ROTARY MINING MACHINE HEAD AND CUTTER CARRIED THEREBY MOVABLE IN ELLIPTICAL PATHS

INVENTOR.

D. P. Graham

BY

INVENTOR.

D. P. Graham

BY

ATTORNEY

W. J. Hallowell

ATTORNEY
FIG. 3

INVENTOR

D.P. Graham

BY

W. S. McCallum

ATTORNEY
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THEREBY MOYABLE IN ELLIPTICAL PATHS

INVENTOR

D. P. Graham

ATTORNEY
ROTARY MINING MACHINE HEAD AND CUTTER CARRIED THEREBY MOVABLE IN ELLIPTICAL PATHS

Dallas P. Graham, Columbus, Ohio

2 Claims. (Cl. 262—26)

This invention relates to mining machines and more particularly to portable mining machines of the continuous type which are employed, for example, in the production of ore from coal. In such machines, the loosened bodies of coal, following removal, are conveyed means forming a part of the machine and conducted therein by mine cars or other carriers for removal from a mine.

Machines of this type directly attack coal or other minerals present in a seam undergoing working, and are so constructed as to dispense with the need of explosives in loosening the coal from its natural bed or seam and reduce the same to a size enabling the coal to be loaded in mine cars. Prior mining machines for this purpose have employed power-driven rotatable cutter-carrying heads mounted to turn about horizontal axes in parallel order to the vertical working face of the seam being mined. As a result, the radii of such heads have been restricted to conform with the height or thickness of the coal seam.

In the mining of coal, it is common to provide working rooms or passages which are substantially rectangular in vertical cross section, having vertical side walls and a horizontal floor and roof. Rooms or passages which are substantially circular in transverse cross section, after the manner of a tunnel, are impracticable, since floor laid tracks and other mechanical equipment are used in such rooms or passages, necessitating room width and height. These conditions are such that when continuous mining machines are provided with rotary cutting heads, a plurality of such heads arranged in transversely spaced horizontally disposed order are provided, with the cutters being brought into overlap. Under these conditions, the width of a room or passage cut by the machine in the coal seam is wider than when a single head is used, but the circularly moving cutters, turning about a horizontal axis, leave coal fillets or cusps in the roof, floor or side walls of the seam penetrated by the mining machine. To remove these fillets or cusps often requires slow and costly manual operations in cleaning the room or passage to pass required dimensions and for equipment installation and manipulation. The use of chain-mounted cutters has also been proposed for removing these formations in producing flat, planar side, roof and bottom walls. Chain cutters, however, are objectionable in that they produce, as a result of their cutting action, a relatively large amount of fines and coal dust. In addition, such chain cutters add mechanical complications to mining machines of this character.

Accordingly, it is an object of the present invention to provide a continuous mining and loading machine wherein in the cutters of the movable heads, instead of moving in circular paths, as heretofore, are so mounted as to travel in elongated elliptic orbits of movement, whereby to increase the radii of a room or passage cut by the machine in a coal seam over that produced by an equivalent number of circularly traveling cutters, to reduce substantially the amount of manual work or machinery necessary in room cleaning, to provide substantial roof and floor coverage, and to reduce substantially the tendency to cause roof and floor breakage, particularly in those portions of the machine which are not contained within the elliptical orbits of the cutters.

A further object of the invention is to provide means for bodily raising and lowering and adjusting laterally the cutter heads of such a machine in adapting said heads to coal seams of varying thicknesses.
ignates the frame structure of the machine in its entirety. In this instance, the frame structure has been shown as being portably mounted through the use of endless power-driven cover-to-trotter belts 11, although it is within the scope of the invention to support the frame structure by other conventional means if such should be so desired.

At its front, the frame structure is formed to provide an inclined track 13 extending from the front end of the machine and in the center of this apron, there is located the forward end of a longitudinally extending centrally disposed material-conveying trough 14. On this trough, there is mounted a conveyor which has been shown diagrammatically as an endless chain 14 carrying laterally projecting and longitudinally spaced flights 15. By means of this conveyor, loose metal from the apron is conveyed toward the front end of the apron and positioned in the forward lower end of the trough. The flights 15 and positively advanced longitudinally and rearwardly by the conveyor.

Preferably, at its rear end, the trough includes a laterally swinging discharge extension 16 for the purpose of providing flexibility in the position of discharge of the mined materials from the rear end of the machine. Such discharge may be made in a manner so that the materials will be deposited in mine cars, conveyors or the like, for transportation from the mine. Any suitable motor arrangement and suitable power transmission means may be provided for driving the traction belts 11 and the conveyor 14.

