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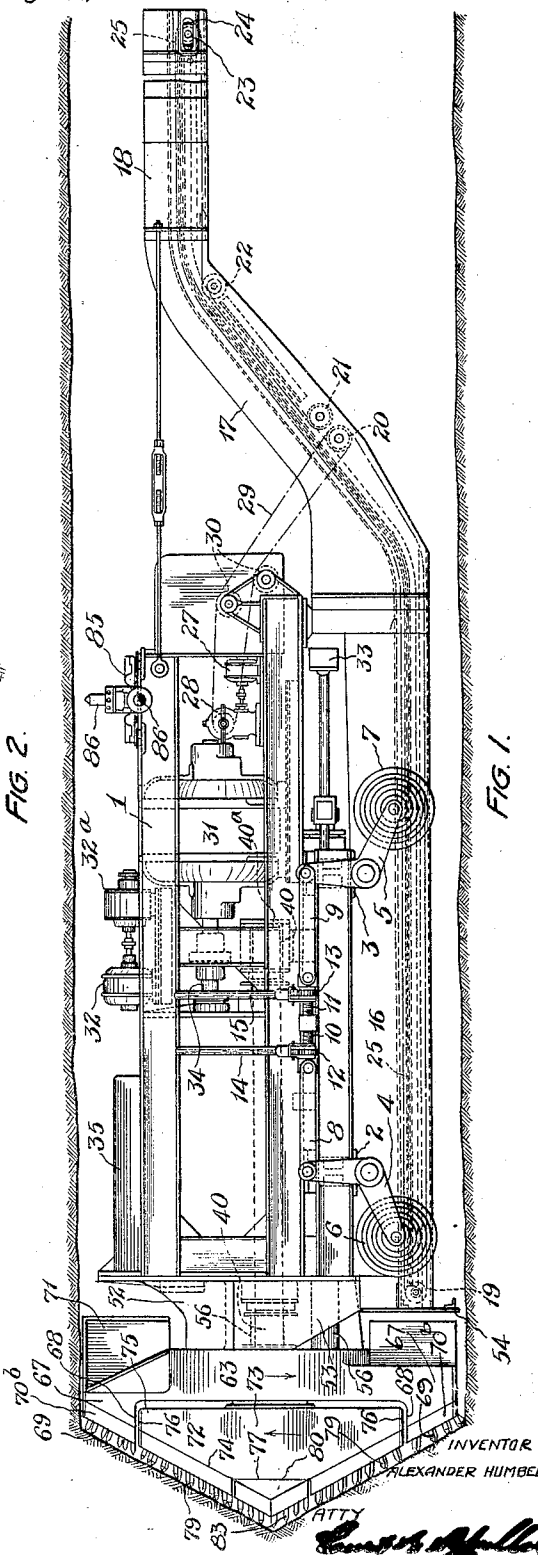
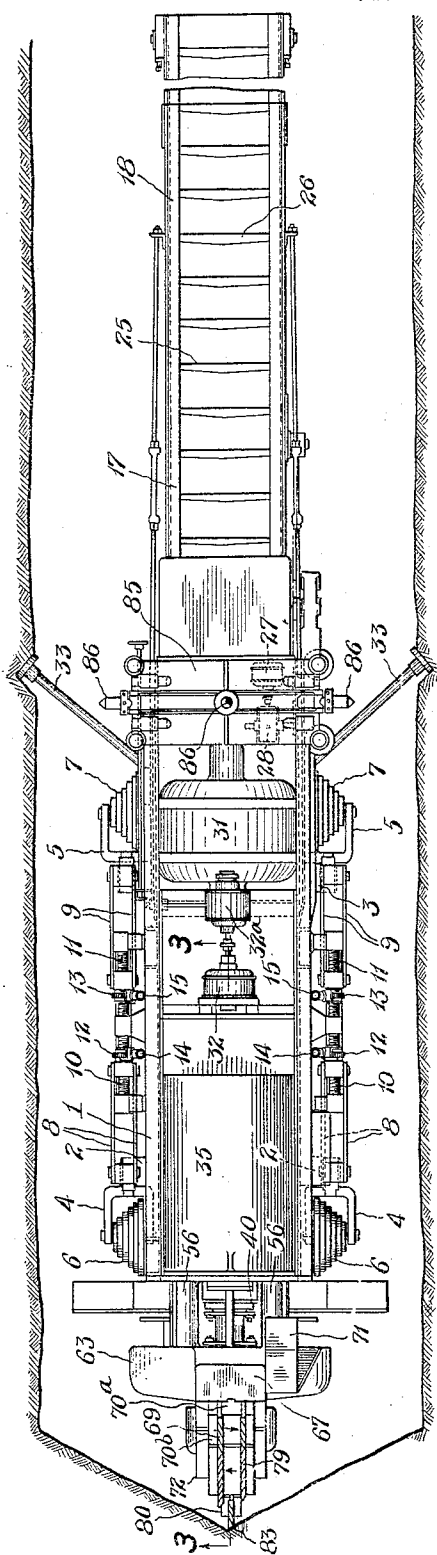
A. HUMBEL

