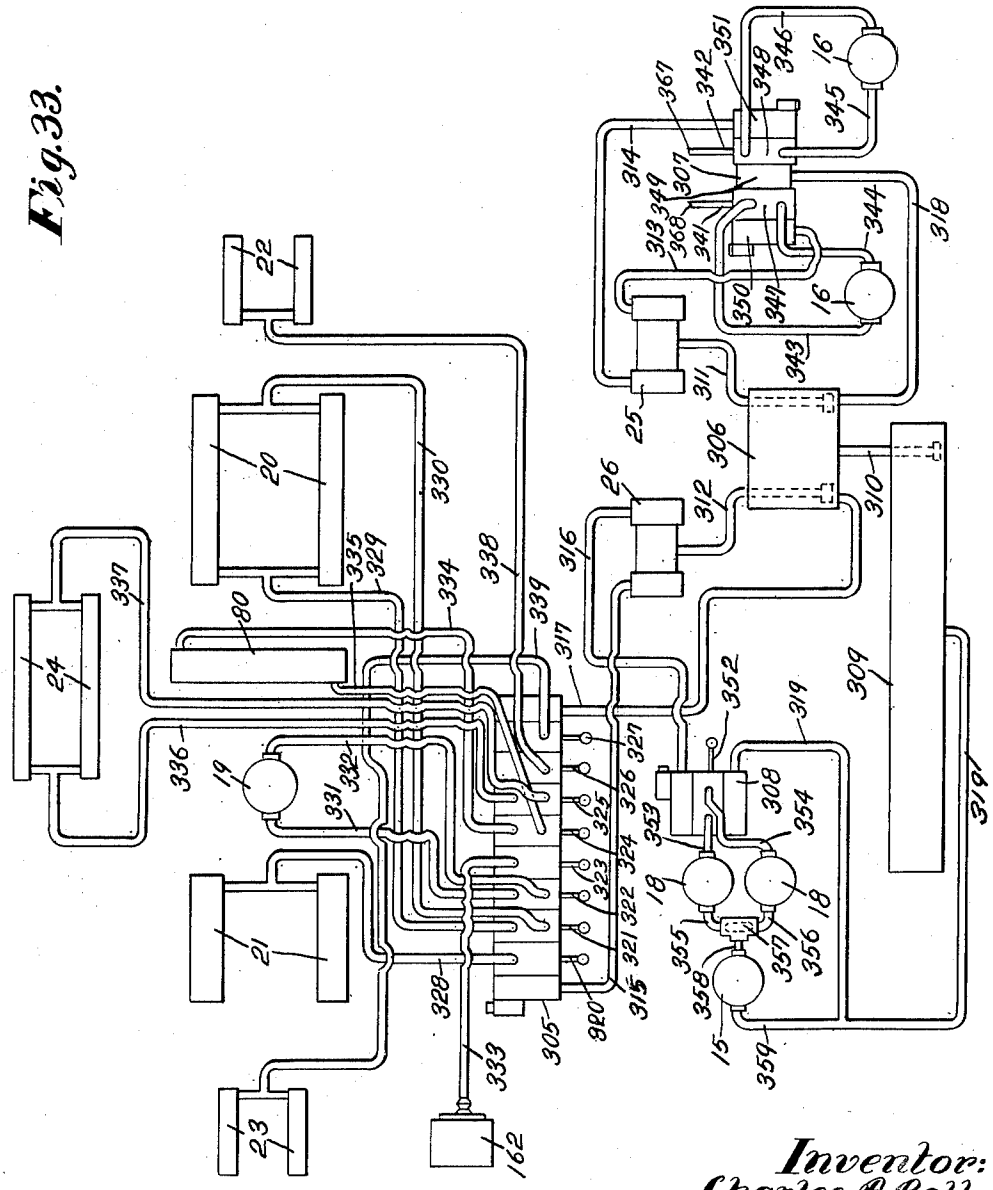
Fig. 33.



Inventor:
Charles F. Ball.
by
Charles F. Osgood,
Attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 15

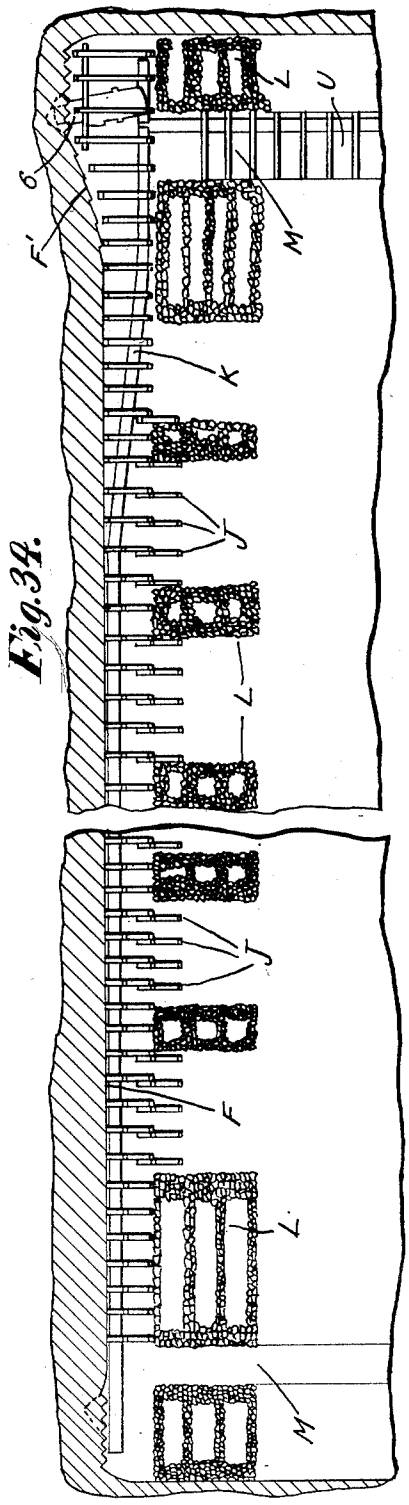


Fig. 34.

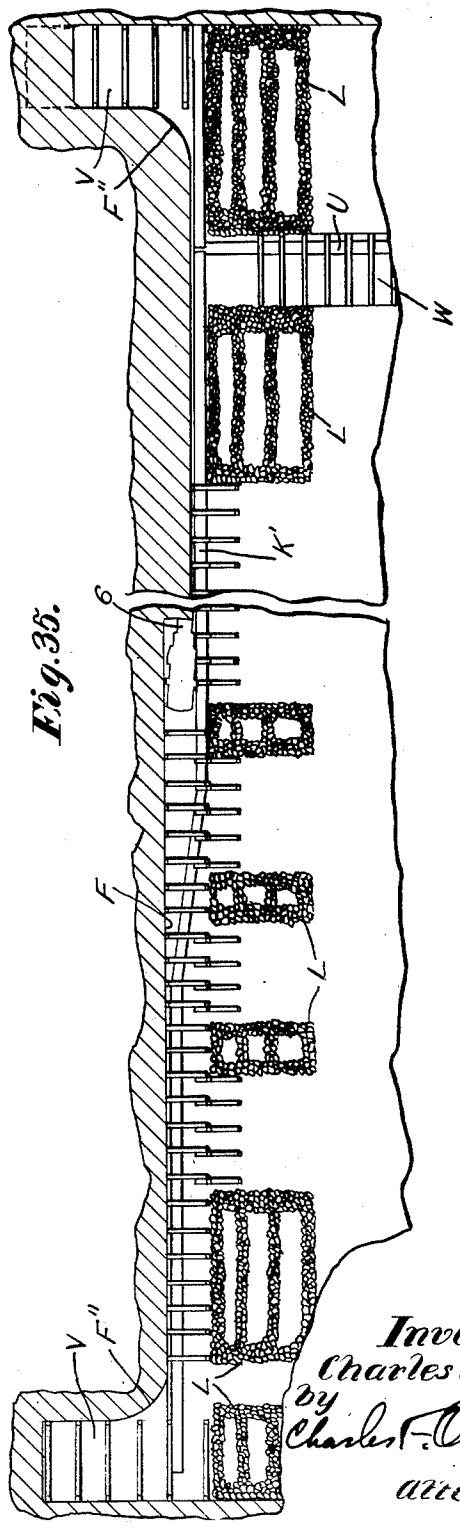


Fig. 35.

Inventor:
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attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Filed April 9, 1949 17 Sheets-Sheet 16

Fig. 36.

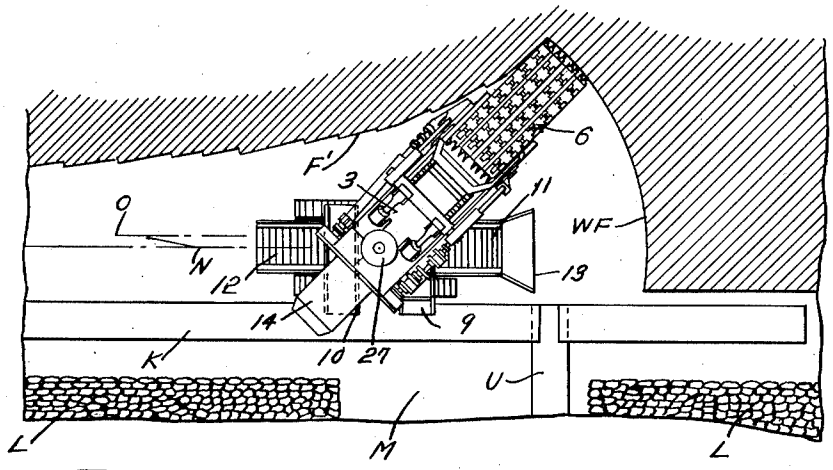


Fig. 37.

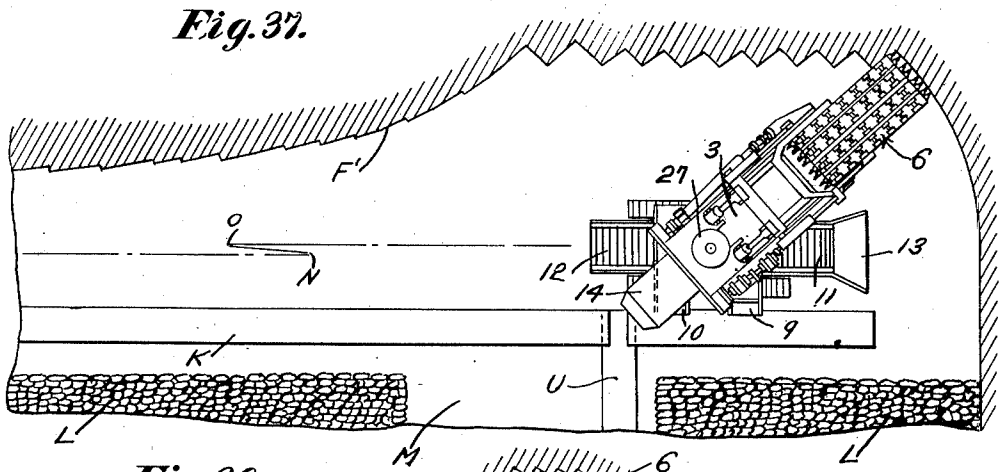
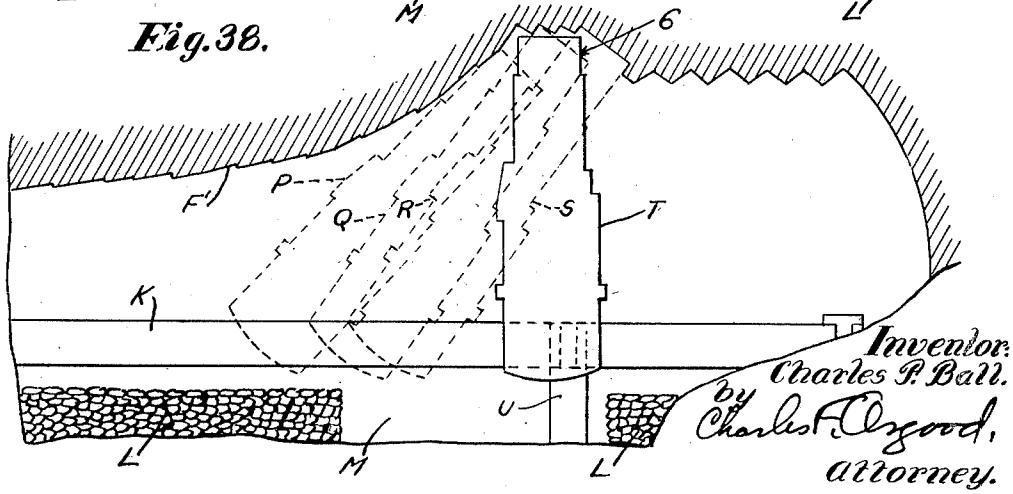


Fig. 38.



Inventor:
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by Charles F. Osgood,
attorney.

April 5, 1955 C. F. BALL 2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

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Fig. 39.

