Nov. 7, 1950 F. C. GREENE 2,528,748

GRANULAR MINING MACHINE

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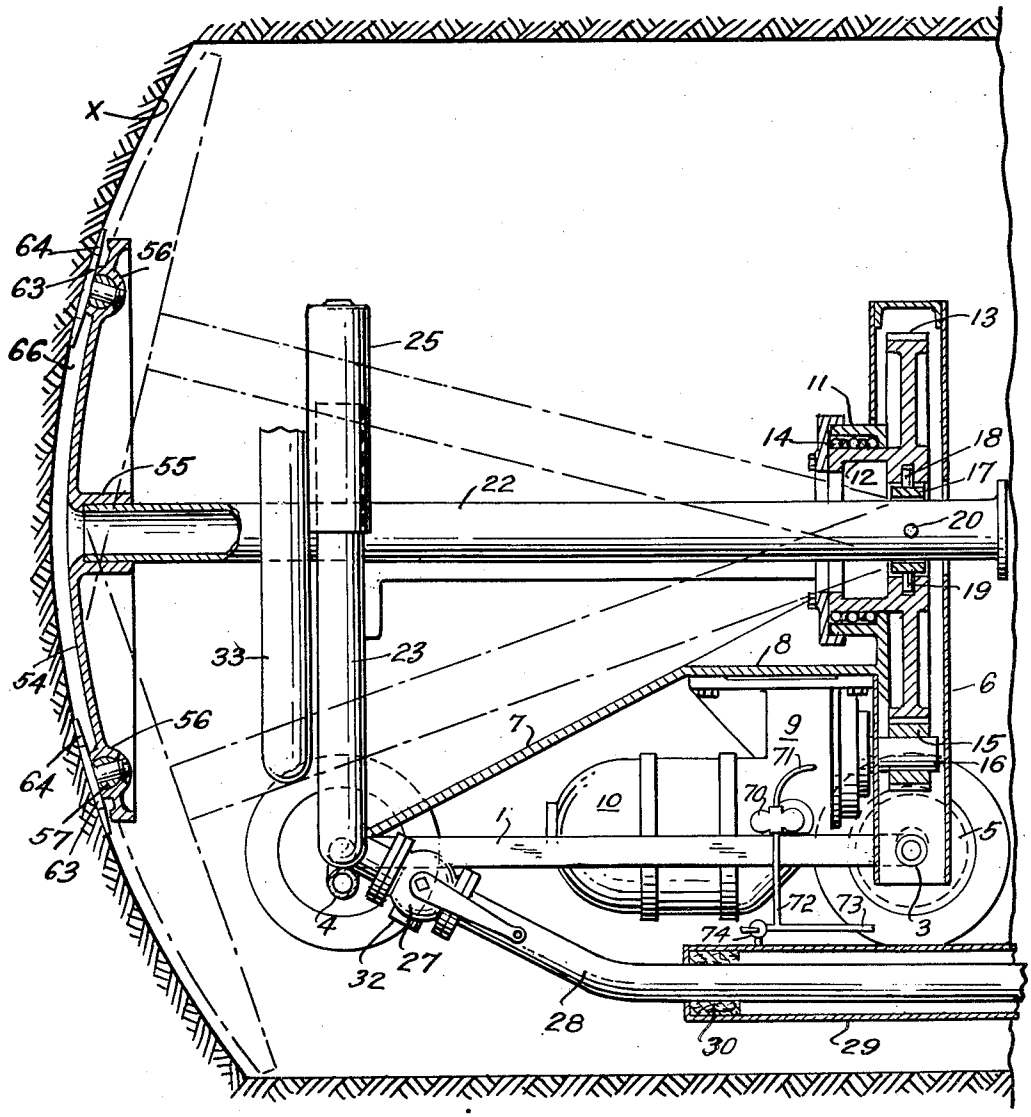


Fig. 1.