The movement of a section is particularly concerned with the front or cutting end of the machine, and in this regard, use is made of a cutting mechanism M which, additionally, is formed to include a vertically disposed transversely extending base plate 17, the latter carrying spaced stationary gear housing base sections 18. Carried by the frame structure is the head structure 20 in which a pair of motors 19, usually electrically operated, although if necessary, the armature or operating shaft of each of these motors is provided and engaged with the gear shafts 19, which extend longitudinally forwardly from the motor base plate 17 at each side of the trough 13. The ends of the shaft sections 20 are equipped with universal joints shown at 21 in adapting the shafts to the vertical adjustment, hereinafter described, of the base plate 17 and the cutting mechanism carried thereby.

In obtaining such vertical adjustment on the part of said plate and cutting mechanism, pivoted sets of transversely spaced longitudinally extending lever arms 22 are utilized. These arms have their rear ends pivoted as at 23 in vertically registering order to support the frame structure 10 and their front ends likewise pivotally connected as at 24. Projecting from the rear face of the base plate 17, the lever arms 22 project from the frame structure extending outwardly to the faces of the motor plate 19. They are pivotally connected at their lower ends to the frame 10 and at their upper ends to the arms 22. Any other equivalent means for raising and lowering the head cutters may, of course, be used.

The stationary base section 18 of each of the gear housings carries a fixed center spindle 27 which normally is disposed horizontally in a forwardly projecting position. Reversible about the fixed axis formed by each of these spindles is a rotateable head 28 which constitutes the movable section of the housing.

In the rotatable support of each of the heads 28, the enlarged base end of each of the spindles 27 carries a brass thrust bearing 29, which is secured to the bearing end of the head 28. These arms have their rear ends pivoted as at 30 in vertically registering order to support the fixed portion of the frame structure 10 and their front ends likewise pivotally connected as at 31. Projecting from the rear face of the base plate 17, the lever arms 32 project from the frame structure extending outwardly to the faces of the motor plate 19. They are pivotally connected at their lower ends to the frame 10 and at their upper ends to the arms 32. Any other equivalent means for raising and lowering the head cutters may, of course, be used.

Each of the spindles 27 is shouldered as at 34 and threaded as at 35 for the reception of a clamping nut 36 which holds the inner race 37 of the intermediate antifriction bearing on each of the spindles against longitudinal displacement. Beyond the threaded region 38, each spindle includes a stationary cylindrical section 39 on which is provided the keyway 40 at 62 a sun gear 41. Engaged with the teeth of the sun gear 41, shown in Fig. 4, the latter being mounted on a drive shaft 42 carried by the outer end section 43 of each head housing. The teeth of the planetary gear mesh with those of a gear 46 which are formed upon the inner end of a tubular hub 67 of a cutter-carrying spider member 48.

It will be seen that as the housing heads rotate about the longitudinal axes of their spindles 61, as a result of the driving action obtained by the shaft 47, gear teeth 51 and the internal gear 40 of the planetary ring 40, gear 46 as a result of the constant meshing engagement thereof which the teeth possess with those of the gear 63 on the spider 61. The rotation of the planetary ring 40, gear 65, as well as its orbit of circular travel around the longitudinal axis of the spiral 27, produces rotation on the part of the hub 67 and the cutter carrying spider.

Each of the outer end sections 43 of the housing heads, which acts as a crank, through the planetary gear shown, produces rotation of the cutter arms in an opposite or reverse direction. Positioned in the hollow center of the hub 67 is a shaft 69, the outer end of which receives and has keyed to, and is otherwise fixed thereto the hub 70 of the ship structure 80, and drill structure shown at 71 and 72, respectively. The hub 70 is further held in place by a disk 73 seated in a socket 74, and a screw bolt 75, and surrounding the spindle, an outer race member 71, and tapered interlocking roller members 80. The outer race members 80 being secured to the spindle are mounted on a threaded shaft which has been shown in a position 81 for opening formed longitudinally the cone and drill in circular annularly with the outer end of the antifriction thrust-receiving bearing. The outer race 78 and 79 formed in connection with the hub structure 80 of the outer end of the spindles 82 being engaged in openings provided in an annular flange 83 extending inwardly from the hub 76 of the cone and drill structure. The outer ends of the bolts 82 may
be equipped with binding nuts 84. Dust-excluding and oil-retaining gaskets 85 are positioned between the flanges 81 and 83 and surround the bolts 82.