1,888,085

MINING MACHINE

Filed Aug. 21, 1930

3 Sheets-Sheet 1



Nov. 15, 1932.

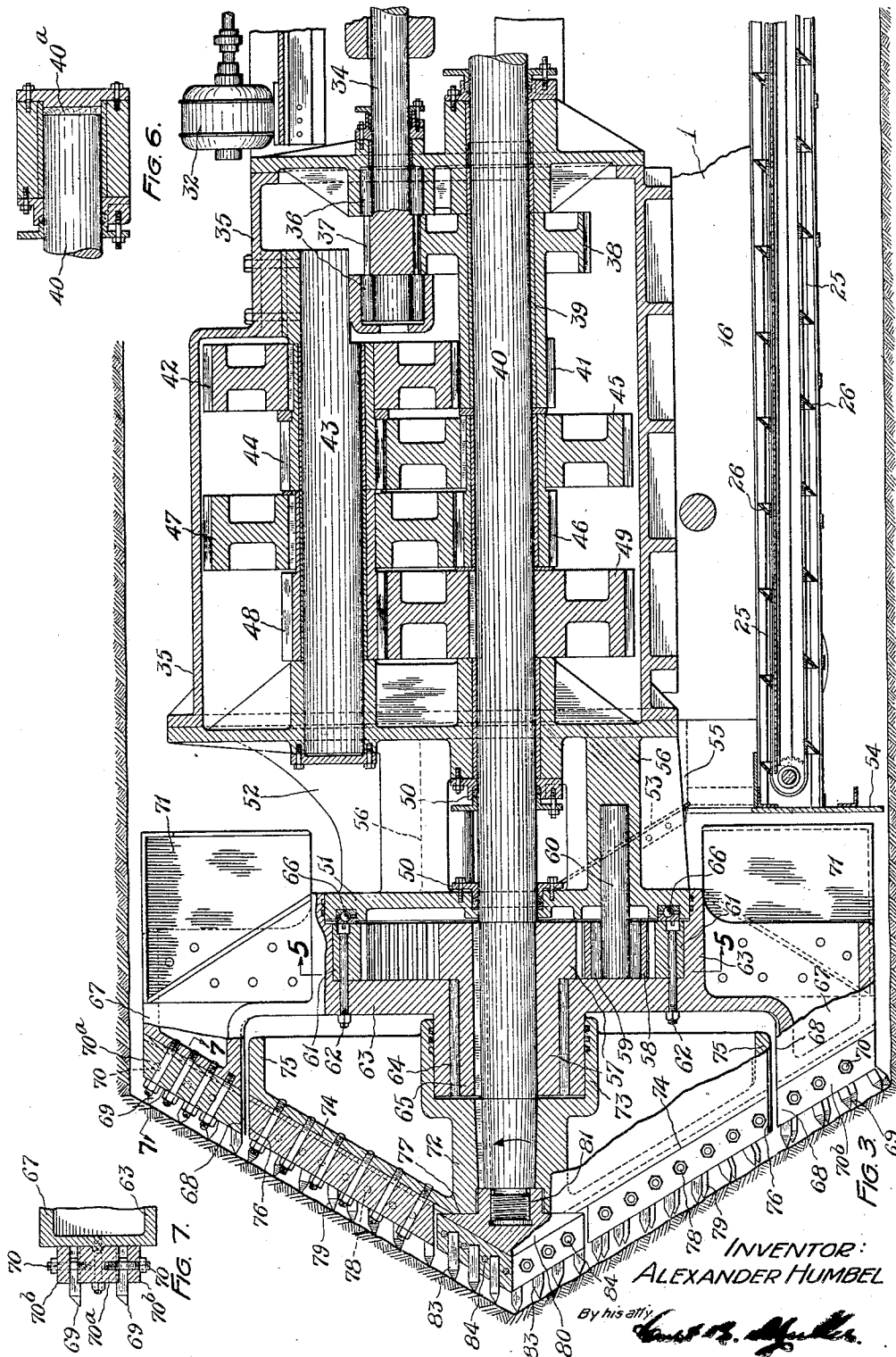