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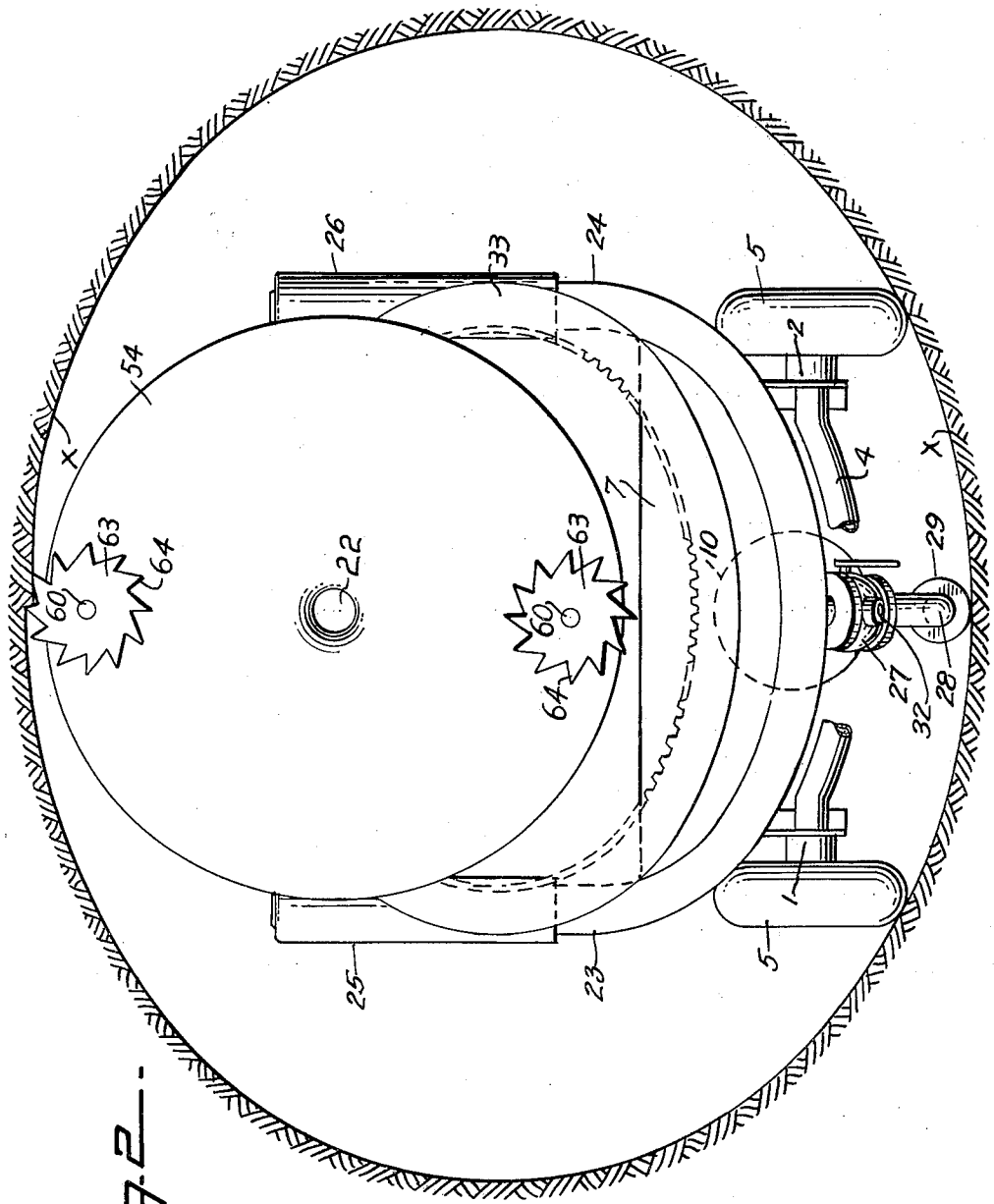


Fig. 2.