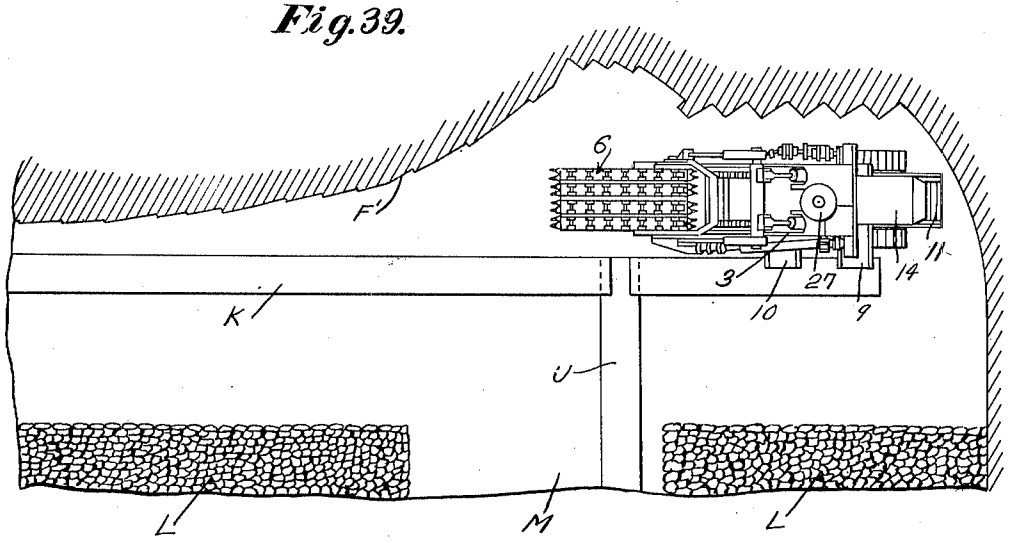


Fig. 40.

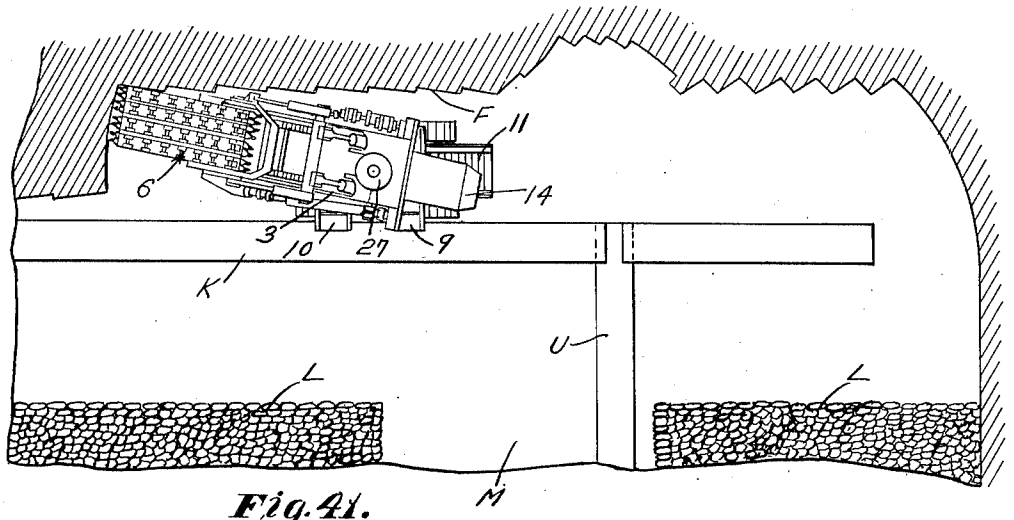
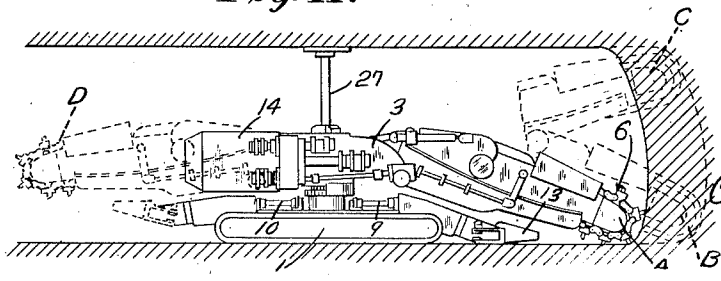


Fig. 41.



Inventor:
Charles P. Ball.
by
Charles F. Osgood.
Attorney.

United States Patent Office 2,705,626 Patented Apr. 5, 1955

2,705,626

CONTINUOUS MINING APPARATUS OF THE REVERSIBLE LONGWALL TYPE

Charles F. Ball, Franklin, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application April 9, 1949, Serial No. 86,516

21 Claims. (Cl. 262—28)

This invention relates to a mining apparatus and more particularly to a continuous mining apparatus for removing minerals such as coal from a solid mine vein in a substantially uninterrupted manner without the use of explosives, and for conveying the dislodged mineral or coal as it is removed from the mine vein to a convenient point of delivery.

Mining apparatus of the character of the present invention is designed mechanically to remove completely, by a unitary and self-contained machine, minerals such as coal from a solid mine vein or coal seam in a relatively continuous and uninterrupted manner, thereby eliminating the conventional separate steps of cutting, drilling, blasting and loading the mineral or coal by means of separate pieces of equipment. The mineral or coal as it is dislodged from the mine vein or coal seam is suitably collected, properly broken to size, and conveyed to a convenient point of delivery remote from the working face so that manual loading of the mineral or coal is substantially avoided. By reason of the extreme compactness, both vertically and laterally, of the apparatus of the present invention, the same is particularly adapted to use in the relatively restricted spaces resulting from close roof propping or timbering common to longwall faces encountered in the longwall system of mining, and since such an apparatus must operate in opposite directions along the longwall face in accordance with such system, the apparatus of the present invention is made readily reversible without the necessity of complete turning around of the apparatus. The apparatus of the present invention, due to its novel features of construction, is ideally suitable for the complete mechanical mining and loading of minerals such as coal from a longwall face, from thin coal seams or veins, and, due to its lateral compactness, may be conveniently moved through the narrow and relatively restricted passageways commonly encountered in mining in accordance with the longwall system. Moreover, the mining apparatus of the present invention further is capable of performing all essential work in the formation of roadways opening laterally of the longwall face, and in the formation of recesses or open spaces in the coal seam or vein of sufficient area to permit turning of the vein attacking and disintegrating mechanism at the ends of a longwall face, thereby enabling ready reversal of the apparatus to effect removal of the coal or other mineral from the working face in either direction along the longwall face without the need of completely turning the apparatus around. Further, the apparatus of the present invention not only simplifies timbering but also, due to its novel features of construction, is capable of completely removing in a substantially uninterrupted manner the mineral or coal from the longwall face of a solid mine vein or coal seam without the use of explosives, thus facilitating and expediting removal of the mineral or coal and making the working conditions safer and less detrimental to health.

The invention, from a broad aspect, resides in improvements in a continuous mining apparatus of a compact construction especially adapted for use in underground coal mines having low head room, and including vein disintegrating mechanism for removing relatively wide vertical segments of the working face, for breaking up oversize chunks of the dislodged coal, and for conveying the dislodged and broken up coal away from the working face to a convenient point of delivery, all in a novel manner. The invention, from a more specific aspect, resides in improvements in a continuous mining apparatus which

is extremely laterally compact and adapted to remove coal from a longwall coal face and to move parallel to the face in the restricted space provided between the coal face and the face conveyor, and may comprise a mobile base, such as a crawler base, carrying a swivelled frame swingable horizontally about an upright axis located centrally of the base, with respect to the base, and carrying a frame structure which projects in advance of the base and which is swingable in vertical planes relative to the swivelled frame and swingable horizontally with the swivelled frame with respect to the base. Power devices may be provided for turning the swivelled frame and for vertically swinging the frame structure about their respective pivots. The swingable frame structure is extensible to vary its effective length and has power devices for extending and retracting the same, and supports at its extendable outer portion the vein or coal seam attacking and disintegrating mechanism. The swivelled frame is swingable horizontally relative to the base to locate the vein-attacking and disintegrating mechanism in different lateral positions angularly with respect to the swivel axis and the vein-attacking and disintegrating mechanism is disposable with respect to the working face in a position to be sumped into the coal at the floor level by extending the frame structure by its power devices, and when the outer portion of the attacking and disintegrating mechanism has been sumped into the coal, the frame structure may be swung upwardly by its power devices at a relatively high speed and with a powerful upward thrust to cause the attacking and disintegrating mechanism to effect dislodgment, with a ripping or tearing action, of a veritcal segment of the working face of the coal between the sumped position of the attacking and disintegrating mechanism and its raised position at the roof level. The disintegrated coal or mineral is moved rearwardly along the top of the attacking and disintegrating mechanism to discharge into a breaker and hopper device wherein any oversize chunks of coal or other mineral are reduced to proper size and conducted downwardly to a front conveyor carried by the rearward portion of the frame structure beneath the rearward portion of the attacking and disintegrating mechanism, and this conveyor may in turn discharge onto a main discharge conveyor overlying the base and arranged crosswise of the base. When the attacking and disintegrating mechanism reaches the end of its upward stroke at the roof level, the frame structure may be retracted by its power devices to withdraw the attacking and disintegrating mechanism from the working face, and the attacking and disintegrating mechanism may then be lowered and positioned laterally, and may again be sumped into the coal and swung upwardly to remove an adjacent vertical segment of the working face. The base may then be advanced along the longwall face to a new operating position and under certain conditions the swivelled frame may be turned on its swivel relative to the base to locate the disintegrating mechanism at different angles of attack with respect to the face of the coal, and the sumping, swinging and withdrawal operations above described may be repeated in any position of adjustment of the disintegrating mechanism to effect disintegration of vertical segments of the working face. By angularly positioning the disintegrating mechanism with respect to the base successive segments of coal may be dislodged from the coal seam to provide a widened space at either end of the longwall face of sufficient area to permit reversal of the attacking and disintegrating mechanism as will later be explained. The disintegrated coal or other mineral which is discharged onto the transverse conveyor by the front conveyor may be conveyed to a suitable point of delivery laterally of the base such as on a face conveyor arranged parallel with the face at the prop side of the apparatus between the latter and the roof props. Any loose coal or other mineral which falls from the attacking and disintegrating mechanism or directly from the working face onto the mine floor during the dislodging operation, may be picked up or gathered by a front shovel or scraper and a gathering conveyor carried at the front end of the base and this gathering conveyor is arranged on the base to discharge onto the transverse conveyor. The apparatus is designed to operate in either of opposite directions along the longwall face and the

swivelled frame may be swung on its swivelled mounting to position the attacking and disintegrating mechanism to operate at either end of the base which is reversible, and a second transverse conveyor on the base is arranged to receive the disintegrated coal discharged from the front conveyor in the reversed position of the disintegrating mechanism. Also, a second gathering conveyor may be arranged at the opposite end of the base and the shovel or scraper may be transposed to the opposite end of the base so that any loose coal on the mine floor may be directed toward such second gathering conveyor during reverse movement of the apparatus. The transverse conveyors are symmetrically arranged on the base at the opposite ends of the latter and at opposite sides of the frame swivel so that they may receive the disintegrated mineral or coal discharged from the front conveyor in either of the reversed positions of the attacking and disintegrating mechanism and are so arranged and constructed that they may be extended in an endwise direction laterally from one side of the base irrespective of direction in which the apparatus is operating.