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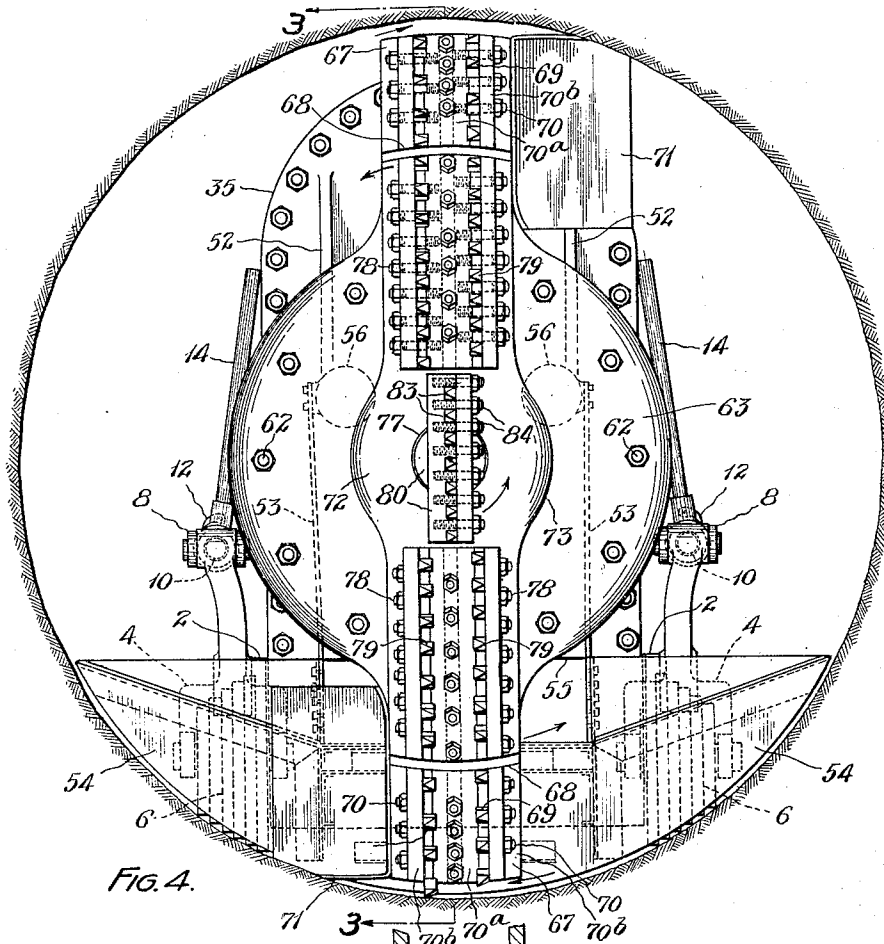


FIG. 4.