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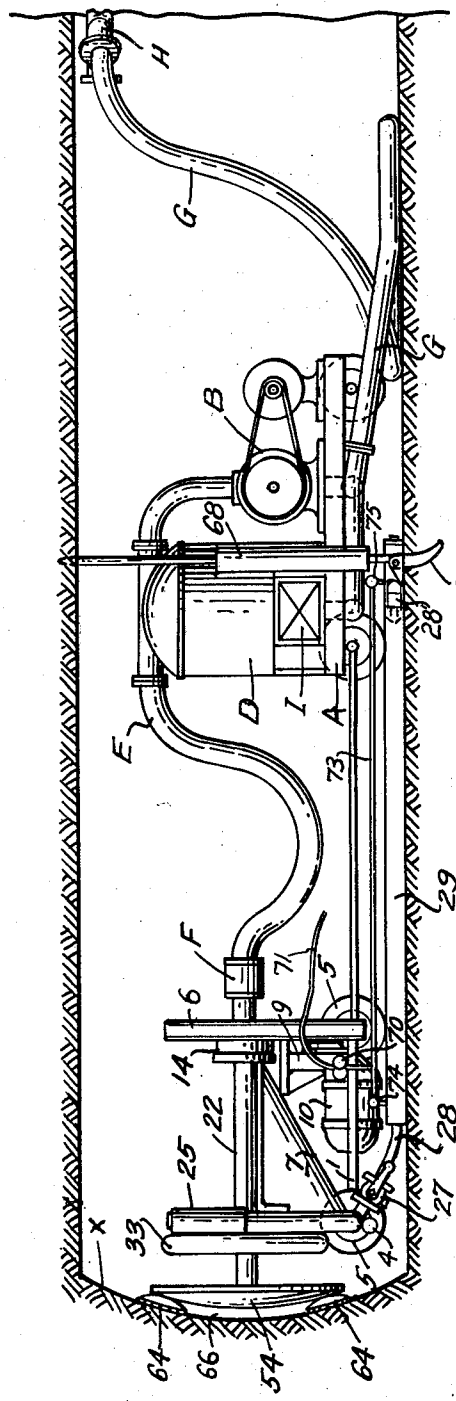


Fig. 5.

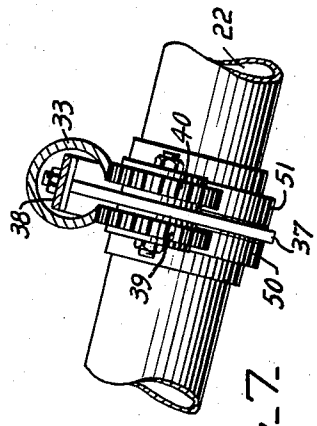


Fig. 7.

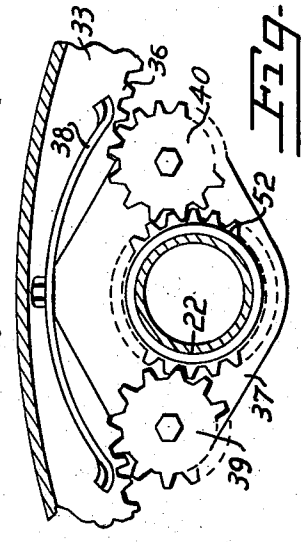


Fig. 6.

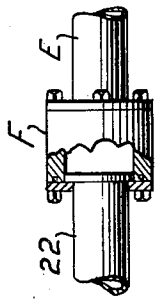


Fig. 8.

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Nov. 7, 1950 F. C. GREENE 2,528,748

GRANULAR MINING MACHINE

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Fig. 4.