Intermediately of its longitudinal tubular hub 67 which carries the spider member 68 is surrounded by a roller-type antifriction bearing 86. Dust-excluding and oil-retaining rings 87 are arranged in an annular space 88 formed between the hub 89 and the hub region 89 of the case 43.

Antifriction bearings 90 of the needle type are shown as arranged between the needle 91 and the shaft 92. Axial dust-excluding ball bearing 91 is arranged around the inner end of the shaft 92 and is contained within a face 92 of the housing section 41 and the inner end of the hub 67.

All antifriction bearings provide for the free rotation of the revolving parts which they are designed to support and, also, to resist inwardly directed longitudinally applied forces on such rotatable parts produced by the applied forces on the cutting elements of the spider member, engagement of the cutting elements on the spider member and the cutting elements carrying the tool bits.

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Preferably, the spider member 68 is formed, as shown in Fig. 5, to include three radiating arms 56, 57, and 72. The arms 56, 57, and 72 extend from a common center 93, and are of equal length. Each arm is provided with a bearing 80 for the tool bit. The center 93 is shown in Fig. 5.

In this construction, the spider members and the cutter carried thereby rotate about their centers in directions opposite to the directions of rotation of the clamping members. In this manner, the axis of rotation of the transversely disposed vertical bed may be adjusted laterally of the machine and with respect to each other.

While I have set forth in detail a single preferred embodiment of a continuous mining and loading machine embodying my present invention, it is not to be understood that in so doing, I limit the invention to the precise art form and part arrangements illustrated and described, since I reserve the right to employ all structural variations or modifications of my invention which may prove to be effective in the future.

Williams claims:

1. In a mining machine, a supporting frame, a cutting head mounted on said frame, said head including stationary and rotatable casing sections, a spider member carried by said stationary section, a gear on said spider member, an idler planetary gear carried by the rotatable section of said spider member, the teeth of said last-named gear being in mesh with those of the stud member gear, an arm-carrying shaft rotatably supported in the rotatable section of said head in parallel relation to said stud member gear, a driven gear provided on said shaft for rotation therewith, said driven gear having the teeth thereof disposed in meshing engagement with those of said last-named idler gear, and cutting means spaced apart, said gear and rotatable with said shaft.

2. In a mining machine, a supporting frame, a cutting head mounted on said frame, said head including stationary and rotatable casing sections, a spider member carried by said stationary section, a gear on said spider member, an idler planetary gear carried by the rotatable section of said head, the teeth of said last-named gear being in mesh with those of the stud member gear, an arm-carrying shaft rotatably supported in the rotatable section of said head in parallel relation to said stud member gear, a driven gear provided on said shaft for rotation therewith, said driven gear having the teeth thereof disposed in meshing engagement with those of said last-named idler gear, and cutting means arranged exteriorly of said head and rotatable with said shaft.

3. A cutting head mechanism for mining machines comprising: a head casing including a relatively stationary base section and a rotatable housing section, a fixed anti-axial member projecting from said base section and upon which said housing section is supported, an internal gear teeth meshing with said anti-axial member, a power-driven gear supported by said base section having its teeth meshed in meshing engagement with said internal gear teeth, a sun gear provided stationary on said axial member, an idler planetary gear rotatably carried by said housing section having its teeth meshed with those of said sun gear, a shaft rotatably supported in said housing member in parallel relation to and at one side of said axial member, a driven gear fixed to rotate with said shaft, said driven gear having the teeth thereof disposed in meshing with those of said last-named idler gear, and a cutter-carrying arm member rotatably supported on an outer end of said shaft exteriorly of said housing member.

4. A cutting head mechanism for mining machines as defined in claim 3 and wherein the front of said axial member is disposed in axial registry with said shaft extending beyond said housing section the said axial member being provided with a deformed break-out cone and drill rotatable in unison with said arm member.

5. In a mining machine, a supporting head, a stationary stud member projecting from said head, a power-driven gear provided for rotation about the axis of said stud member, a stationary gear provided on said stud member for engagement with said power-driven gear, the teeth of said last-named gear in mesh with those of the stationary stud member gear, a shaft rotatably supported for movement around the circumference of said stationary gear and in unison with said power-driven gear, a driving gear mounted to rotate with said power-driven gear.