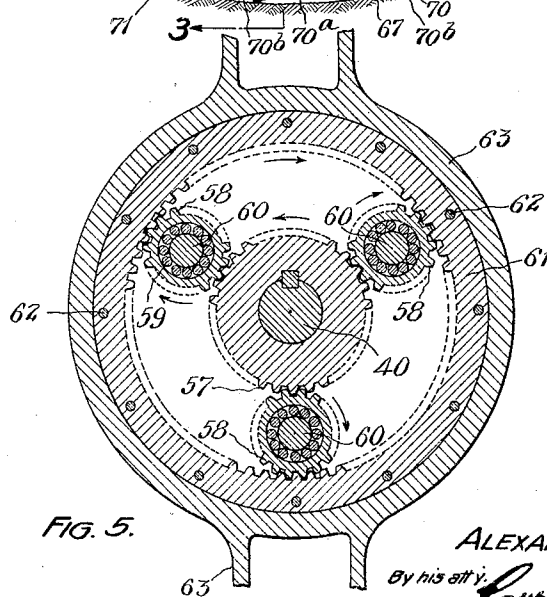


FIG. 5.

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MINING MACHINE

Application filed August 21, 1930. Serial No. 476,957.

My invention pertains to a mining machine and more particularly to a machine adapted by a mining or excavating operation to cut an entry of sufficient size to provide standing room for miners.

I am well acquainted with the prior art both practical and patented, the state of the latter being partially evidenced by the following patents:

10	Jones	No. 172,028	of January 11, 1876
	Cargill	No. 197,456	of November 27, 1877
	Sherman	No. 490,318	of January 24, 1893
	Fly	No. 540,306	of June 4, 1895
	Conlin	No. 719,567	of February 3, 1903
	Wittich	No. 1,191,864	of July 18, 1916
	Hughes	No. 1,333,491	of March 9, 1920
	Hebsacker	No. 1,460,671	of July 3, 1923
15	Freda	No. 1,511,957	of October 14, 1924
	Hebsacker	No. 1,532,243	of April 7, 1925
	Hamilton	No. 1,554,723	of September 22, 1925
	McKinlay	No. 1,603,621	of October 19, 1926

A machine of this character is necessarily large, ruggedly constructed and desirably should be successful in strata of varying hardness. As disclosed by the above listed group of patents, it has heretofore been proposed to bore tunnels by means of a traveling machine which collects the dislodged material and continuously conveys it rearwardly preparatory to removal from the tunnel. The object of my invention has been to produce a somewhat different type of machine adapted for difficult mining service and that object has been realized by manufacture and successful use. Novel features of my invention are:

A turnable head having a conical nose with individual removable cutter bits, so arranged that they will in operation, comprehend the entire cross sectional area of the earth being mined.

The provision of two turnable cutter heads rotating in opposite directions, one within the confines of the other, and rotated about the same axis, whereby to achieve a balanced operating stability of the machine.

Rotation of the inner head at approximately double the speed of the outer head to achieve a nearly equal cutting speed of the

tools and therefore about the same period of effective use.

A sturdy, compact and completely enclosed driving mechanism.

Manner of mounting the composite or duplex cutter head.

An arrangement including a scoop or shovel carried by the outer cutter head for collecting and delivering loosened material directly behind the duplex boring head.

Advantageous details of construction later herein specified and explained.

It is to be realized that the scope of my invention comprehends many equivalent constructions. The showing of the drawings and the particular description are merely a specified exemplification of a plurality of mechanical embodiments and arrangements,

Adverting to the drawings:

Figure 1 is a side elevation of a mining machine embodying the principles of my invention.