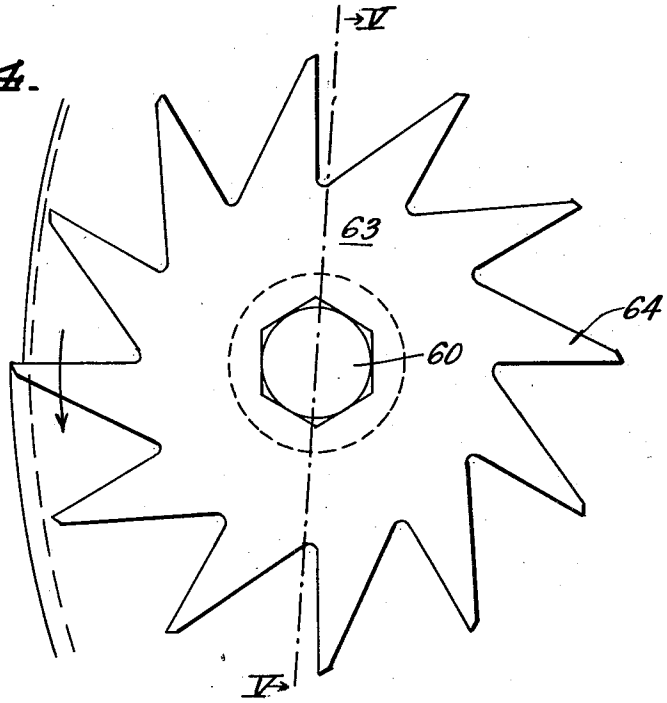
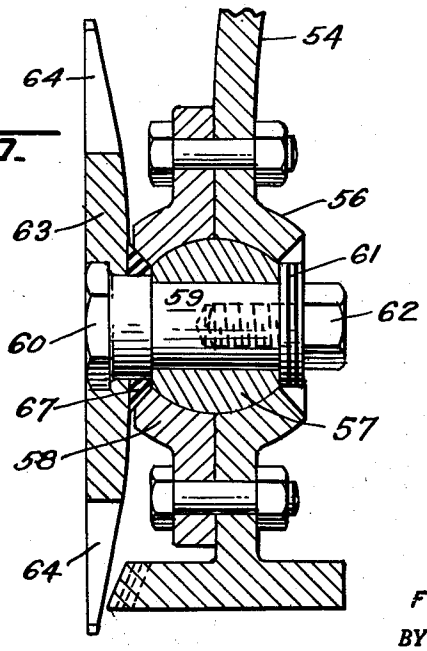


Fig. 5.



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UNITED STATES PATENT OFFICE

2,528,748

GRANULAR MINING MACHINE

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Application November 14, 1945, Serial No. 628,434

8 Claims. (Cl. 262—7)

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This invention relates to a granular mining machine and more particularly to a machine for mechanically mining coal and similar friable minerals.

Among the objects of the invention is to bore into the face of a bed of coal or similar subterranean deposit, and reduce it to granules, without the formation of dust or powder.

Another object is the removal of the severed granules from the face of the cut by air suction, without contamination of surrounding atmosphere within the tunnel formed by the mining machine.

Another object is to mine the product in a simple and efficient manner without the formation of noncommercial byproducts in the form of explosive powders, or silicosic dusts dangerous to health and machinery.

A further object is the adaptation of the present invention to existing means and methods of conveying the granular product from the mine.

Heretofore, mechanized coal and similar mining has been accomplished by grinding the face of the vein by abrasive wheels, and similar methods. This results in incidental dusty and powdered residuals, of an explosive nature and deleterious to health. There is also the additional cost of removing inert wastes from the mass of usable products, the commercial volume of which is reduced thereby.

The present disclosure has to do with the production of granular coal particles for technical conversion, rather than for direct combustion. Such conversions contemplate the production of metallurgical fuels, low volatile chars, as ideal fuels or carbons for manufacturing blue-gas and for hydrogenation processes for the production of hydrocarbon fuels. The granular size of the product resulting from the operation of this invention may be regulated to suit the particular use contemplated, as hereinafter described.

Other objects and advantages will appear as the description progresses. In the specification and drawings the invention is disclosed in its preferred form. But it is to be understood that it is not limited to this form, because it may be embodied in modifications within the spirit of the invention as defined in the claims following the description.

In the four sheets of drawings:

Fig. 1 is a side elevation partly in section of the machine with the cutter shaft in its horizontal position and indicating in dotted lines the upper and lower positions of this shaft.