An object of the present invention is to provide an improved mining apparatus. Another object is to provide an improved continuous mining apparatus capable of operating in either of opposite directions along a longwall face of an underground coal mine. Yet another object is to provide an improved continuous mining apparatus which is extremely compact, both vertically and laterally, whereby the apparatus may readily move through the restricted passageways and low head room encountered in the mining of coal in accordance with the longwall system. A further object is to provide an improved mining apparatus whereby the coal of the working face of a coal seam may be dislodged from the solid without the use of explosives, and the dislodged coal may be conveyed to a convenient loading point without need of manually handling the dislodged coal. A still further object is to provide an improved continuous mining and loading apparatus which is extremely compact both vertically and laterally and which is also extremely flexible in operation and sensitive to control. Still another object is to provide an improved continuous mining apparatus having vein-attacking and disintegrating mechanism which is disposable in reversed positions with respect to the base of the apparatus whereby coal may be dislodged from a coal face during movement of the apparatus in either of opposite directions along the face. Another object is to provide an improved continuous miner especially designed for use in accordance with the longwall system of mining and which embodies improved coal attacking and disintegrating mechanism which may be reversely positioned with respect to the base of the apparatus whereby the coal may be dislodged from the face of the mine vein during either direction of movement in the apparatus, and embodying means whereby the apparatus may be readily reversed. A further object is to provide an improved conveying means for a continuous miner of the reversible longwall type whereby the coal dislodged from the coal seam may be loaded at a convenient point remote from the coal face irrespective of the direction in which the apparatus is operating. Still another object is to provide an improved continuous mining apparatus comprising a mobile base having a swivelled frame mounted thereon to swing horizontally with respect thereto and carrying an extensible frame structure which is swingable in vertical planes and on the outer portion of which coal-detaching, face-attacking and disintegrating mechanism is carried whereby when the frame structure is extended and retracted, the attacking and disintegrating mechanism may be sumped into the coal seam or retracted from the coal face, and having embodied therein improved means for swinging the frame structure in vertical planes to effect movement of the disintegrating mechanism vertically in an arcuate path from its sumped position near the floor level to its raised position at the roof level. Another object is to provide an improved continuous mining apparatus of the above character wherein the swivelled frame is swingable to locate the coal-attacking and disintegrating mechanism at either end of the base to enable operation of the apparatus in either direction along a longwall coal face. Still a further object is to provide an improved mining apparatus having a mobile base adapted to move in either direction along a longwall coal face and carrying a gathering or cleanup conveyor at both of its opposite ends whereby any loose coal on the mine floor may be gathered and discharged on a transverse conveyor during either direction of movement of the base. Another object is to provide an improved reversible continuous miner of the longwall type adapted to operate in either of opposite directions along a longwall coal face and embodying reversible vein-attacking and disintegrating mechanism and conveying means on the base onto which the disintegrated coal may be discharged during either direction of operation of the apparatus. A further object is to provide an improved reversible continuous mining apparatus adapted to operate in either of opposite directions along a longwall coal face and adapted continuously to load the disintegrated coal onto a face conveyor arranged parallel with the coal face during either direction of operation of the apparatus. Still another object is to provide an improved reversible continuous mining apparatus of the longwall type embodying reversible coal attacking and disintegrating mechanism which is adapted to dislodge coal successively in relatively wide vertical segments at either end of the longwall face to provide sufficient turning area for the attacking and disintegrating mechanism whereby the apparatus may be readily reversed. Another object is to provide an improved mining and loading apparatus having a novel combination and arrangement of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a plan view of a continuous mining apparatus constructed in accordance with the preferred illustrative embodiment of the invention.

Fig. 2 is a side elevational view of the mining apparatus shown in Fig. 1, with the vein-attacking and disintegrating mechanism in its lowered, retracted position.

Fig. 3 is an enlarged central longitudinal vertical sectional view taken substantially on line **3—3** of Fig. 1, illustrating details of the forward portion of the mining apparatus.

Fig. 4 is an enlarged central longitudinal vertical sectional view taken substantially on line **4—4** of Fig. 1, illustrating details of the rearward portion of the mining apparatus.

Fig. 5 is a fragmentary side elevational view of the forward portion of the mining apparatus, showing the vein attacking and disintegrating mechanism in its forward extended position at the floor level.

Fig. 6 is an enlarged horizontal sectional view taken substantially on the planes of line **6—6** of Fig. 2.

Fig. 7 is an enlarged horizontal sectional view taken substantially on line **7—7** of Fig. 2, illustrating details of one of the crawler tread structures.

Fig. 8 is a vertical sectional view taken substantially on line **8—8** of Fig. 7.

Fig. 9 is an enlarged cross-sectional view taken substantially on line **9—9** of Fig. 1.

Fig. 10 is a detail horizontal sectional view taken on line **10—10** of Fig. 4.

Fig. 11 is an enlarged detail sectional view taken on the planes of line **11—11** of Fig. 3, illustrating details of the vein-attacking and disintegrating mechanism.

Fig. 12 is a front end view of the mechanism shown in Fig. 1, with the disintegrating chains omitted to facilitate illustration.

Fig. 13 is a side view of the mechanism shown in Fig. 12, showing a rotary side disintegrator.

Fig. 14 is a detail sectional view taken on the planes of line **14—14** of Fig. 13, illustrating details of one of the rotary side disintegrators.

Fig. 15 is a detail sectional view taken on the plane of line **15—15** of Fig. 4, with the chains omitted.

Fig. 16 is a horizontal section taken on line **16—16** of Fig. 18.

Fig. 17 is a detail longitudinal vertical sectional view taken substantially on line **17—17** of Fig. 15, illustrating a portion of the drive for the vein-attacking and disintegrating mechanism.

Fig. 18 is an enlarged detail longitudinal vertical sectional view taken on line **18—18** of Fig. 6.

Fig. 19 is a plan view, with parts shown in horizontal section, illustrating a portion of the drive for the transverse discharge conveyors.

Fig. 20 is an enlarged detail vertical sectional view

taken substantially on the planes of line 20—20 of Fig. 1.

Fig. 21 is a detail horizontal sectional view taken on line 21—21 of Fig. 20.

Fig. 22 is a sectional view taken substantially on line 22—22 of Fig. 4, showing the front conveyor.

Fig. 23 is a detail vertical sectional view taken on line 23—23 of Fig. 22, illustrating the details of the front conveyor drive.

Fig. 24 is a plan view taken on line 24—24 of Fig. 2, showing the detachable front shovel or scraper.

Fig. 25 is an enlarged plan view taken on line 25—25 of Fig. 3, illustrating details of one of the gathering or pickup conveyors.

Fig. 26 is a central longitudinal vertical sectional view taken on line 26—26 of Fig. 25.

Fig. 27 is an enlarged detail vertical sectional view taken on line 27—27 of Fig. 25.

Fig. 28 is an enlarged fragmentary plan view of the gathering conveyor shown in Fig. 25.

Figs. 29 and 30 are detail vertical sectional views taken respectively on lines 29—29 and 30—30 of Fig. 28.

Fig. 31 is a detail cross-sectional view taken on line 31—31 of Fig. 28.

Fig. 32 is a perspective view of a pair of adjacent conveyor links of the gathering conveyor shown in Fig. 28.

Fig. 33 is a diagrammatic view showing the hydraulic fluid system and associated control valve means of the apparatus.

Fig. 34 is a diagrammatic view in plan showing the mining apparatus operating in accordance with the longwall system of mining, with the apparatus operating to dislodge a series of vertical segments of coal from the coal face to provide a widened space to permit reversal of the vein-attacking and disintegrating mechanism.

Fig. 35 is a diagrammatic view in plan, similar to Fig. 34, illustrating a different manner of operating the mining apparatus in accordance with the longwall system.

Figs. 36 to 40 inclusive are diagrammatic views in plan illustrating the manner of reversing the apparatus at the end of a longwall face.

Fig. 41 is a diagrammatic side view of the apparatus operating in a mine, showing the vein-attacking and disintegrating mechanism in sumping, sumped and raised positions as indicated in full and dotted lines.

The improved continuous mining apparatus, as shown in the drawings, constitutes an improvement over that disclosed in a copending application of common ownership of one Harold F. Silver, Ser. No. 11,688, filed February 27, 1948, and generally comprises a mobile base 1, herein a tractor or crawler base, adapted to travel over the floor of a mine, and carrying centrally thereof a vertical swivel 2, on which a horizontal supporting frame 3 is mounted to swing horizontally with respect to the base, and which, in turn, has an extensible frame structure or head frame 4 pivotally mounted thereon at 5 to swing in vertical planes with respect thereto and to swing in horizontal planes therewith relative to the base. The extensible frame structure 4 extends forwardly in advance of the base and carries, at its outer portion, vein or coal seam-attacking and disintegrating mechanism or dislodging head generally designated 6, for detaching and disintegrating minerals such as coal in relatively wide vertical segments from a solid mine vein or coal seam. The detached and disintegrated mineral or coal is moved by the attacking and disintegrating mechanism 6 rearwardly along the top thereof and is discharged into a breaker and hopper device generally designated 7, in which any oversize chunks of mineral or coal are reduced to proper size and through which broken and disintegrated material is conducted to a front conveyor 8, herein carried by the rearward portion of the extensible frame structure 4 and underlying the rearward portion of the attacking and disintegrating mechanism 6. The conveyor 8 discharges on an endwise adjustable, transverse discharge conveyor or conveyor portion 9 mounted on the top of the base beneath the swivelled frame 3. The attacking and disintegrating mechanism discharges onto the front conveyor 8 in the different extended positions of the frame structure 4 and the front conveyor 8 discharges onto the transverse conveyor 9 in the different angular positions of the swivelled frame assumed during the operation of the attacking and disintegrating mechanism at one end of the base. The base is symmetrical end to end and the vein-attacking and disintegrating mechanism may be reversed with respect to the base simply by swinging the swivelled frame through 180° to enable reverse operation of the apparatus, and a second endwise adjustable transverse conveyor or conveyor portion 10 is arranged on the base at the opposite side of the swivel 2 from the conveyor 9, in a position to receive the disintegrated mineral from the front conveyor 8 when the attacking and disintegrating mechanism is reversed with respect to the base. Arranged symmetrically at opposite ends of the bases are gathering or cleanup conveyors 11 and 12 mounted to swing in vertical planes and a transposable shovel or scraper 13 is attachable to either end of the base for directing loose material from the mine floor onto one of the pickup conveyors irrespective to the direction in which the apparatus is operating. A motor 14, preferably an electric motor, carried by the swivelled frame 3 serves to drive the vein-attacking and disintegrating mechanism 6 and the auxiliary front conveyor 8; a motor 15, preferably a hydraulic motor, drives the cross conveyors 9 and 10; motors 16, 16, preferably hydraulic motors, drive the crawler treads 17 of the base; and motors 18, 18, preferably hydraulic motors, drive the gathering or cleanup conveyors 11 and 12. A motor 19, preferably a hydraulic motor, serves to swing the swivelled frame 3 on its swivelled mounting relative to the base. The crawler treads 17 of the base serve to tram the apparatus about the mine and to steer the apparatus by suitable control of the motors 16, 16. Extensible hydraulic jacks 20, 20 serve to extend and retract the swingable frame structure 4 and extensible hydraulic jacks 21, 21 serve to swing the frame structure in vertical planes. Extensible hydraulic jacks 22, 22 and 23, 23 serve to raise the cleanup conveyor and scraper. Extensible hydraulic jacks 24, 24 serve to adjust the transverse conveyors 9 and 10. The motor 14 also drives pumping means 25 and 26 which supply liquid under pressure to the hydraulic devices above referred to. Arranged centrally of the vertical swivel 2 is a hydraulic roof jack 27 for holding the base steady and for supporting the roof above the apparatus during the coal dislodging operation.

The tractor or crawler base 1 comprises a horizontal frame 28 having an integral vertical tubular column or post 29 of sturdy construction arranged centrally thereof (Figs. 4 and 6), and secured at its sides to tread frames 30, 30 about which the endless crawler treads 17 are guided for circulation. Chain drive sprockets 31 are journaled on bearings supported by transverse shafts 32, and these shafts are secured at their ends within vertical side plates 33 of the tread frames 30 at one end of the latter as shown in Fig. 7. At the opposite ends of the tread frames are chain idler sprockets 34 keyed to the opposite end portions of transverse shafts 35 which are journaled in bearings supported by adjustable brackets 36. The brackets 36 are guided in longitudinal guideways 37 within the tread frames 30 and adjustable longitudinally by adjusting screws 38 threaded within the brackets, to vary the tension of the tread chains 17. The chain sprockets 31 engage and drive the tread chains 17 and in turn are driven by chain sprockets 39 secured thereto and engaged by endless drive chains 40 which are driven by chain sprockets 41. The hydraulic motors 16 are of the conventional reversible type and are arranged within the tread frames 30 as shown in Figs. 7 and 8, and have their power shafts connected through universal joints 42 to telescopic shafts 43 which are in turn connected by universal joints 44 to longitudinal shafts 45, the latter suitably journaled within bearings supported by brackets 46 secured to a gear case 47. Fixed to the shafts 45 are beveled pinions 48 which mesh with and drive beveled gears 49 fixed to transverse shafts 50. The shafts 50 are likewise suitably journaled within bearings supported by the gear case. Fixed to and driven by the shafts 50 are spur pinions 51 meshing with spur gears 52 fixed to shafts 53 herein arranged parallel with the shafts 50 and likewise suitably journaled within bearings supported by the sides of the gear case. Fixed to the shafts 53 are spur pinions 54 meshing with spur gears 55 fixed to parallel shafts 56 likewise suitably journaled within bearings supported within the gear case 47. Spur pinions 57 fixed to each of the shafts 56 at opposite sides of the gear 55 mesh with and drive spur gears 58 fixed to a parallel shaft 59. The shafts 59 likewise are suitably journaled in bearings supported by the gear case. Meshing with and driven by the

spur gears 58 are spur gears 60 fixed to parallel shafts 61 likewise suitably journaled in bearings supported by the gear case 47. The chain sprockets 41 are fixed to the shafts 61 intermediate the spur gears 60. Thus the endless tractor treads 17 may be individually driven by the hydraulic motors 16 through the reduction gearings above described, and these reduction gearings and their casings are, like the motors, enclosed within the tread frames, and the gearings are adapted to run in oil baths in the gear casings. The control valve means for the hydraulic motors 16 will later be described, and by properly controlling the motor speeds the tractor treads may be driven to propel and steer the apparatus both as it is trammed about the mine and during the dislodging operations.