Figure 2 is a plan view of Figure 1.

Figure 3 is an enlarged vertically longitudinal section through the center of the forward part of the machine on line 3—3 of Figure 2, with certain parts appearing in elevation.

Figure 4 is an enlarged front view of the machine.

Figure 5 is a vertical cross-section on line 5—5 of Figure 3.

Figure 6 is a vertical longitudinal section of a thrust bearing at the end of the main shaft.

Figure 7 is a section on line 7—7 of Figure 3.

In mining machines purposed to operate continuously in hard natural strata, it is necessary not only to dislodge but also to convey the material elsewhere and preferably that is to be accomplished by a continuous operation past or through the machine, involving the use of a conveyor and a cart or car for delivery to the shaft entry. Since

it is often necessary to follow the run of an existing strata or vein, it is preferable to provide means for accomplishing the bodily adjustment of the machine so as to present its working nose in the direction desired. It is furthermore necessary slowly, yet steadily, to advance the machine and also when employing a rotatable cutter head to provide means for resisting the torque tending to turn and hence to frustrate its cutting operation. My machine incorporates mechanism for fulfilling the stated requirements, some of which are illustrated, though known to involve old principles. I make no claim herein to the conveyor, except as the latter cooperates with my receiving hopper.

A composite frame 1 carries on its lower side a pair of forward bearing brackets 2 and a pair of similar brackets 3 rearwardly thereof. Pivottally mounted in each of the front brackets 2 is a sturdy bellcrank lever 4 and similarly on each of the rear brackets a bellcrank lever 5. The lower arms of the levers 4 and 5 each has operatively mounted thereon forward wheels 6 and rear wheels 7 respectively. The wheels are fashioned with stepped and studded peripheries approximately to conform to the arcuate tunnel bottom. The upper arms of the levers 4 and 5 articulate with yoke links 8 and 9 respectively which extend toward each other on each side of the frame and are pivottally connected with screws 10 and 11 respectively, operated by a connection therewith of pawl and ratchet 12 and 13 respectively which are in turn subject to individual control of hand levers 14 and 15 respectively. By swinging any one of the levers downwardly from the position in which they appear in Figures 1 and 4, the bellcrank lever with which it is connected and hence some particular wheel may be raised or lowered, as will be readily understood, and thereby permit of adjusting the longitudinal axis of the machine with reference to a horizontal plane.

Conveyor mechanism

Appropriately carried in a depending position lengthwise of the frame, is a flanged conveyor housing 16 which extends diagonally upward at 17 beyond the rear end of the frame and then continues substantially horizontal at 18. Operatively mounted in the housing 16, from front to rear, are sprockets 19, 20, 21, 22 and 23, the latter being adapted to be adjusted along a slot 24, as for instance, by the illustrated take-up adjusting screw. An endless flexible conveyor 25 is adapted to travel around the sprockets and carries cross-bars 26 for the well known purpose of insuring the advance of any material deposited in the conveyor trough, especially up the incline at 17. Carried upon the rear end of the frame is a motor 27, driving a worm-gear-reducer 28, which is flexibly connected

by a sprocket chain 29 with the sprocket 20 over which and also over a pair of guiding idler sprockets 30, the chain passes. By this means the conveyor 25 is caused continuously to travel around the series of sprockets with its upper run moving in a direction from front to rear.

Advancing appliance

A motor 32 drives a hydraulic pump 32a which in turn is adapted to apply adequate pressure through a hydraulic cylinder to two extensible members 33, one located on each side of the machine and serving as struts or hydraulic jacks to cause the machine to advance; the rate of advance being effected by valves controlled by the operator and dependent on the nature of the material mined. The details of the interconnecting mechanism between the jacks and pump, being old, need not be described in detail.