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Fig. 2 is a front view of the same with the cutter head in elevated position.

Fig. 3 is a side elevation of the same in relation to the granule transporting system.

Fig. 4 is an enlarged detail in front elevation, of the rowel or pick-bit for reducing the face of the vein.

Fig. 5 is a cross section of the same on the line V—V, Fig. 4.

Fig. 6 is a fragmentary detail in front elevation of the supporting carriage and contour drive for the gyrating tubular shaft, the contour guide being shown in vertical section.

Fig. 7 is a similar detail of the same in side elevation.

Fig. 8 is a fragmentary detail of the swivel F, partially in vertical section showing the flanged rear end of the gyrating shaft.

Referring first to Fig. 1, in detail the structure comprises a chassis having the triangular main frame with the side beams 1, 2, diverging from the rear axle 3 to the front axle 4. The wheels such as 5 are mounted freely on the ends of the axles and have pneumatic tires thereon to resiliently support and form the mobile base for the machinery.

The gear case 6 extends vertically and is mounted between the rear axles 3. The superstructure 7 extends forward from above the main axis of the gear case, and flares downward and is mounted on the front axles 4. This superstructure is in the form of a semicircular open cone extending laterally along the front axle line between the front wheels. The reverse tapers of the main frame and superstructure form a rigid base mounting for the power machinery. The superstructure has the under bracket 8 from which the gear box 9 is suspended. The motor 10 is integrally mounted on the gear box and extends forwardly and is cross braced between the side beams 1, 2, for stability. This general structure forming in effect, a double "3-point" bracing suited to irregular roadways, is preferred because of its simplicity and rigidity, but it is subject to modification and rearrangement to meet varying conditions.

The superstructure 7 has the integral annular bearing 11, supporting the hub 12, of the driven gear 13, rotating on the interposed anti-friction and thrust bearing 14. The driven gear 13 meshes with the driving pinion 15, keyed on the shaft 16, that is driven by the intermediate reduction gearing in the gear box 9, driven by the motor 10.

The universal joint within the hub of the gear

13, has the ring 17 in opposed relation to the bearing cover bolted to the hub 12. This ring has the trunnions 18, 19, pivotal within the gear hub 12, and the transverse trunnions such as 20, pivotally supporting the driven end of the gyrating tubular shaft 22.

The forward support for this gyrating shaft comprises the pair of vertical hydraulic rams 23, 24, being the opposite ends of an arcuate tube fixed to the front edge of the superstructure, above the front axles 4, Fig. 2. These rams have the telescoping caps 25, 26, with interposed pressure packing. These rams are cross connected and receive equal hydraulic pressure through the control valve 27, interposed in the tubular stem 28 extending into the thrustor ram 29, with interposed pressure packing at 30. This thrustor ram lies upon the floor of the tunnel and is anchored by the sprag 31, driven into the floor, see Fig. 3, and receives hydraulic pressure from a service source not shown, to cause the caps 25, 26 to rise or fall according to the control of the valve 27, which has a bleeder at 32 for releasing the pressure to cause the caps to descend.

The contour guide 33 is welded or fixed to the caps 25, 26, and rises and falls therewith. It preferably consists of a heavy guage pipe bent to the desired contour with a slot milled at the desired angle through its wall to the interior at 34. The lateral margins of this slot are provided with gear teeth 36, forming in effect an internal gear around the inner contour of the guide.

The shaft 22 passed through the plate 37 which extends through the slot at 34 and into the interior of the guide 33, and has the shoe 38, the ends of which are formed to ride on the interior of the tube on the opposite side of the slot 34 above the gear teeth 36 and support the weight of the shaft assembly 22, see detail Fig. 1, interposed in the dot-dash line indicating the elevated position of the drive shaft 22.