6. In this construction, the spider members and the cutter carried thereby rotate about their centers in directions opposite to the directions of rotation of the clamps producing the elliptical motion. Also, the cutter members are disposed vertically and set so as to be adjustable laterally in the machine and in respect to each other. This enables the machine to be adapted to mining various types of coal in bulk of different grades and qualities.
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shaft, said driving gear having the teeth thereof disposed in meshing engagement with those of said idler gear, a cutter-carrying member rotatably supported on the outer end of said idler gear, a power-driven gear rotatable about the axis of said stationary gear, an idler gear rotatable with said power-driven gear, the teeth of said idler gear being in constant mesh with those of the stationary gear, a shaft rotatably supported for movement around the circumference of said stationary gear and in unison with said power-driven gear, a driving gear fixed to rotate with said shaft, said driving gear having the teeth thereof disposed in constantly meshing engagement with those of said idler gear, a member rotatably supported on the outer end of said shaft, and cutting devices carried by said member in spaced radial relation to said shaft, said cutting devices being movable in elliptical orbital paths through the combined rotation of said shaft and bodily rotational movement thereof about the circumference of said stationary gear.

7. In a mining machine, a supporting frame, a stationary gear provided on said frame, a power-driven gear rotatable about the axis of said stationary gear, an idler gear rotatable with said power-driven gear, the teeth of said idler gear being in constant mesh with those of the stationary gear, a shaft rotatably supported for movement around the circumference of said stationary gear and in unison with said power-driven gear, a driving gear fixed to rotate with said shaft, said driving gear having the teeth thereof disposed in constantly meshing engagement with those of said idler gear, a member rotatably supported on the outer end of said shaft, and cutting devices carried by said member in spaced radial relation to said shaft, said cutting devices being movable in elliptical orbital paths through the combined rotation of said shaft and bodily rotational movement thereof about the circumference of said stationary gear.

8. In a mining machine, a supporting frame, a stationary gear provided on said frame, a power-driven gear rotatable about the axis of said stationary gear, an idler gear rotatable with said head, the teeth of said gear being in constant mesh with those of the stationary gear, a shaft rotatably supported by said head for movement around the circumference of said stationary gear and in unison with said head, a driving gear fixed to rotate with said shaft, said driving gear having the teeth thereof disposed in constantly meshing engagement with those of said idler gear, and a material-engaging arm member rotatably supported on said shaft for movement around the circumference of said stationary gear.

9. In a mining machine, a supporting frame, a pair of cutter heads, each of said heads including stationary and rotatable sections, means for imparting rotation to the rotatable section of each of said heads to effect turning movement thereof, a stationary stud member projecting from each of the stationary sections of said heads and about the axis of which said stationary sections concentrically revolve, a stationary sun gear on each of said stationary sections, an idler gear rotatable with each of said rotatable sections, said idler gear having teeth in constant mesh with each of said sun gears, a shaft rotatably mounted in each of the rotatable sections of said heads in relationship with an associated stud member, a driving gear on each of said shafts having teeth in constant mesh with those of an associated idler gear, a cutter supporting member carried by an outer end of each of said shafts exteriorly of said heads, each of said members including a plurality of spaced radially extending arms carrying kerf-cutting devices, the latter traveling in elliptical orbits, with the orbits of the cutting devices of one head overlapping those of the other.

10. A mining machine as defined in claim 9, and wherein the radial arms of said heads carrying said cutting devices are relatively disposed to avoid engagement with the arms and devices of the other of said heads.

11. In a mining machine, a supporting frame, a stationary spindle carried by said frame and projecting substantially horizontally therefrom, a cutting head revoluble about said spindle, said head including a housing formed with an internal gear, a power-driven pinion having the teeth thereof in mesh with those of said internal gear, a stationary sun gear mounted on said spindle, an idler gear carried by and mounted within said housing and having the teeth thereof in mesh with those of said sun gear, a planet gear, a quill rotatably supported by said housing and on which said planet gear is mounted, said quill being arranged in parallel radial offset order with respect to said spindle, an arm rotatable with said quill, and a working face-cutting tool carried by said arm and projecting forwardly therefrom.

12. In a mining machine; a supporting frame; spindle means carried by said frame; a cutting head revoluble about said spindle means; shaft means rotatably carried by said head in offset, spaced parallel relation to the axis of rotation of said head; cutting tool-carrying means carried by said shaft means and extending laterally outwardly therefrom; drive means connected to revolve said head about said spindle; and motion-transmitting means carried by said head and drivingly connected with said shaft means and operable upon rotation of said head to impart to said shaft means simultaneous bodily orbiting movement in a circular pattern about said spindle means and axial rotation in a direction to cause the cutting tool-carrying means carried thereby to describe a substantially elliptical pattern in a plane substantially perpendicular to the axis of rotation of said cutting head.

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