Cutter shaft driving mechanism

Directing attention to Figure 3, a main driving shaft 34 extends rearwardly to be driven by the motor 31. The other end of the shaft 34 enters a composite gear-reduction housing 35 through a suitable packing box. The forward end of the shaft 34 is supported in a duplex roller bearing 36 and carries between spaced circumferentially arranged entities thereof a pinion 37, which drives a gear 38, provided with a bushing 39, enveloping and rotatably mounted on a cutter operating shaft 40, which continues out through the front of the housing 35, which is observable to be slightly rearward of the front end of the conveyor 25. The rearward thrust on the main shaft 40 is taken by a thrust bearing assembly, shown in Figure 6, consisting of a bearing bracket mounted on the frame 1 and a fiber thrust washer 40a, the bearing being protected by a suitable stuffing box to keep out dirt. Fashioned on a forwardly projecting hub of the gear 38 is a pinion 41 meshing with a gear 42, which is fixed on the hub of a pinion 44 provided with a bushing and rotatably mounted on an auxiliary shaft 43. Thence, the driving progression is through a train including the pinion 44, a gear 45, a pinion 46, a gear 47, a pinion 48 and finally a gear 49, which is keyed to the shaft 40 thereby furnishing a powerful drive of the latter in a counter clockwise direction, indicated by the arrow on its front end as shown in Figure 4.

Cutter heads and cooperating relationship

Just forward of the housing 35 the shaft 40 passes through two packing boxes 50, the forward one of which is rigidly secured to a sturdy disk 51 reinforced by a series of webs 52 which are supported on the housing 35. Extending downwardly and rearwardly from the disk 51 commencing below the shaft 40

is a chute 53, which extends across the top of a pusher plate 54, which is located in front of the conveyor 25. The design and arrangement of the parts just described serve to provide a hopper intersected by the shaft 40 and provided below with an opening 55.

Three bosses 56 extend between the disk 51 and front of the housing 35 and are equispaced circumferentially. Forwardly of the disk 51 the shaft 40 has keyed to it a gear 57, (see Figure 5), which meshes with each of three pinions 58 having an anti-friction bearing 59 on the projecting portions of shafts 60, which are mounted in the bosses 56. The three pinions 58 are adapted to drive an internal gear 61, necessarily in a relatively reversed direction with respect to the rotation imparted to the shaft 40. The gear 61 is secured by means of bolts 62 to a revoluble cutter head 63 having a roller bearing mounted at 64 on a collar 65 which is integral with the pinion 57. The gear 61 and cutter head 63 together revolve against an anti-friction thrust bearing 66 seated in the front face of the disk 51. Projecting forwardly from diametrically opposite sides of the cutter head 63 are arms 67, the opposed surfaces 68 of which are arcuately concave, as shown in Figure 4. Cutter bits 69 are detachably secured in two parallelly extending rows against center blocks 70a by means of clamping bars 70b and ports 70. The cutter bits 69 project in a generally forward direction and so located that the tips of each row thereof are diagonally aligned, as may be seen in Figure 3, in order that substantially the entire surface in the path of the face of the cutter head may be contacted by the cutter bits. As illustrated, the cutter bits 69 form diametrically spaced parts of a conical cutting nose, but it should be understood that their presentation may follow the contour of a different generated surface.

The forward faces of the arms 67, with reference to the direction of rotation, indicated by the arrow in Figure 4, each carry a scoop 71 adapted during their orbital movement successively to collect loosened material, swing it upwardly and spill it between the rear of the disk 51 and the front of the housing 35 for discharge through the hopper opening 55 onto the conveyor 25, which latter will, at the rear end of its course of travel, drop it into a cart or car for removal from the mine.