Two pairs of pinions 39, 40, and 50, 51, are mounted on the opposite sides of the plate 37, on the opposite sides of the gyrating shaft 22 and meshed with the teeth 36 and the ring gears 52, 53, fixed on this shaft on opposite sides of the plate 34. This train of gearing transmits the rotation of the shaft 22 to the internal gear teeth 36 on the contour guide and causes the shaft to follow the contour of the guide, that may have any desired contour, see Fig. 2.

The cutter head 54 is preferably in the form of a concavo convex steel casting, having its hub 55 fixed on the forward open end of the gyrating shaft 22. In practice this head is about six feet in diameter and has interspaced bearing sockets such as 56, around its peripheral margin. These are arranged in a pitch circle about sixty inches in diameter, with about twelve of such sockets interspaced therein. These dimensions are in no sense critical, since they may be varied according to the results desired.

Each such socket has a spheroidal bearing 57 of suitable bearing metal held therein by the cap 58, bolted to the head 54, see Fig. 5. These form bearings for the bolts such as 59, having the polygonal head 60 and the washer 61 held in position by the nut 62 threaded on the bolt.

The particular merit of this invention resides in the form of the pick-bits 63 that percussively chisel a kerf off the face of the coal X. These star-like wheels are strictly percussion instrumentalities forced radially into the coal or vein that is fractured by the shattering action of each bit point 64 as it "walks" across the face of the vein to more than the depth of its own thickness. They are not to be confused with saws, abrasive wheels or chisel wheels that are driven from a center of rotation.

Each of the bit points 64 as hereinafter claimed, resemble and function in a manner similar to the squared point of a miner's pick when driven into the mass X; which action is multiplied a proportional extent as the head 54 revolves at appropriate speeds according to the nature of the mass X being disintegrated.

Each pick bit 63 has an axial socket to receive the head 60 of the bolt 59, by which it is attached to the head 54, and revolves within the bearing 57. The points 64 are shaped and hardened like a coal miner's pick with a similar bevel and rake to increase the fracturing effect of the pecussive penetration. The reason that the coal miner's pick does not produce dust is a matter of simple physics. When the "squared" point strikes the solid coal the square exerts a diffused impact pressure, like hydraulic pressure, which forces compact granules or splinters from the solid coal face. This impact bears no resemblance to abrasion, scraping, chiseling or similar mechanical erosive effects, producing explosive and silicosic dust, not tolerable in underground coal mines.

As the resultant granules are dislodged by the action of the pick bits they pass into the space 66 between the face of the convex cutter head 54 and the face of the vein X. While these granules are in suspension they are sucked into the tubular center of the shaft 22, the outer end of which is connected with a source of suction described below.

The preferred method of disposing of the granulated product of the cutter head 54 is by air suction through the shaft 22; from whence it is transported through pipes or ducts by a current of air or water flowing therethrough and carrying the granules by velocity suspension. There are several such machines available, the one at present preferred is the Airveyor Portable Unit, marketed by the Fuller Company of Catasauqua, Pennsylvania, U. S. A.

This unit has a capacity of about forty tons per hour, for a distance of about twenty-five feet by air suction, with a delivery distance of about seventy-five feet for discharge into the water or other form of conveyor, for coal and masses of similar gravity.

This unit comprises the trailer A, having a motor driven suction unit B, having its intake C opening into a closed separator unit D. The intake E of the separator is flexibly connected with the end of the shaft 22 by the swivel joint F as shown in Fig. 3. The discharge G is flexibly connected with the transport system at H. The granular coal entering the upper portion of the separator D strikes a baffle and descends into the air-lock at I, from which it flows into the discharge duct G and is forced into the transport system H, as described. The particular manner of disposing of the granular product of this invention is merely incidental and it is not limited by the system shown.