The casings for the reduction gearings are guided at 62 for longitudinal movement in the tread side frames, and a screw and nut device 63 is provided for each casing whereby the same may be adjusted longitudinally in their guides to vary the tension of the drive chains 40. Upon disassembly the gear casings may be slid along their guides outwardly through the ends of the tread side frames. Prior to removal of the gear casings, the nuts of the adjusting devices 63 must be removed and the end frame portions of the tread frames detached, in an obvious manner.

The swivelled supporting frame 3 is mounted on the tractor base to swing horizontally above the tops of the crawler treads 17 and has a tubular support portion 65 swivelled on vertically spaced bearings 66 and 67 supported by the swivel post 29, the upper bearing being of the combined radial and thrust roller type and the lower bearing being a sleeve bearing. The hydraulic motor 19 is of the conventional reversible type and is carried by the swivelled frame 3 and, as shown in Fig. 21, has a chain sprocket 68 fixed to its power shaft and connected by an endless drive chain 69 to a chain sprocket 70 fixed to a horizontal shaft 71 suitably journaled in bearings supported within the swivelled frame 3. Fixed to the shaft 71, intermediate its bearings, is a worm 72 meshing with a driving worm wheel 73 (see also Fig. 20) fixed to a vertical shaft 74 likewise journaled in bearings supported within the swivelled frame. Keyed to the lower end of the shaft 74 is a spur gear 75 meshing with a large spur gear 76 (see Figs. 4 and 6) fixed to the vertical post 29 below the lower bearing sleeve 67 in the manner shown. A maximum swing of substantially 200° is provided, and no more, thus eliminating the possibility of the flexible conduits of the hydraulically operated devices of the apparatus, becoming twisted and broken. Thus by suitably operating the hydraulic motor 19 the swivelled frame 3 may be turned on its vertical swivel 2 in one direction or the other relative to the tractor base, and when the motor is stopped the liquid may be trapped in the motor to lock the frame in adjusted position. Moreover the teeth of the worm gears are of such pitch as to aid in locking the swivelled frame in position, although such teeth do not provide a positive lock. The control valve means for the hydraulic motor 19 will later be described.

In this illustrative embodiment, arranged centrally within the tubular bearing post 29 as shown most clearly in Fig. 4 is the hydraulic roof jack 27 which includes a vertical double acting hydraulic cylinder 80 carried by a top plate 81 secured as by screws to the top of the swivelled frame 3. Reciprocable vertically in this cylinder is a piston 82 having its piston rod 83 extending upwardly through a packing 84 carried by the top plate 81. A roof engaging abutment plate 85 has a spherical or ball-like portion 86 received in a suitable socket 87 in the upper end portion of the piston rod 83, whereby the abutment plate 85 may universally tilt within limits to accommodate itself to an uneven mine roof or other extraneous abutment. Liquid under pressure may be supplied to the cylinder 80 to act on the bottom pressure area of the piston to move the latter upwardly within the cylinder bringing the abutment plate 85 into firm contact with the mine roof thereby to hold the tractor base steady and to support the roof during the coal dislodging operation. The control valve means for the hydraulic roof jack will later be described.

Now referring to the extensible frame structure 4 which carries the vein-attacking and disintegrating mechanism 6, it will be noted that a rearward frame part 90 has spaced side portions 91, 91 which pivotally engage bearing sleeves 92 supported by bearing supports 93 secured, as by screws, to projecting side portions 94, 94 of the swivelled frame 3. The rear frame part 90 has downwardly sloping, upwardly curved lateral guideway-providing flanges 95 along the sides of its upper portion, and longitudinally spaced guides 96, 96 secured to the side portions 97 of an extendable outer frame part or sliding frame portion 98, engage the guideways. Thus the outer frame part or sliding frame 98 may slide back and forth along the curved guideway-providing flanges 95 relative to the rear frame part 90. The means for extending and retracting the extensible frame structure comprises the extensible hydraulic jacks 20 and these jacks are of the double acting cylinder and piston type and include hydraulic feed cylinders 100, pivoted at 101 on the side frames 91 to swing in vertical planes and containing reciprocal pistons 102 having forwardly projecting piston rods 103 which are pivotally connected at 104 to brackets 105 suitably secured to the sides 97 of the outer sliding frame part 98. The vein-attacking and disintegrating mechanism 6 is carried by the outer frame part 98 in a manner to be later explained. The upper guideway-providing flanges of the rear frame part 90 are so arranged and constructed that a substantially rectilinear motion is imparted to the outer tip end of the vein-attacking and disintegrating mechanism as the outer sliding frame part 98 is moved along its guideways relative to the inner frame part so that when the vein-attacking and disintegrating mechanism 6 is sumped into the coal near the floor level the bottom of the outer tip end thereof substantially follows the floor level. The means for swinging the extensible frame structure 4 in vertical planes about its pivotal mounting on the forward portion of the swivelled frame 3 comprises the hydraulic jacks 21 which are of the single acting cylinder and piston type including hydraulic cylinders 107 swivelled at 108 on brackets at the top on the swivelled frame 3 to swing in vertical planes, and these cylinders contain reciprocable pistons 109 having piston rods 110 projecting forwardly through the front packed heads of the cylinders. The forward ends of the piston rods are pivotally connected at 111 to lugs or arms 112 (Fig. 4) herein secured, as by welding, to a transverse tubular member or sleeve 113, herein, in turn, secured at its ends, as by welding, to the tops of the side portions 91 of the rear frame part 90, rearwardly of the hopper device 7. Thus by supplying liquid under pressure to the cylinders 100 and 107 the frame structure 4 may be extended and retracted as desired and may be swung in vertical planes about its pivot 5 relative to the swivelled frame 3. By trapping the liquid within these cylinders the parts may be locked in adjusted position. The control valve means for these cylinders will later be described.

The vein-attacking and disintegrating mechanism 6 may assume various forms but herein comprises a plurality, preferably four in number, of endless disintegrating chains 115 which are guided for circulation in vertical orbital paths within guideways carried by the outer sliding frame part 98 in the manner fully disclosed in my copending application Ser. No. 17,993, filed March 30, 1948. The specific structure of these endless disintegrating chains is not my invention and is the invention of one Arthur Lee Barrett. The disintegrating chains each comprise a series of chain blocks 116 pivotally connected together by usual strap links 117. On each chain block are lateral lugs 118 formed with usual sockets for receiving the shanks of vein-attacking instruments herein shown in the form of standard cutter bits 119. The bit shanks are held in the lug sockets by usual set screws 120. The block lugs are relatively inclined laterally to locate the bits in relatively inclined positions to provide for proper bit lacing in a well-known manner. It will be evident that the disintegrating chains may assume other forms, and may be similar to those disclosed in the above mentioned Silver application Ser. No. 11,688. The endless disintegrating chains 115 pass around guide sprockets 121, 122, 123 and 124 at the outer end of the sliding outer frame part 98, and these sprockets have their hubs keyed to a transverse shaft 125 suitably journaled in roller bearings 126 supported within bearing supports or brackets 127 arranged intermediate the sprockets, as shown in Fig. 11. Secured to the outer sprockets 121 and 124 are rotary side disintegrators comprising annular members 128 secured to the sprocket hubs and these annular members have lugs provided with sockets for receiving the shanks of laterally projecting disintegrating

instruments in the form of standard cutter bits **129**. The bit shanks are secured in position within the sockets by usual set screws **130**. Thus the rotary disintegrators are driven by the endless disintegrating chains through the sprockets and transverse shaft **125**. By the provision of the rotary disintegrators at the opposite sides of the attacking and disintegrating head, disintegration of the mineral may be effected during limited lateral movement of the head. The bearing supports **127** are secured to a rearward cross frame **132** (see Fig. 3) and parallel rods **133** are suitably fixed at their forward ends to this cross frame for supporting the latter. These rods extend longitudinally rearward within the outer frame part **98** and are guided for longitudinal movement in suitable bearing bosses **134** secured to a cross plate **135** in turn secured to the side plates of the outer frame part. These rods have threaded rearward portions **136** guided in a rear cross plate **137** likewise secured to the sides of the outer frame part, and adjusting nuts **138** threadedly engage the portions **136** for adjusting the rods, together with the cross frame **132**, longitudinally relative to the outer frame part **98** to vary the location of the guide sprockets axes, thereby to vary the tension of the disintegrating chains. The side plates **97** of the outer frame part **98** have openings **139** to permit free access to the adjusting nuts **138** from the outer sides of the frame structure. An outer frame comprising end frame portions **140**, **140** and an intermediate frame portion **141** with said frame portions arranged between the sprockets and of generally U-shape in longitudinal section (Fig. 3), is secured as by screws to the cross frame **132**. These frame portions **140** and **141** extend around and enclose the bearing supports **127** and the hubs of the inner chain sprockets **122** and **123** and are arranged with their inner edges disposed in close adjacency to the sprockets, and the bearing brackets **127** carry conventional "piston ring" seals **142** which sealingly engage the inner surfaces of the flanges **143** on the sprockets to prevent entry of dirt. Secured as by screws to the top of the cross frame **132** (Fig. 3) is a transverse top plate **144** which overlaps and slidingly engages a transverse plate **145** secured to the top of the outer frame part **98**. A rearwardly located cross frame **146** is secured to the side plates of the outer frame, and arranged at the top of the cross frame **146** and the transverse plate **145** is an outer transverse plate **147**, and the plates **144** and **147** cooperate to provide the upper surface of the outer frame part along which the disintegrating chains are suitably guided. Secured as by screws to a bottom plate **148** at the bottom of the outer frame **98** are chain guides **149** which serve to guide the lower runs of the disintegrating chains along the bottom of the outer frame part. Since the structure of the guides for the disintegrating chains may be similar to that disclosed in my copending application Ser. No. 17,993, above referred to, further description thereof is herein unnecessary. The disintegrating chains may be driven in unison by coaxial chain sprockets **151** (see Fig. 15) keyed to a transverse shaft **152** herein aligned with the pivot **5** of the swinging frame structure **4**, and this shaft is journaled in roller bearings **153** supported within bearing supports **154** secured to the side frame portions **97** of the sliding outer frame part **98**. Surrounding the shaft **152** intermediate the chain drive sprockets are circular spacer members **155**. The drive sprockets **151** engage and drive the disintegrating chains **115** to effect circulation thereof in vertical orbital paths about their guideways with the top runs of the chains moving rearwardly along the top surface of the outer part of the swinging frame structure.

The motor **14** drives the disintegrating chains and rotary disintegrators and this motor is secured to the swivelled frame **3** at the opposite side of the vertical swivel **2** from the side which supports the vein-attacking and disintegrating mechanism, as shown in Fig. 4, so that the weight of the motor tends to counterbalance the weight of the attacking and disintegrating mechanism. Keyed to the front end of the motor power shaft is a spur pinion **157** (Fig. 4) which meshes with and drives a spur gear **158** (Fig. 9) which in turn meshes with and drives a spur gear **159**. These spur gears are suitably enclosed in a gear housing **160** and are suitably journaled on bearings supported within the gear housing. The gear **159** is secured to a longitudinal, horizontal tubular shaft **161** which is connectible through a hydraulically operated friction clutch **162** to a coaxial shaft **163** which extends forwardly centrally from the gear **159** and is connected through a universal joint **164** to a telescopic drive shaft **165**. The friction clutch **162** may be similar to that disclosed in my copending application Ser. No. 51,587, filed September 28, 1948, now Patent No. 2,593,521, and embodies spring loading means adapted to permit the clutch to slip upon overload. The front end of this drive shaft is connected through a universal joint **166** to a longitudinal shaft **167** journaled in roller bearings **168** supported within a gear housing **169** secured to the adjacent side of the sliding outer frame part **98**. A hypoid bevel pinion **170** fixed to the shaft **167** meshes with and drives a hypoid bevel gear **171** having its hub keyed to the adjacent end of the sprocket drive shaft **152** (Fig. 15). Thus the disintegrating chains may be continuously driven by the motor **14** irrespective of the position of the outer frame part **98** relative to the rear frame part **90** or the angular position of the frame structure **4** about its pivot **5**, so that the attacking and disintegrating mechanism may be driven in all its extended and retracted positions and angular positions relative to the swivelled frame **3**.

Associated with the adjustable cross frame **132** and the outer frame portions **140** and **141** of the adjustable disintegrating head may be means for supplying spray water to the coal face in proximity to the zone of the action of the disintegrating instruments on the coal and this spray water supplying means may be generally similar to that disclosed in a copending application to one John R. Sibley, Ser. No. 102,996 filed July 5, 1949 which is a continuation of application Ser. No. 47,422, filed September 2, 1948, and now abandoned. In this improved construction, the frame portions **140** and **141** having passages **172** formed by channel members **173** welded to the inner surfaces of the frame portions and a transverse channel **174** on the cross frame, has openings communicating with the passages **172** and is connected by a pipe to a suitable source of water supply. The water is discharged from the passages **172** through suitably located spray openings. Thus as the mineral or coal is disintegrated the dust is allayed approximately as soon as it is created, by the water spray.