Keyed to the shaft 40 in front of the head 63 is another cutter head 72, which, as illustrated, is designed with a rearwardly projecting collar 73 embracing the forwardly projecting collar of the head 63. The head 72 is of peculiar shape to comprise diametrically separated forward faces 74, which converge in a forward direction and are adapted to come into oblique alignment with the front faces of the arms 67 thereby being adapted

to be partially complementary in generating a conical surface. The two outer ends of the cutter head 72 extend slightly rearwardly at 75 and their end surfaces 76 conform to an arcuately convex contour juxtaposed and symmetrical with reference to the concave arcuate surfaces 68, as shown in Figures 3 and 4. The front central portion of the head 72 is recessed at 77 sufficiently to permit the extremity of the shaft 40 to protrude and to provide space for a nut. A series of bolts 78 serve to secure two rows of cutter bits 79 similarly to those on the outer cutter head so that the cutter bits of one row are staggered with reference to those of the other row and so that the two rows of cutter bits 79 are adapted to lie parallel with the two rows of cutter bits 69 respectively. As may be observed in Figure 3, the direction of projection of the cutter bits 69 and 79 is not uniform thereby realizing the advantage of more effectively breaking up the loosened rock.

A nut 80 has a screw-threaded connection at 81 with the extremity of the shaft 40 and serves to hold the cutter head 72 in place. The front face 82 of the nut 80 also has a contour conforming to the two converging lines so as, together with the front cutting faces of the heads 63 and 72, to complete a generated cutting surface with a conical nose, of which the nut will act as a steadying pilot. The nut 80 is itself provided with detachable cutter bits 83 securely clamped by bolts 84 and, as clearly shown in Figure 4, the cutter bits 83 constitute 2 converging rows parallel respectively with the spaced rows of cutter bits 69 and 79, but located midway therebetween. It will be understood that the nut 80 and cutter head 72 being fixed to the shaft 40 will rotate at the same speed and in the same direction, whereas the outer enveloping head 63 will, by reason of the gear train, illustrated in Figure 5, rotate in the reverse direction and at a comparatively slower speed. It is manifestly preferable to have the head 63 rotate less often so as to approximate substantially equal wear as between the cutter bits 69 and 79.

By having a plurality of cutter heads rotating in reverse directions (as exemplified, an outer head rotating clockwise and an inner head counter-clockwise) the advantage is had of a balanced operation. The inner head is preferably rotated at about double the speed of the outer head or so as to produce the same cutting speed of the tools carried thereby. The action of the cutting operation as a whole is also stronger and steadier for this heavy duty type of machine in consequence of their being mounted about a common axis.

While the opposed rotation of the heads results in a stable operation of this mining machine, an emergency torque resistance device is provided and is indicated at 85. This de-

vice consists of three screw actuated anchor points 86, one being adapted to be imbedded in the top and the other two in the upper side walls of the excavation, and the whole is slidably mounted on the upper members of the frame 1, so as to permit the machine to advance while the anchor points are fixedly imbedded in the walls of the excavation. The construction constitutes a torque resistance appliance to be used only when starting the mining operation and only one of the cutters may be dislodging material. It also involves a safety factor in case the strata of material to be mined is so situated that one cutter head may be working in soft material while the other cutter head may be engaging material which is hard, tenacious, and dislodged only with difficulty, resulting in a condition of unbalanced torque.

I claim:

1. In a mining machine, the combination of a frame, a shaft mounted thereon, an outer cutter head rotatably mounted thereon near the forward end of said shaft and provided only at opposite sides with forward projections, opposed sides of said projections being defined by concave arcuate surfaces, an inner head mounted on the end of said shaft and having convex edges adapted to conform to and describe a path within the path of said concave surfaces of the outer head and means for rotating said heads at different speeds.

2. In a mining machine, the combination of a frame, a shaft operatively mounted thereon, a cutter head carried by said shaft, a fixed disk mounted on said shaft behind said head, a housing mounted on said shaft and spacedly connected with said disk and forming in conjunction with the latter a hopper, and a scoop carried by said head and adapted periodically to discharge into said hopper.