This invention operates substantially as follows: The motor 10, through the change speed gearing at 9, drives the shaft 22, through the gearing 13, 15, at the selected speed. The rotation of the shaft, acting through the gear train 39—53, rotates the head 54 and causes the series of pick-points 64 to dig into the face of the

vein X, cutting a kerf slightly thicker than the pick-bits 63, over an area circumscribed by the controlling contour of the guide 33. The gyration of the head causes a planetary rotation of the pick-bits 63, in an orbit defined by the contour guide 33 and eventually forming a tunnel through the mass X, having a curvilinear outline limited by the contour guide 33. The face of the tunnel is concave on the radius from the pivotal center of the universal joint at 18—21.

The thruster stem 28 has the piston 28' on its rearward end within the ram 29. The pump 70 provides hydraulic pressure for the ram, and has the inlet 71 leading to the mine water system, and discharges into the outlet 72, Fig. 1, and the feed pipe 73 connected to the ram ahead and behind the piston 28, and selectively controlled by the manual valves 74, 75 respectively.

As the face of the tunnel recedes, the control valve at 27 is opened, causing the thrustor ram 28—29 to advance the machine accordingly. This advance can be manually synchronized by the valve 27 to continually maintain the desired pressure of the pick-bits against the face of the vein X. When the thrustor reaches the end of its thrust, the sprag anchor at 31 is lifted and the thrustor collapsed and reanchored for another and advance stroke of the thrustor. When the pick bits become dulled the telescoping thrustor is backed up to make space between the head 54 and the face X of the tunnel, to permit replacement of the pick bits.

The diameter of the pick bit and the number of teeth in its periphery is largely determined by the nature of the bed of coal or mass being reduced. A diameter of about fourteen inches with twelve points 64 is average for coal. The depth of lateral penetration in the kerf, is determined largely by the nature of the coal and the desired size of the resultant granules. The penetrating percussion of the teeth can be regulated by the speed of the drive at 9. In soft or ligneous coals or dirt "spot" tunneling, concave discs, as used in agricultural implements may be substituted for the pick-bits shown, for "shaving" off the face of the mass X. The pick bits may be given a limited chattering effect by interposing the rubberlike cushion 67 between the bit and the bearing 57, to increase the lateral prying action of the points 64.

Unlike powdery and dusty masses, the granules resulting from the action of this machine, are readily transported in pipe lines, by pumping stages along the line, as in transporting petroleum and other fluids.

The contour of the tunnel can be made self supporting without timbering and bracing, under ordinary circumstances. Should the nature of the vein or material operated upon, be such that it will not provide proper anchorage for the sprag at 31, the extensible jack-post 68 from there to the ceiling of the tunnel may be interposed to anchor the thrustor at 28.

The traction gearing described is interposed between the gear box 9 and the rear wheels at 3, for transporting the machine from place to place when not operating.

I claim:

1. A mining machine of the class described, including a mobile base, power means mounted on said base; a gyrating, rotary shaft supported at one end of the base and driven by said power means; a contour guide on said base, movable means supported by said guide supporting the forward portion of said shaft; driving means in said shaft operatively engaging said movable means on the guide to move the same so that the shaft follows the contour of the guide; a cutter head fixed on the forward end of said shaft; a percussion pick-bit rotatably mounted adjacent the periphery of said head and including a plurality of tangentially tapered teeth terminating in relatively blunt points, said pick-bit being rotated by the penetration of said points into the mass being mined; and means for progressively advancing said mobile base.

2. A granular mining machine of the class described, comprising a mobile base with motive means thereon; a universal joint mounted on said base; a gyrating shaft driven by said motive means and supported by said universal joint; a contour guide mounted on said base; a mobile carriage mounted on said contour guide and supporting the forward portion of said shaft; and driving means on said shaft and engaging said guide for causing said shaft to follow said contour.

3. A granular mining machine of the class described, comprising a mobile base with motive means thereon; a universal joint mounted on said base; a gyrating tubular shaft driven by said motive means and supported in said universal joint; raising and lowering means on said base; a contour guide mounted on said raising and lowering means and supporting the forward portion of said shaft; driving means on said shaft engaging said contour guide for causing said shaft to follow the contour of said guide; a cutter head fixed on the forward end of said shaft; a percussion pick-bit rotatably mounted adjacent the periphery of said head and having tangentially tapered teeth terminating in relatively blunt points and a suction conduit communicating with the interior of the said tubular shaft to withdraw granules produced by the pick-bit therethrough.