In this improved construction, secured to the upper portion of the side plates **97** of the sliding outer frame part **98** of the extensible frame structure **4** are outwardly flared, flexible side members **175**, desirably of reinforced rubberized material, which cooperate to provide a trough whereby the mineral or coal dislodged by the disintegrating chains and rotary disintegrators may be conducted without substantial spillage rearwardly along the top of the attacking and disintegrating mechanism to discharge into the chute or hopper device **7**. The flexible side members may yield in the event they engage an obstruction such as the mine roof. The top runs of the disintegrating chains move the disintegrated mineral or coal rearwardly to discharge into a chute **176** provided by a hopper-like frame **177** at the rearward portion of the sliding outer frame part **98**, rearwardly of the chain drive sprockets **151**, as shown in Fig. 3. The hopper has a pivoted upper chute portion or hood section **178** which has side portions **179** pivoted at **180** at the sides **97** of the outer frame part **98**. This pivoted hood section is so arranged and constructed that it directs the disintegrated mineral or coal discharged therein downwardly toward the lower chute opening and tends to prevent substantial spillage of the loose material laterally from the top of the chute. A cross brace member **181** is secured to and extends horizontally between the sides **97** of the rearward portion of the sliding frame part **98** as shown in Fig. 3, and projecting forwardly and downwardly from this cross member are parallel breaker plates or bars **182** which are disposed to cooperate with the bits of the disintegrating chains in the breaking up of unduly large lumps or chunks of coal to a size wherein the coal may readily flow downwardly through the bottom chute discharge onto the underlying front conveyor **8**. Also extending horizontally between and secured to the sides of the sliding outer frame part **98** is a combined brace and deflector **183** which is disposed near to the chain orbits rearwardly of the attacking and disintegrating mechanism and which is shaped to deflect the coal from the disintegrating chains as they pass around the drive sprockets **151**. This deflector directs the coal rearwardly and downwardly through the lower chute section. The

pivoted upper hood section **178** has a horizontal cross brace rod **184** extending between and secured to its sides **179** and this rod may rest on the cross member **181** when the upper chute section is in its lowered position. The pivoted upper hood section is yieldingly urged upwardly when the attacking and disintegrating mechanism is in its advanced position by integral downwardly curved side arm portions **179'** which are secured to the ends of a cross rod **185** rotatably mounted in the sides **97** of the outer frame, and secured to the cross rod at one end is a lever arm **186** which is pivotally connected at its lower end at **187** to a rod **188** arranged at one side of the swingable frame structure and slidingly guided in a guide lug **189** secured to the adjacent side of the rear frame part **90**. A spring **190** surrounding this rod engages a stop **191** secured to the rear end of the rod. A washer **192** surrounds the rod between the guide lug **188** and the spring. When the vein-attacking and disintegrating mechanism is moved forwardly relative to the rear frame part **90** the washer **192** engages the lug **189** and the spring **190** is compressed thereby swinging the lever arm in the direction to swing the upper hood section upwardly and yieldingly to hold it there as shown in Fig. 5. In the event the upper hood section engages an extraneous abutment, as for example when the disintegrating mechanism is swung upwardly to the roof level with the upper hood section in engagement with the roof, the chute section may yield downwardly to prevent breakage. Whenever the attacking and disintegrating mechanism is retracted on the frame structure the upper hood section moves to its lowered position as shown in Figs. 2 and 3.

Now referring to the structure of the front conveyor **8** carried by the swingable frame structure **4**, it will be noted that guided for circulation on the rear frame part **90** beneath the rearward portion of the disintegrating chains **115** is an endles conveyor **195** having side chains **196** and transverse scraper bars **197** which travel rearwardly along the upper surface of a transverse plate **198** (Fig. 22) suitably secured to the sides **91** of the rear frame part **90**. The endless side chains **196** of the conveyor are guided by front idler sprockets **199** journaled on bearings supported by a cross shaft **200**. A sleeve **201** surrounds the shaft **200** intermediate the sprockets **199** and is welded to the sprocket hubs for maintaining the latter in properly spaced relation on their bearings intermediate the side frames **91**. The projecting ends of the shaft **200** are guided in longitudinal slots **202** in the side frames **91** and brackets **203** having openings for receiving the shaft have threaded portions **204** passing through openings in lateral lugs **205** integral with the side frames. Nuts **206** engaging the threaded portions **204** at the forward sides of the lugs **205** serve to adjust the brackets **203** longitudinally to move the shaft **200** in its guide slots moving the idler sprockets therewith thereby to vary the tension of the conveyor chains. Threaded on the portions **204** at the rear sides of the lugs **205** are lock nuts **207** for locking the shaft-brackets in adjusted position. Rear drive sprockets **208** secured to a transverse shaft **209** engage the conveyor side chains **196** and the shaft **209** is journaled at its ends in bearings supported within the bearing supports **93**. An aligned shaft **210** is coupled to the shaft **209** secured to the adjacent bearing support. The shaft **210** is connected to the shaft **209** through a splined sleeve **212** which has a press fit on the shaft. The shafts **209** and **210** are aligned with the pivot **5** of the swingable frame structure **4**. Arranged within the housing **211** and keyed to the shaft **210** intermediate its bearings is a worm wheel **213** (Fig. 23). Meshing with and driving this worm wheel is a worm **214** formed integral with a longitudinal shaft **215** suitably journaled with bearings supported within the housing **211**. The shaft **215** is connected by a universal joint **216** to a telescopic shaft **217** which is in turn connected by a universal joint **218** to a longitudinal shaft **219** suitably journaled within the gear housing **160** (Fig. 9). A spur gear **220** coaxial with the shaft **219** meshes with a large spur gear **221** journaled on bearings supported by a parallel shaft **222**, and the gear **221** meshes with and is driven by the motor pinion **157**. The gear **220** is connectible to the shaft **219** by a conventional manually operable friction clutch **223** (Fig. 2), and this clutch has usual spring loading means and is adapted to slip upon overload. Thus the conveyor **8** may be driven from motor **14** through the connections above described irrespective of the angular position of the frame structure **4** on its pivot **5**.

The transverse discharge conveyors **9** and **10** will now be described in detail and it might be stated for purposes of clarification that these conveyors **9** and **10** may be considered as portions of a single conveyor instead of as two entirely distinct conveyors. The hydraulic motor **15** is of a conventional design and is secured to a gear housing **224** which is, in turn, secured by screw and slot connections **225** to the adjacent sides of sliding frames **226** which are guided for endwise adjustment in transverse horizontal guideways **227** on the top of the base frame **28**. The conveyors are of the endless type and are guided for circulation in suitable guideways on the sliding frames **226**. A bevel pinion **228** is keyed to the motor power shaft and meshes with a beveled gear **229** having its hub keyed to a horizontal shaft **230**. The shaft **230** extends longitudinally of the base and is journaled in roller bearings **231** supported within the gear housing **225**. Drive sprockets **232** journaled on bearing sleeves **233** supported on the projecting ends of the shaft are connectible to the shaft for driving thereby by sliding toothed clutch members **234** and **235** which are engageable with teeth on the hubs of the sprockets **232**. Spring pressed locking plungers **236** carried by the clutch members are engageable with spaced notches **237** in the shaft for yieldingly locking the clutch members in their different positions of adjustment. Endless drive chains **238** connect the drive sprockets **232** to sprockets **239** fixed to the conveyor drive shafts **240**, the latter being suitably journaled within the side plates of the sliding conveyor frames. By the provision of the screw and slot connections **225** the gear housing **224** may be adjusted relative to the conveyor frames **226** to vary the tension of the drive chains **238**. The endless conveyors **9** and **10** each comprise endless side chains **241** which are driven by sprockets **242** fixed to the conveyor drive shafts **240**, and transverse scraper bars **243** connected between conveyor side chains travel along the upper surface of transverse plates **244** secured to the conveyor side frames. Each plate **244** has a depressed central portion and inclined end portions to increase clearance between the bottom of the swivelled frame **3** and the tops of the conveyors, as shown in Fig. 9.

The transverse conveyors **9** and **10**, as above described, are slidably guided on the base frame for endwise adjustment crosswise of the base and the extensible hydraulic jacks **24** for effecting conveyor adjustments each comprise a hydraulic cylinder **246** horizontally pivoted by a loose pin connection **247** on the swivelled frame **3** to swing in vertical planes, and reciprocable in the cylinder is a piston **248** having its piston rod **249** projecting outwardly through the outer packed head of the cylinder. The outer end of the piston rod is pivotally connected by a loose pin connection **250** to the sliding frame of the conveyor. By the provision of the pin connections **247**, **250** the cylinders **246** may have slight movement both vertically and horizontally to prevent binding. When liquid under pressure is suitably supplied to the cylinders **246** the pistons **248** may be moved in unison to effect endwise sliding adjustment of the conveyors **9** and **10**, relative to the base. Thus the discharge ends of these conveyors may be adjusted laterally relative to the base thereby to maintain the discharge ends thereof over the desired discharge points as the mining apparatus is moved along the coal face during the dislodging operation.

Now referring to the gathering or pick-up conveyors **11** and **12** and the shovel or scrapper **13**, and more particularly to the conveyor drives, it will be noted that the hydraulic motors **18** which are of a conventional design are mounted beneath the base frame **28** between the inner sides of the tread frames **30**. The location of one of these motors is clearly shown in Fig. 4, and the other motor is symmetrically arranged at the opposite side of the opposite end portion of the base frame. The motors **18** are carried by gear housings **251** pivotally mounted at **252** (Figs. 16 and 18) on the base frame to swing in vertical planes, and the gear housings contain spur reduction gearings **253**. The terminal shafts of these gearings have fixed thereto chain sprockets **254** connected by endless drive chains **255** to chain sprockets **256** fixed to the conveyor drive shafts **257**. The gear casings have

suitable screw and nut adjusting devices **258** (Fig. 18) arranged between the base frame and the gear casings whereby the latter may be swung on their pivoted mountings to vary the tension of the drive chains **255**. The conveyors include endless chains **259** guided for circulation in guideways provided by top flanges **259'** on pivoted frames **260** of a fabricated welded design which are swingable in vertical planes about parallel horizontal axes at **261**, extending transversely of the base. The pivotal axes of the conveyor frames are coincident with the longitudinal axes of the conveyor drive shafts **257**. The conveyors have their top runs supported by top plates **260'** of the conveyor frames; and are guided at their outer portions by idler sprockets **262** journaled on transverse shafts **263** supported at their ends within the vertical side plates **264** of the swingable conveyor frames. The conveyor chains are of a novel design whereby the material conveyed thereby is effectively scraped off and discharged from the conveyors as the latter pass around their drive sprockets, and the conveyor structure is shown in detail in Figs. 25 to 32 inclusive. As illustrated, each conveyor is of the closed link type comprising a series of cross links **265** pivotally connected directly together by continuous hinges, and the outer surfaces of the links are symmetrically curved at **265'** so that as the links pass around the drive sprockets a substantially smooth, nearly semicircular outer surface **266** is provided. Each chain link has a series of lugs **267** which closely interfit within corresponding lugs on the next adjacent links and these lugs have openings **268** which, when disposed in registry, receive rod-like pintles **269** which are secured at their ends to certain of the links by cross pins **270** fitted in openings in the links and passing through openings in the pintles (Fig. 29). A scraper plate or deflector **271** secured to the adjacent side of the transverse conveyor has a knife edge **272** which lies closely to the surface **266** so that any material on the conveyor may be scraped off and deflected rearwardly onto the transverse discharge conveyor, and substantially precluding the possibility of a substantial portion of the material being conveyed past the deflector downwardly around the sprockets. A similar deflector **271'** is provided at the receiving end of the conveyor, as shown in Fig. 26. The conveyors have symmetrical end projections **273** and the drive and idler sprockets are so arranged that their teeth engage these end projections. Thus the end projections constitute the driving elements of the conveyor and receive the driving forces imparted thereto by the drive sprockets. By the provision of such end drive projections a conveyor with a smooth uninterrupted upper conveyor surface between the conveyor side frames is attained, as shown most clearly in Fig. 25. Each conveyor frame **260** is composed of inner and outer portions **274** and **275** having transverse adjacent plane surfaces **276** (Fig. 26) between which shims **277** may be interposed to vary the distance of separation of the surfaces **276**. The frame parts are detachably secured together by bolts **278**. By varying the amount of shimming between the adjacent surfaces of the frame parts the distance between the axes of the driving and idler sprockets may be varied thereby to vary the chain tension. The extensible hydraulic jacks **22** and **23** for swinging the pivoted frames **260** of the pick-up conveyors **11** and **12** each comprising a single-acting hydraulic cylinder **285** pivoted at **286** on the pivoted frame and containing a piston **287** having its piston rod **288** extending downwardly through the lower packed cylinder head. The piston rod is pivoted at **289** on the base frame. The pivots of the cylinders and piston rods are disposed in parallelism with the frame pivots so that the jacks may swing in vertical planes during swinging of the conveyor frames. Thus when liquid under pressure is supplied to the upper ends of the cylinders the pick-up conveyors may be swung upwardly about their pivots and by trapping liquid in the cylinders the conveyor frames may be held in adjusted position. The control valve means for the jacks **22** and **23** will later be described.