3. In a mining machine, the combination of a frame, a shaft operatively mounted thereon, a cutter head carried by said shaft, said frame including a disk and housing in spaced relation to each other to form a hopper directly behind said head, an anti-friction bearing between said head and disk, said head having a radially projecting arm and a scoop carried by the leading edge of said arm with reference to the direction of rotation and adapted periodically to discharge into said hopper and conveying mechanism cooperating with the bottom of said hopper.

4. In a mining machine, the combination of a frame, a head rotatably mounted on said frame and including parts forming in conjunction with the front of said frame a hopper, said head having diametrically projecting arms, a scoop carried by each of said arms and adapted periodically to discharge into said hopper, cutter bits secured on said arms, another head rotatably mounted on said frame and adapted diametrically to align with said arms, cutter bits on said last mentioned

head adapted to form with those on said arms a uniformly spaced row and mechanism for rotating said heads.

5. In a mining machine, the combination of a frame, a shaft mounted thereon so as to project forwardly thereof, a cutter head mounted on said shaft and having divided angularly presented sets of bits, a nut for securing the head on said shaft and a set of cutter bits carried by said nut, said bits on the nut being complementarily arranged with respect to the sets of bits on said head.

6. In a mining machine, the combination of a frame, a shaft mounted thereon so as to project forwardly thereof, a head including forwardly converging diametrical halves and mounted on said shaft, cutting bits detachably carried by said head, a nut for securing the head on said shaft and cutter bits detachably carried in angular arrangement by said nut, the bits on said head and nut being designed to form complementary sections of a portion of a generated surface.

7. The combination for use in a mining machine, of a head, and rows of cutting elements detachably carried by said head, the elements of one row being staggered with reference to those of an adjacent row and one entire row being staggered with reference to another pair of rows.

8. In a mining machine, the combination of a frame, a shaft rotatably mounted thereon, a pair of heads mounted on said shaft and one adapted to turn within the other, angularly related rows of cutting elements detachably carried by each of said heads, pairs of the rows of said heads respectively being adapted simultaneously to come into alinement and the elements of one pair of alineable rows being adapted to form an equispaced series completing the sectional contour of a generated surface together with the other pair of alineable rows.

9. In combination, a frame, a shaft mounted thereon, a cutting head mounted to turn with said shaft and provided with interrupted rows of cutters and a nut for securing said head to the shaft and provided with a row of cutters intermediately of the rows of cutters on said head.

10. In a mining machine, the combination of a frame, a shaft mounted thereon, an inner cutter head rotatably mounted on said shaft, an outer cutter head revolvably mounted for movement concentrically with respect to the axis of said shaft and adapted in conjunction with the inner head to cut a generated surface, mechanism including an internal gear fixed to said outer head, a gear on said shaft and intermediate gearing for connecting said outer cutter head to said shaft and means for driving the latter.

11. In a mining machine, the combination of a frame, a shaft mounted thereon, a central cutter head on the forward end of said

shaft, a complementary cutter head revolubly mounted on said shaft behind said central cutter head, said heads having telescopically fitted collars, and means including an internal gear secured to said revoluble head for actuating it counter to the rotation of said shaft.

12. In a mining machine, the combination of a frame, a shaft mounted thereon, a central cutter head on the forward end of said shaft and having arcuate margins, a complementary cutter head revolubly mounted on said shaft behind said central cutter head and having opposed arcuate faces adapted to be closely appositioned to said margins, cutter bits on said heads adapted to come into alignment and means for actuating said revoluble head counter to the rotation of said shaft.

13. In a mining machine, a frame, a shaft thereon, means for rotating said shaft, and a torque resistance device slidably connected with said frame, including a plurality of anchor rods adapted to engage the top and lateral walls of a tunnel together with means for adjusting said rods.

Signed by me, this 30th day of July, 1930.

ALEXANDER HUMBEL.

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