4. A granular mining machine in the class described, comprising a mobile base with motive means thereon; a thrust bearing mounted on said base; a ring gear mounted in said thrust bearing and driven by said motive means; a gyrating tubular shaft projecting through said gear; a universal joint interposed between said gear and shaft; raising and lowering means on said base; a contour guide mounted on said raising and lowering means and having gear teeth thereon; a carriage mounted on said guide and supporting the forward portion of said shaft; a pinion gear fixed on said shaft and meshing with said gear teeth on said guide for causing said shaft to follow the contour of said guide; a convex head fixed on the outer end of said shaft and concentric with said universal joint; rotary pick-bits mounted on said head; and means for advancing said mobile base; and means for withdrawing granular material through said head and tubular shaft.

5. A mining machine of the class described including a mobile base, power means on the base, a tubular shaft driven by said power means, a universal joint supporting one end of said shaft for rotation and gyration about its axis, an annular, tubular contour guide surrounding the shaft intermediate its ends, said guide having an annular slot extending throughout the inner periphery thereof, gear teeth on the guide adjacent the respective edges of the slot, the free ends of said teeth extending toward the shaft when the same is in a horizontal position, a movable car-

riage supported by the guide and including an apertured plate having a portion thereof passing through the slot and disposed within the tubular guide, means on the plate cooperating with the internal surface of the guide to support the plate, spaced pairs of gears on opposite sides of the portion of the plate exteriorly of the guide, said gears meshing with the teeth in the guide, the said shaft passing through the aperture in the plate and supported therein, longitudinally spaced drive gears on the shaft meshing respectively with the spaced pairs of gears on the plate so that rotation of the shaft effects movement of the carriage and the shaft follows the contour of the guide, and a head fixed to the free end of the shaft including a plurality of spaced freely rotatable cutters mounted thereon adjacent the periphery thereof.

6. A mining machine as defined in and by claim 5 wherein a shoe is secured to the top of the said apertured plate, and which shoe has a width in excess of the slot in the guide so that the shoe rides on the interior of the guide on opposite sides of the slot and thereby supports the weight of the plate and the shaft.

7. A mining machine as defined in and by claim 1 wherein said shaft is hollow and a suction conduit communicates with the interior of the shaft to withdraw the mined particles therethrough.

8. A mining machine including a mobile base, power means mounted on said base, stationary bearing means mounted on the base, a hollow shaft passing through and in spaced relation to said bearing means, a driven pinion having a hub journaled in said bearing means, said pinion being concentrically disposed about said shaft, a universal connection between the pinion and the shaft to permit the shaft to rotate and gyrate, a driving gear in mesh with said pinion, said driving gear receiving power from the power means, spaced vertically extensible supports incorporated with said base forwardly of said power means, each of said supports being disposed on opposite sides of the axis of rotation of said shaft,

an annular contour guide supported by said supports and surrounding in spaced relation said shaft, gear teeth on the contour guide, a movable carriage supported by said guide and supporting said shaft adjacent thereto drive gearing on said shaft and gearing on said carriage meshing respectively with the drive gearing on the shaft and the teeth on the contour guide whereby rotation of the shaft effects gyratory movement thereof on its axis by reason of its geared interconnection with the contour guide so that the shaft follows an annular path corresponding to the shape of the contour guide, the outer end of said shaft having a head fixedly secured thereto, said head having a plurality of freely rotating pick-bits universally mounted thereon, each pick-bit having a plurality of teeth each having a radially disposed edge, and a tangentially disposed edge and each tooth terminating in a blunt point, so that in operation the blunt point exerts impact pressure on the mass being mined to spall off granules therefrom and suction means, including a conduit communicating with the hollow shaft to withdraw the produced granules therethrough and means to advance the mobile base and to elevate the said supports.

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