The pumping means **25** and **26** are mounted on the swivelled frame **3** (as shown in Figs. 1 and 2) and are driven by the motor **14**, and these pumping means are of the conventional dual or tandem pump type. Four separate pumps may be employed, if desired. A spur gear **295** (Fig. 10) meshes with and is driven by the spur gear **221** and is fixed to a tubular shaft **296** which is journaled in ball bearings supported within the gear housing **160**. This shaft is connectible through a conventional manually operable friction clutch **297** to a coaxial shaft **298**. The shaft **298** is connected by a coupling **299** to the driving shaft **300** of the pump **25** which supplies liquid under pressure to the crawler tread driving motors **16**. A spur gear **301** likewise meshing with and driven by the spur gear **221** and arranged below the gear **295**, is fixed to a shaft **302** which is coupled to the drive shaft for the pump **26** which supplies liquid under pressure to the other hydraulic devices of the apparatus.

Now referring to the hydraulic fluid system, shown diagrammatically in Fig. 33, it will be noted that supported at the rear end of the motor **14** is a control valve device **305**, and carried at one side of the motor is a liquid tank **306** and a control valve device **307**. A control valve device **308** is carried at a suitable location by the base frame **28**, and provided within the base frame is a relatively large horizontal cooling tank **309**. The cooling tank **309** is connected to the tank **306** by a conduit **310**. The pumps **25** and **26** have their intakes respectively connected through conduits **311** and **312** to the tank **306**. The discharge sides of the pump **25** are connected by conduits **313** and **314** to the supply passages of the valve device **307**, and the discharge sides of the pump **26** are connected by conduits **315** and **316** to the supply passages of the valve devices **305** and **308** respectively. The discharge passage of the valve devices **305** and **307** are respectively connected by conduits **317** and **318** back to the tank **306**, while the discharge passage of the valve device **308** is connected by conduit **319** to the cooling tank **309**. The valve device **305** has a valve box provided with a series of parallel bores which contain slide valves **320**, **321**, **322**, **323**, **324**, **325**, **326** and **327** of the conventional balanced, spool type each having an operating handle. The bore containing the slide valve **320** is connected by a conduit **328** to the cylinders of the single acting elevating jacks **21** for swinging the vein-attacking and distintegrating mechanism **6** in vertical planes about its pivot. The bore containing the slide valve **321** is connected by conduits **329** and **330** to the opposite ends of the cylinders of the double acting sumping jacks **20**. The bore containing the slide valve **322** is connected by conduits **331** and **332** to the opposite sides of the swing motor **19** for swinging the vein-attacking and disintegrating mechanism horizontally about the vertical swivel **2** relative to the base. The bore containing the slide valve **323** is connected by a conduit **333** to the hydraulically operated clutch **162**, and the bore containing the slide valve **324** is connected by conduits **334** and **335** to the opposite ends of the cylinder **80** of the vertical double acting roof jack **27**. The bore containing the slide valve **325** is connected by conduits **336** and **337** to the opposite ends of the cylinders of the double acting jacks **24** for adjusting the transverse conveyors **9** and **10** in unison. The bores containing the slide valves **326** and **327** are connected by conduits **338** and **339** respectively to the cylinders of the single acting jacks **22** and **23** for raising the pick-up conveyors **11** and **12**. The valve box of the valve device **307** has bores containing slide valves **341** and **342**, and the bore containing the valve **341** connected by conduits **343** and **344** to opposite sides of one of the tread driving motors **16** while the other bore containing the valve **342** is connected by conduits **345** and **346** to the opposite sides of the other tread driving motor **16**. The valve device consists of valve boxes **347** and **348** containing the slide valves **341** and **342** and an intermediate discharge section **349** to which the conduit **318** is connected, and at the outer sides of the valve boxes are end sections **350** and **351** to which the conduits **313** and **314** are connected. The valve box of the valve device **308** has a bore containing a slide valve **352** likewise of the spool type and the bore is connected by conduits **353** and **354** to the intake sides of the motors **18** for driving the pick-up conveyors **11** and **12**. The discharge sides of the motors **18** are connected by conduits **355** and **356** to the opposite ends of a conventional shuttle valve device **357** which embodies a double ended, fluid actuated, end-seating valve for controlling the discharge of liquid from one or the other of the conduits **355** and **356** to a conduit **358** connected with the intake side of the motor **15** which drives the cross conveyors **9** and **10**. The discharge side of the motor **15** is connected by a conduit **359** to the discharge

conduit **319** which leads back to the cooling tank **309**. The control valve devices **305**, **307**, and **308** each have a conventional automatic relief valve for discharging excessive pressures back to the tank thereby to prevent overload of the liquid system. The conduits **310**, **316**, **336**, **337**, **338**, **339**, **343**, **344**, **345**, and **346** have flexible portions which pass through the tubular swivel post **29** exteriorly of the hydraulic jack **27**, thereby avoiding undesired draping of the conduits about the apparatus and the possibility of entanglement, in the general manner of my earlier application Serial No. 17,993 mentioned above. The top plate **81** is suitably slotted in a suitable manner so that the conduits may pass out through the top of the swivel post. The valves **341** and **342** of the control valve device **307** are operated by control handles **361** and **362** (Fig. 1) pivoted on the rear end of the tank **306** and connected by operating rods **363** and **364** extending longitudinally through tubes **365** passing longitudinally through the tank. These rods are pivotally connected to levers **366** which are in turn respectively operatively connected to the stems **367** and **368** of the valves. The cooling tank **309** has relatively large volumetric capacity so that the liquid therein has its temperature substantially lowered prior to flow through the conduit **310** to the liquid tank **306** thereby resulting in the maintenance of a relatively low tempertaure of the liquid in the hydraulic system.

The separate pump discharges, or the separate pumps, supply liquid under pressure through the conduits **313** and **314** in equal quantities to the tread driving motors **16**, **16** so that when the valves **341** and **342** are in open position, the motors are operated at the same speeds, thereby driving the treads at the same speed to propel the apparatus in a straight path. When steering to the right or left is desired one of the valves may be positioned to throttle or cut off liquid flow to one of the motors, without changing the speed of the other motor, resulting in turning of the apparatus in the desired direction. Also the provision of separate sources of liquid under pressure to the motors **16**, **16** prevents undesired increased flow of liquid to the motor under the smaller load, a desirable feature in the event one tread loses traction and slips. Without the provision of separate liquid pressure sources for the motors, control of the motor speeds to effect steering would be extremely difficult.

The general mode of operation of the improved longwall mining apparatus described above will now be described. The mining apparatus may be trammed about the mine and steered by the motors **16**, **16** which drive the crawler treads **17**, under the control of the slide valves **341** and **342**, and by properly positioning these slide valves these motors may be independently controlled so that the crawler treads may be driven either in unison at the same speed or at relatively different speeds. The slide valves **341** and **342** may be positioned to effect reversal of the motors **16** to reverse the drive of the crawler treads. When the working face is reached the pump drive control clutch **297** is released and when it is desired to effect dislodgment of the coal or other mineral from the mine vein or coal seam the slide valve **324** may be positioned to effect liquid supply to the cylinder **80** of the hydraulic roof jack **27** to bring the upper abutment plate of the latter into firm engagement with the mine roof thereby to hold the base steady and to support the roof during the dislodging operation. Liquid under pressure may then be supplied to the hydraulically operated clutch **162** under the control of the slide valve **323** to connect the disintegrating chains **115** to the motor **14** so that the chains are rapidly circulated about their guideways on the frame structure **4**. The friction clutch **223** may also be applied to connect the front conveyor **8** to the motor **14** and the slide valve **352** may be positioned to effect running of the motors **18** and **15** which drive the front pick-up conveyor and the transverse discharge conveyors. The vein-attacking and disintegrating mechanism **6** may then have its outer tip end lowered to the mine floor by discharge of liquid from the cylinders of the elevating jacks **21** under the control of the slide valve **320**, to permit swinging of the frame structure **4** downwardly by gravity about its pivot **5**, to the position indicated in full lines at A in Fig. 41. When the vein-attacking and disintegrating mechanism is in its lowered sumping position at the floor level, the liquid may be trapped in the elevating cylinders by the slide valve **320** to lock the frame structure **4** rigidly in position. The slide valve **321** may then be positioned to effect supply of liquid under pressure to the cylinders of the sumping jacks **20** to effect extension of the frame structure **4** thereby to sump the outer portion of the attacking and disintegrating mechanism into the coal near the floor level. During the sumping operation the curved guideway-providing flanges **95** on the rear frame part **90** guide the outer frame part **98** in such manner that the outer portion of the vein-attacking and disintegrating mechanism has its forward tip end move along a substantially rectilinear path at the level of the mine floor. When the attacking and disintegrating mechanism assumes its sumped position, indicated in dotted lines at B in Fig. 41, liquid may be trapped in the sumping jack cylinders rigidly to lock the attacking and disintegrating mechanism in extended position and liquid under pressure may then be supplied to the cylinders of the elevating jacks **21**, under the control of the slide valve **320**, to effect swinging of the frame structure **4** upwardly about its pivot **5** to move the outer portion of the attacking and disintegrating mechanism upwardly in an arcuate path between the mine floor and mine roof, to the position indicated in dotted lines at C in Fig. 41, thereby to complete the dislodgment of a relatively wide vertical segment of coal from the solid seam. During this upward swinging movement of the vein-attacking and disintegrating mechanism the elevating jacks apply a rapid and powerful upward thrust to the endless disintegrating chains **115** of the attacking and disintegrating mechanism to cause the disintegrating instruments to break or tear loose the coal in relatively large chunks or fragments from the working face. During the dislodging operation, as the attacking and disintegrating mechanism is swung upwardly the pivoted hood section **178** of the hopper-like chute is held in raised position relative to the lower chute casing by the spring device **185**, **187**, and **189**, and when the attacking and disintegrating mechanism assumes its raised position the pivoted hood section may engage the mine roof and may yield downwardly due to the provision of the yielding spring device. And, as the endless disintegrating chains **115** detach the coal from the solid the dislodged coal is carried rearwardly along the top runs of the chains to discharge into the breaker and hopper device **7**, and the breaker bars **182** cooperate with the chains to break up any very large chunks of coal so that the broken-up coal may pass freely down through the chute opening and discharge onto the front conveyor **8**. Due to the arrangement of the front conveyor beneath the discharge opening of the chute in all positions of the vein-attacking and disintegrating mechanism the disintegrated coal passing through the chute is discharged onto the front conveyor irrespective of the extended or retracted position of the extensible frame structure **4**. The front conveyor discharges onto the transverse discharge conveyor **9** which conveys the coal laterally of the apparatus to a convenient point of delivery. By properly positioning the slide valve **325** liquid under pressure may be supplied to the cylinders of the jacks **24** to effect endwise adjustment of the transverse conveyors relative to the base thereby to extend the discharge end of the transverse conveyors outwardly a substantial distance beyond the side of the base. As the vein-attacking and disintegrating mechanism is swung downwardly after the completion of the dislodgment of a vertical segment of coal from the working face, the slide valve **322** may be positioned to supply liquid under pressure to the swing motor **19** to swing the swivelled frame **3** laterally about its swivel axis on the base to locate the attacking and disintegrating mechanism in a different radial position, as shown in Fig. 40, so that the attacking and disintegrating mechanism may again be sumped into the coal and swung upwardly to dislodge an adjacent relatively wide vertical segment of coal from the working face. The friction clutch **297** may then be applied to drive the pump **25** to supply liquid under pressure to the motors **16** to propel the apparatus forwardly a distance equal to the depth of the sumping movement of the attacking and disintegrating mechanism, and when the ap-

paratus is properly positioned the clutch **297** may be again released. The sumping and upward swinging operations may then be repeated to effect dislodgment of a vertical segment of coal from the advanced end wall of the face. As the apparatus is advanced along the face the front shovel or scraper **13** gathers up any material in its path on the mine floor and directs such loose material rearwardly onto the front pick-up conveyor **11** which moves the material rearwardly onto the transverse discharge conveyor **9**. The shovel **13** and pick-up conveyor may be swung upwardly above the floor level by the hydraulic jacks **22** under the control of the slide valves **235** and the hand valves **336**. By venting the jack cylinders the pick-up conveyor and scraper may be lowered to the floor and by trapping the liquid in the cylinders the conveyor and scraper may be locked in any desired position either at or above the floor level. Evidently, during the dislodging and disintegrating operation the pumping means **25** which supplies liquid under pressure to the tread driving motors **16** may be driven only when it is desired to propel the apparatus by the crawler treads. In the event the front conveyor **8** should become jammed or otherwise overloaded the friction clutch **223** will automatically slip to prevent damage to the parts, and the front conveyor may be disconnected from its drive simply by manually releasing the friction clutch. The drive of the pick-up conveyor may be interrupted at will simply by moving the slide valve **352** to its central position and liquid may then flow freely from the pump **26** through the conduits **316** and **319** to the cooling tank **309**.

When it is desired to operate the mining apparatus in the reverse direction the attacking and disintegrating mechanism may be swung upward into its normal transport position above the floor level, and liquid under pressure may then be supplied to the swing motor **19** under the control of the slide valve **322** to effect swinging of the swivelled frame **3** horizontally relative to the base to locate the attacking and disintegrating mechanism in its reversed position at the opposite end of the base, as indicated in dotted lines at D at the left of Fig. 41, and when the attacking and disintegrating mechanism assumes its reversed position the motor **19** may be stopped by moving the slide valve to its central position and the worm gearing and the liquid trapped in the motor at that time serve to lock the swivelled frame in position with respect to the base. The scraper **13** may then be detached from the pick-up conveyor **11** and transported to the opposite end of the base and attached to the pick-up conveyor **12**. The pick-up conveyor **11** may then be swung upwardly out of the way by its elevating jacks and the conveyor **12** may be lowered to the floor level by its jacks under the control of the slide valves **326** and **327**. The clutch **234** which controls the drive of the transverse discharge conveyor **9** may then be disconnected and the clutch **235** which controls the drive of the transverse discharge conveyor **10** may be connected. The motors **16** may then be reversed under the control of the slide valves **341** and **342** to effect propulsion of the apparatus in the reverse direction, and when the exposed end of the face is reached the vein-attacking and disintegrating mechanism may be sumped into the coal and then swung upwardly, in the manners above described, to dislodge a vertical segment of coal from the face.

In Fig. 34 the apparatus is diagrammatically shown operating along a longwall coal face F with the mining apparatus located at the right hand end of the face and in a position where it is about to be reversed so that it may move along the face in the opposite direction i. e. from right to left. Roof props and timbers J are distributed along the length of the longwall face at the outer side of the face conveyor K for supporting the roof above the restricted space where the mining apparatus and conveying means operate during the mining operations and the face conveyor may be advanced in a suitable manner toward the longwall face as the coal is mined and loaded out. The mine roof back from the props and timbers is shown supported by conventional pack walls L and these pack walls support the roof as the timbering is advanced. Extending from the face at substantially right angles to the line of the roof props are roadways M. The manner of operating the mining apparatus for dislodging the mineral from the mine vein to provide sufficient space to permit reversal of the attacking and disintegrating mechanism 6 is shown diagrammatically in Figs. 36 to 40 inclusive. In Fig. 36 the mining apparatus is shown approaching the right hand end of the longwall face and as the apparatus is progressively advanced the swivelled frame **3** is swung horizontally to locate the attacking and disintegrating mechanism in different lateral positions to effect successive dislodging operations at increasing angles in the direction of advance of the longwall face thereby to form an inwardly curving and jagged face as indicated at F'. During these operations the mining apparatus, when it reaches the point N in its forward travel, may be moved backwards and nearer to the face F until it assumes the point O, and thereafter the base of the apparatus may be moved forwardly in a straight path parallel to the longwall face until it reaches the right hand end of the face. When the mining apparatus is advanced to the position shown in Fig. 36 the exposed end WF of the face is progressively advanced in steps by dislodging series of adjacent vertical segments of coal in successive bands across the working face until the mining apparatus reaches the right hand end of the face as shown in Fig. 37. The tractor base is then propelled toward the left bringing the attacking and disintegrating mechanism to the position indicated in dotted lines at P, and as it is operated to dislodge the coal it is moved progressively forwardly toward the right to the dotted line positions indicated at Q, R, and S. The tractor base is then propelled forwardly to the right and the attacking and disintegrating mechanism is swung horizontally on its swivel with respect to the base into the right angle position shown in full lines at T in Fig. 38. Thus by so operating the attacking and disintegrating mechanism a pocket of low height and of sufficiently wide area is provided so that, when the crawler base of the mining apparatus is propelled farther toward the right hand end of the longwall face, the attacking and disintegrating mechanism may be swung horizontally about its swivel until it assumes a position in substantial alinement with the base as shown in Fig. 39. Obviously the low height pocket in the coal may be formed when the apparatus is in its position shown in Fig. 36 and prior to movement of the apparatus toward the position shown in Fig. 37, thereby avoiding the need of the apparatus returning to the positions shown in Fig. 38. The mining apparatus may then be advanced toward the left to remove vertical segments of the working face in the manner above described and shown in Fig. 40. During the various dislodging operations above described the disintegrated mineral dislodged from the mine vein is discharged laterally of the base of the apparatus by the transverse conveyors which discharge the disintegrated mineral onto the face conveyor K and when the apparatus is moved away from the face conveyor into the position shown in Fig. 37 the transverse conveyors may be adjusted by their hydraulic jacks laterally of the base so that they discharge at all times onto the face conveyor. The face conveyor discharges onto a main conveyor U which is disposed in the right hand roadway as shown in Fig. 34. When the mining apparatus approaches the left hand end of the coal face, the attacking and disintegrating mechanism may be operated in the manner above described to effect reversal of the attacking and disintegrating mechanism so that the apparatus may again effect dislodgement of the coal in the direction toward the right.

In Fig. 35 a somewhat modified manner of dislodging the coal in accordance with the longwall system is shown. In this figure three are formed in a suitable manner at the ends of the longwall face F suitable stalls V and the face conveyor K' is shown extending along the longwall face between these stalls and the main conveyor U is located in a roadway W at right angles to the face near the right hand stall. The mining apparatus is shown dislodging vertical segments of the working face in a direction toward the right and when the mining apparatus assumes a position within the right hand stall the attacking and disintegrating mechanism may be swung horizontally on its swivel with respect to the base to form a curved face F'' so as to provide sufficient space so that the attacking and disintegrating mechanism may be reversed with respect to the base into a position to effect dislodgment of the coal from the working face in the opposite direction i. e. from right to left. As the long-

wall face is advanced the stalls are progressively advanced as indicated in dotted lines at the right in Fig. 35. When the mining apparatus reaches the stall at the left hand end of the working face it is operated in the manner above described to effect reversal of the attacking and disintegrating mechanism so that dislodgment of the coal in a direction from left to right may again occur.

As a result of this invention an improved continuous mining apparatus is provided for dislodging mineral such as coal from a solid mine vein in a substantially uninterrupted manner without the use of explosives, and for conveying the dislodged mineral as it is dislodged from the mine vein to a convenient point of delivery. It will further be evident that an improved continuous mining apparatus is provided which is especially adapted to use in dislodging coal or other mineral from a solid coal seam or mine vein in accordance with the longwall system of mining and the mining apparatus is not only extremely vertically compact to enable operation thereof in mines having low head room but is also extremely laterally compact so that it may operate in the relatively narrow spaces common to longwall coal faces. The improved continuous mining apparatus is readily reversible so that when it reaches an end of the longwall face it may be quickly reversed so that dislodgment of the coal in the opposite direction may occur with little interruption. The continuous mining apparatus, due to its novel design, may be operated to provide widened areas at either end of the longwall face to provide sufficient space so that the vein-attacking and disintegrating mechanism may be readily reversed. The mining apparatus by the provision of the improved conveying means may discharge the disintegrated mineral directly onto a face conveyor arranged parallel with the longwall face, during its various operations. The novel hydraulic system and the hydraulic motors greatly simplify the structure of the apparatus, enabling extreme compactness which is vital in a longwall type of mining apparatus. The mining apparatus is not only extremely compact both vertically and laterally and readily reversible but is also rugged in design and extremely flexible in operation well adapted to meet the demands of service encountered in the mining of coal. These and other advantages and manners of use of the improved mining apparatus will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which my invention may assume in practice, it will be understood that this form is shown for purposes of illustration and that the invention may be modified and 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 reversible mining apparatus of the longwall type, a reversible mobile base adapted for arrangement in parallelism with the face of a mine wall and movable in either of opposite directions along the mine wall depending upon the direction of operation of the apparatus, a frame swiveled on said base centrally between the ends of the latter to swing in horizontal planes with respect to said base about an upright axis and disposable by swinging movement on its swivel into either of opposite reversed positions with respect to said base wherein the outer portion of said frame may project from said base at either end of the latter, a vein-attacking and disintegrating mechanism carried by said outer portion of said frame and adjustable with said frame into said reversed positions at either end of said base and embodying a series of parallel orbitally movable disintegrating elements for dislodging and disintegrating the mineral from the solid during either direction of movement of said base to provide a passageway in the mine wall inside the face for receiving the apparatus as mining progresses, said attacking and disintegrating mechanism when in a central position longitudinal of said base being symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed operating positions of said mechanism, and means for moving said attacking and disintegrating mechanism along a substantially straight path longitudinally relative to said base to sump said mechanism into the mine vein in either of said reversed positions of said mechanism.

2. In a reversible mining apparatus of the longwall type, a reversible mobile base disposed in parallelism with the face of a mine wall and movable endwise in either of opposite directions along the face and having a frame provided with a swivel support located centrally of said base, a frame overlying said base and having a bearing portion swivelly mounted on said support to swing in horizontal planes with respect to said base, a frame structure pivotally mounted on said swivel frame at one side of said swivel support to swing in vertical planes with respect to said frame and projecting forwardly in advance of said base, vein-attacking and disintegrating mechanism carried by the outer portion of said swingable frame structure and including disintegrating elements movable in parallel vertical orbits relative to said frame structure for dislodging and disintegrating the mineral from the solid, said swiveled frame being swingable on said swivel support to locate said attacking and disintegrating mechanism in an operating position at either end of said base depending upon the direction of operation of the apparatus, and means for moving said attacking and disintegrating mechanism bodily forwardly endwise along a substantially rectilinear path relative to said base while said base remains stationary and while said frame structure remain stationary as regards swinging movement in vertical planes about its pivot in either of said reversed operating positions of said mechanism for sumping the latter into the mine vein and for retracting said mechanism endwise from the vein.

3. In a mining and loading apparatus of the longwall type, a mobile base movable in an endwise direction in parallelism with the face of a mine wall, a frame swivelly mounted on said base to swing in horizontal planes with respect thereto, said frame having its outer portion overlying the forward end of said base, a frame structure pivotally mounted on said outer portion of said swiveled frame to swing in vertical planes with respect thereto, vein-attacking and disintegrating mechanism carried by said swingable frame structure and embodying movable disintegrating elements for dislodging and disintegrating the mineral from the solid, a conveyor mounted on said frame structure beneath said attacking and disintegrating mechanism for receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism, a motor carried by said swiveled frame, mechanism driven by said motor for driving said disintegrating elements of said attacking and disintegrating mechanism, and mechanism separate from said driving mechanism and also driven by said motor for driving said conveyor whereby the latter may be driven independently of said disintegrating elements of said attacking and disintegrating mechanism, said conveyor driving mechanism including driving connections having a driving element coaxial with the pivot of said frame structure.

4. In a reversible mining apparatus of the longwall type, a reversible mobile base movable endwise in either of opposite directions along the longwall face of a mine wall, vein-attacking and disintegrating mechanism having a series of parallel disintegrating elements movable in vertical orbits for dislodging and disintegrating a wide segment of mineral from a solid mine vein, means for mounting said mechanism centrally on said base and adjustable relative to said base to locate said vein-attacking and disintegrating mechanism selectively in an operating position at either end of said base whereby the apparatus may operate in either direction along the longwall face without turning around of said base, said attacking and disintegrating mechanism when disposed in its central longitudinal position being symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed operating positions of said mechanism, and means for moving said attacking and disintegrating mechanism along a substantially straight path relative to said base to sump said mechanism into the mine vein in either of said reversed positions of said mechanism.

5. In a reversible mining and loading apparatus of the longwall type, a reversible mobile base movable endwise in either of opposite directions along the longwall face of a mine wall in a direction parallel with the face, vein-attacking and disintegrating mechanism having movable disintegrating elements for dislodging and disintegrating

a wide segment of mineral from a solid mine vein between the floor and roof to provide a passageway in the mine wall inside of the face in which the apparatus moves as mining progresses, means for adjustably mounting said mechanism centrally on said base for adjustment relative to said base to locate said vein-attacking and disintegrating mechanism selectively in an operating position at either end of said base whereby the apparatus may operate in either direction along the longwall face without turning around of said base, said attacking and disintegrating mechanism when disposed in its central longitudinal position being symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed positions of said mechanism, means for moving said attacking and disintegrating mechanism along a substantially straight path relative to said base to sump said mechanism into the mine vein in either of said reversed positions of said mechanism, and discharge conveyor means on said base beneath said adjustable mounting means and on which the mineral dislodged and disintegrated by said attacking and disintegrating mechanism is discharged in either of said reversed operating positions of said mechanism.

6. In a reversible mining and loading apparatus of the longwall type, a reversible mobile base movable endwise in either of opposite directions along a longwall face of a mine wall in a direction parallel with the face, vein-attacking and disintegrating mechanism having movable disintegrating elements for dislodging and disintegrating mineral from a solid mine vein, means for mounting said vein-attacking and disintegrating mechanism centrally on said base for adjustment selectively into reversed operating positions at either end of said base whereby the apparatus may operate in either direction along the mine wall without turning around of said base, said attacking and disintegrating mechanism when disposed in its central longitudinal position being symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed positions of said mechanism, conveying means carried by said mounting means and adjustable therewith with respect to said base for receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism in the different positions of adjustment of the latter with respect to said base, means for moving said attacking and disintegrating mechanism along a substantially straight path relative to said base to sump said mechanism into the mine vein in either of said reversed positions of said mechanism, and conveying means carried by said base beneath the said adjustable mounting means for receiving disintegrated mineral discharged from said first mentioned conveying means in either of said reversed positions of said attacking and disintegrating mechanism.

7. In a reversible mining and loading apparatus of the longwall type, a reversible mobile base movable in either of opposite directions along a longwall face of a mine wall in a direction parallel with the face, vein-attacking and disintegrating mechanism having movable disintegrating elements for dislodging and disintegrating mineral from a solid mine vein, means for mounting said vein-attacking and disintegrating mechanism on said base for adjustment selectively into reversed operating positions at either end of said base, conveying means carried by said mounting means and adjustable therewith with respect to said base for receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism in the reversed operating positions of said mechanism with respect to said base, and conveying means carried by said base beneath the said adjustable mounting means for receiving disintegrated mineral discharged from said first mentioned conveying means, said last mentioned conveying means including a pair of parallel transverse conveyors mounted on said base at opposite sides of a vertical transverse plane bisecting said base, and said first mentioned conveying means adapted to discharge the disintegrated mineral on one of said conveyors when said attacking and disintegrating mechanism is located at one end of said base and to discharge the disintegrated mineral on said other conveyor when said mechanism is located in its reversed position at the opposite end of said base.

8. In a reversible mining and loading apparatus of the longwall type, a mobile base having reversible traction means and movable in either of opposite directions along a longwall face of a mine vein, vein-attacking and disintegrating mechanism, means for mounting said attacking and disintegrating mechanism on said base for adjustment selectively into reversed operating positions at either end of said base, said attacking and disintegrating mechanism symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed operating positions of said mechanism, and gathering means symmetrically arranged at the opposite ends of said base for cleaning up any loose mineral on the mine floor in advance of said base irrespective of the direction of travel of said base and without the need of turning said base around, said attacking and disintegrating mechanism overlying one of said gathering means in either of the reversed positions of said mechanism with respect to said base and said mechanism extending forwardly and downwardly into close adjacency to the underlying gathering means when in its lowered position with respect to said base.

9. In a reversible mining and loading apparatus of the longwall type, a reversible mobile base movable endwise in either of opposite directions along a longwall face of a mine wall in parallelism with the face, vein-attacking and disintegrating mechanism having movable disintegrating elements for dislodging and disintegrating mineral from a solid mine vein, means for mounting said vein-attacking and disintegrating mechanism centrally on said base for adjustment selectively into reversed operating positions at either end of said base whereby the apparatus may operate in either direction without turning around of said base, said attacking and disintegrating mechanism symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed positions of said mechanism, conveying means carried by said mounting means and adjustable therewith into said reversed positions with respect to said base for receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism in either of said reversed operating positions of said mechanism, conveying means carried by said base beneath the said adjustable mounting means for receiving disintegrated mineral discharged from said first mentioned conveying means in said reversed positions of the latter, and gathering means symmetrically disposed at the opposite ends of said base for cleaning up any loose mineral on the mine floor in advance of said base during either direction of travel of said base and for discharging the loose mineral so gathered onto said second mentioned conveying means, one of said gathering means underlying said attacking and disintegrating mechanism in either of said reversed positions of the latter.

10. In a reversible mining and loading apparatus of the longwall type, a reversible mobile base movable endwise in either of opposite directions along a longwall face of a mine wall, vein-attacking and disintegrating mechanism having movable disintegrating elements for dislodging and disintegrating mineral from a solid mine vein, means for mounting said vein-attacking and disintegrating mechanism on said base for adjustment selectively into reversed operating positions at either end of said base, conveying means carried by said mounting means and adjustable therewith with respect to said base for receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism in the reversed operating positions of said mechanism with respect to said base, conveying means carried by said base beneath the said adjustable mounting means for receiving disintegrated mineral discharged from said first mentioned conveying means, said last mentioned conveying means including a pair of parallel transverse conveyors mounted on said base at opposite sides of a vertical transverse plane bisecting said base, and said first mentioned conveying means discharging the disintegrated mineral on one of said conveyors when said attacking and disintegrating mechanism is located at one end of said base and discharging the disintegrated mineral on said other conveyor when said mechanism is located in its reversed position at the opposite end of said base, and gathering means disposed at the opposite ends of said base for cleaning up any loose mineral on the mine floor in advance of said base during either direction of travel of said base without

the need of turning the latter around and respectively discharging the loose mineral so gathered onto said conveyors, said attacking and disintegrating mechanism overlying one of said gathering means in either of its reversed positions with respect to said base, and said mechanism extending forwardly and downwardly in close adjacency to said gathering means when in its lowered position with respect to said base.

11. In a mining and loading apparatus, a mobile base movable over the floor of a mine, vein-attacking and disintegrating mechanism for dislodging mineral from a solid mine vein to provide a passageway in the vein between the floor and roof, means for swivelly mounting said mechanism on said base to swing horizontally relative thereto about an upright axis, and conveying means on said base for receiving the mineral dislodged by said attacking and disintegrating mechanism and including discharge conveyor means arranged transversely of said base at right angles to the longitudinal axis of said base for conveying the dislodged mineral laterally at one side of said base to discharge beyond said side of said base, said swivel axis of said swivelled mounting means for said mechanism located midway between the portions of said discharge conveyor means which are the most widely spaced from each other in a direction longitudinally of said base, said discharge conveyor means receiving the mineral dislodged by said mechanism in the different swivelled positions thereof relative to said base and said discharge conveyor means.

12. In a reversible mining apparatus of the longwall type, a mobile base movable endwise in either of opposite directions over the floor of a mine in parallelism with a longwall face, and a self-contained vein-attacking and disintegrating mechanism mounted centrally on said base for unitary adjustment into reversed positions with respect to said base to locate the forward vein-attacking portion thereof at either end of said base whereby the apparatus may operate in either direction without turning around of said base and for dislodging and disintegrating the mineral of a solid mine vein in either of its reversed operating positions, and said mechanism including motor driven vein attacking and disintegrating devices, said attacking and disintegrating mechanism symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal plane in either of said reversed operating positions of said mechanism, and means for sumping said devices along a substantially straight path and swinging said attacking and disintegrating devices in vertical planes relative to said base while said base remains stationary and said devices being operative in either of the reversed positions of said attacking and disintegrating mechanism to effect dislodgement and disintegration of relatively wide segments of mineral from the mine vein to form a passageway in the mine vein inside the face between the floor and the roof in which the apparatus moves as mining progresses, said sumping and swinging means including motor driven means for driving the same to effect sumping and swinging movements of said attacking and disintegrating devices as aforesaid.

13. In a reversible mining apparatus designed particularly for longwall work, the combination comprising a reversible base movable endwise in either direction along a longwall face of a mine vein generally in parallelism with the face, a vein-attacking and disintegrating mechanism for dislodging and disintegrating a section of the mineral vein between the floor and roof and of such width as to provide a space inside the face for receiving the apparatus as mining progresses during either direction of operation of the apparatus along the face, a mounting structure adjustably mounted on said base centrally of the latter and having a portion overlying said base and by which said attacking and disintegrating mechanism is carried, said mounting structure adjustable relative to said base to locate said attacking and disintegrating mechanism at either end of said base whereby the mineral of the mine vein may be dislodged to provide such space during either direction of operation of the apparatus, said attacking and disintegrating mechanism when in its central position longitudinal of said base being symmetrically arranged with respect to said base with the longitudinal axes of said mechanism and said base lying in a common central longitudinal vertical plane in either of said reversed operating positions of said mechanism, and means for moving said attacking and disintegrating mechanism along a substantially straight path longitudinally relative to said mounting structure to sump said mechanism into the mine vein in either of said adjusted positions of said mechanism relative to said base.

14. A reversible mining apparatus as set forth in claim 13 wherein conveying means is carried by said base and relative to which said mounting structure is adjustable and which is arranged on said base beneath said overlying portion of said mounting means so that the mineral dislodged by and discharged from said attacking and disintegrating mechanism may be received by said conveying means in either of said reversed positions of said attacking and disintegrating mechanism relative to said base.

15. A reversible mining apparatus as set forth in claim 14 wherein said conveying means comprises a pair of conveyors arranged symmetrically at opposite sides of the central portion of said base and located at the opposite end portions of said base so that when said attacking and disintegrating mechanism is positioned by said adjustable mounting structure at one end of said base it discharges the dislodged mineral onto one of said conveyors and when positioned reversely at the opposite end of said base it discharges the discharged mineral onto said other conveyor.

16. A reversible mining apparatus as set forth in claim 14 wherein said attacking and disintegrating mechanism comprises a head frame pivoted on said overlying portion of said mounting structure to swing in vertical planes and carrying series of disintegrating elements movable in parallel vertical orbits, said adjustable mounting structure comprising a frame swivelly mounted centrally on said base and having its outer portion overlying said base and disposable near an end of said base in either reversed position of said attacking and disintegrating mechanism, said head frame pivotally mounted on said outer portion of said swivelled frame, and said conveying means disposed on said base beneath said overlying frame portion rearwardly of the pivot of said head frame in either of said reversed positions of said attacking and disintegrating mechanism.

17. In a mining and loading apparatus of the longwall type, the combination comprising a base movable along the longwall face of a mine vein in a direction parallel with the face, a frame swivelly mounted on said base to swing horizontally with respect thereto and having a forward portion overlying one end of said base with the bottom of said frame portion spaced a substantial distance vertically above the top of said base, a vein-attacking and disintegrating mechanism pivotally mounted on said forward frame portion to swing in vertical planes relative thereto, and conveying means mounted on said base and relative to which said frame is swingable for receiving the mineral dislodged by said attacking and disintegrating mechanism including a conveyor arranged transversely of said base between the top of the latter and the bottom of said forward frame portion, the pivot of said attacking and disintegrating mechanism located a substantial distance above said transverse conveyor and said frame portion spaced vertically above said conveyor to provide a substantial passageway for the lateral discharge of the disintegrated mineral, and said transverse conveyor in the main located in a transverse zone between the parallel vertical planes in which the swivel of said frame and said pivot of said attacking and disintegrating mechanism respectively lie, said swivel axis of said frame swivel located rearwardly of said transverse conveyor.

18. A mining and loading apparatus as set forth in claim 17 wherein said base is reversible without turning and is movable in either of opposite directions along the mine vein in parallelism with the longwall face, and said conveyor includes a pair of transverse conveyor portions located on the base at the opposite sides of the swivel of said frame on the opposite end portions of said base, and said frame is swingable horizontally to locate said attacking and disintegrating mechanism into positions at either end of said base, and said transverse conveyor portions receiving the disintegrated mineral discharged from said attacking and disintegrating mechanism in either reversed position of the latter with respect to said base.

19. In a reversible mining apparatus of the longwall type, a reversible mobile base movable endwise in either

direction along a mine wall in parallelism with the longwall face, a frame overlying said base and swivelly mounted centrally on said base to swing horizontally relative thereto, said frame having portions at the opposite sides of its swivel superimposed above said base to provide substantial spaces between said frame and said base, a vein-attacking and disintegrating mechanism pivotally mounted at an outer portion of said frame and including a disintegrating head pivoted to swing in vertical planes and embodying disintegrating elements movable in parallel vertical orbits to remove the mineral from the solid between the floor and roof to provide a passageway in the mine wall inside the face to receive the apparatus as mining progresses, transverse conveyors mounted on said base at the opposite end portions thereof in said spaces between said frame portions and said base, means for swinging said frame horizontally about its swivel to locate said attacking and disintegrating mechanism in an operating position at either end of said base, and said attacking and disintegrating mechanism discharging the dislodged and disintegrated mineral onto one of said transverse conveyors in either reversed position of said disintegrating head with respect to said base.

20. A reversible mining apparatus of the longwall type as set forth in claim 19 wherein said attacking and disintegrating mechanism in either of its reversed positions with respect to said base extend forwardly, longitudinally above said base, and said reversible base is provided with floor clean-up devices at the opposite ends thereof for cleaning up any disintegrated mineral which falls from said attacking and disintegrating mechanism to the mine floor during the mining operation without bodily turning of said base, and said attacking and disintegrating mechanism overlying one of said floor clean-up devices in close adjacency thereto when in an operating position at either end of said base, said clean-up device and said overlying attacking and disintegrating mechanism extending forwardly and downwardly in substantial parallelism when said attacking and disintegrating mechanism is disposed with its outer extremity at the floor level.

21. A reversible mining apparatus of the longwall type as set forth in claim 20 wherein said transverse conveyors are arranged between the swivel and the floor clean-up devices at the opposite sides of the swivel in positions to receive the disintegrated mineral discharged not only from said attacking and disintegrating mechanism but also from said floor clean-up devices.

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