E. O'TOOLE.

EXCAVATING MACHINE.

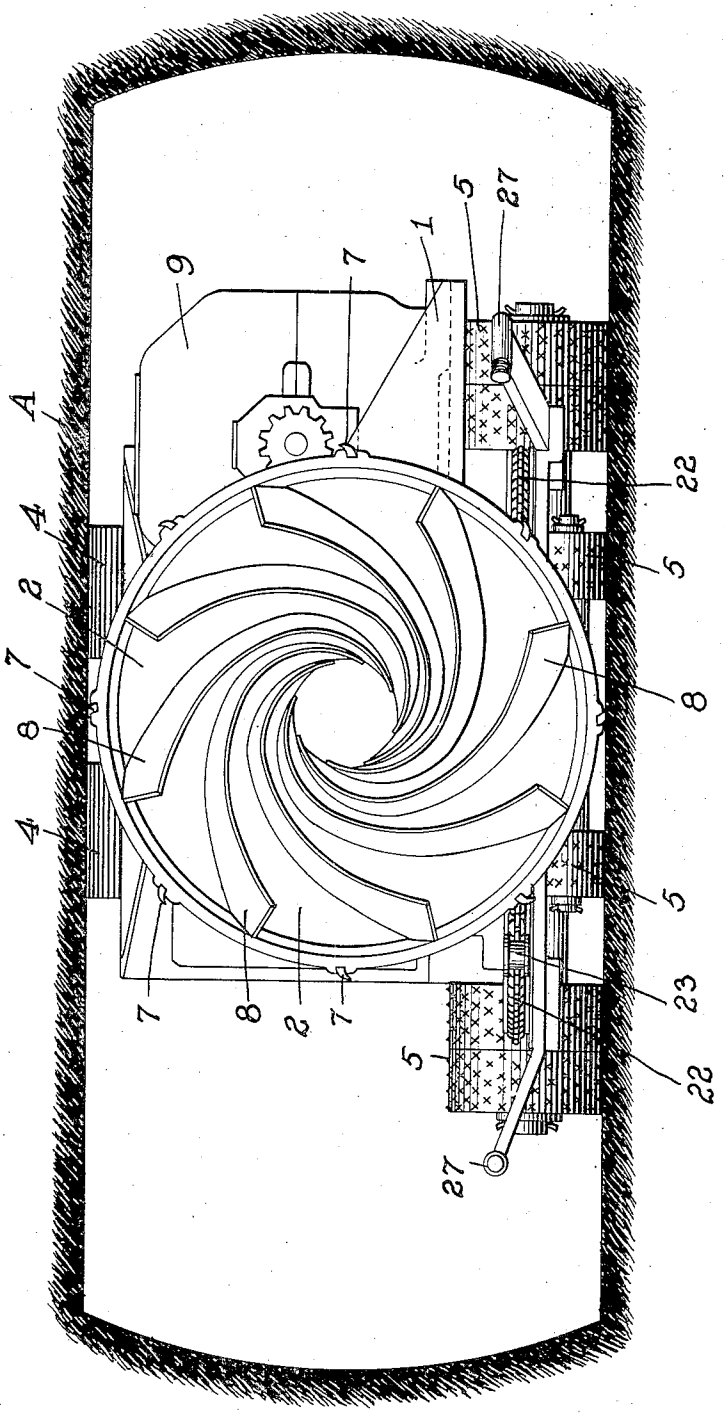
APPLICATION FILED JUNE 28, 1910.

1,011,994.

Patented Dec. 19, 1911.

6 SHEETS—SHEET 1.

FIG. 1.



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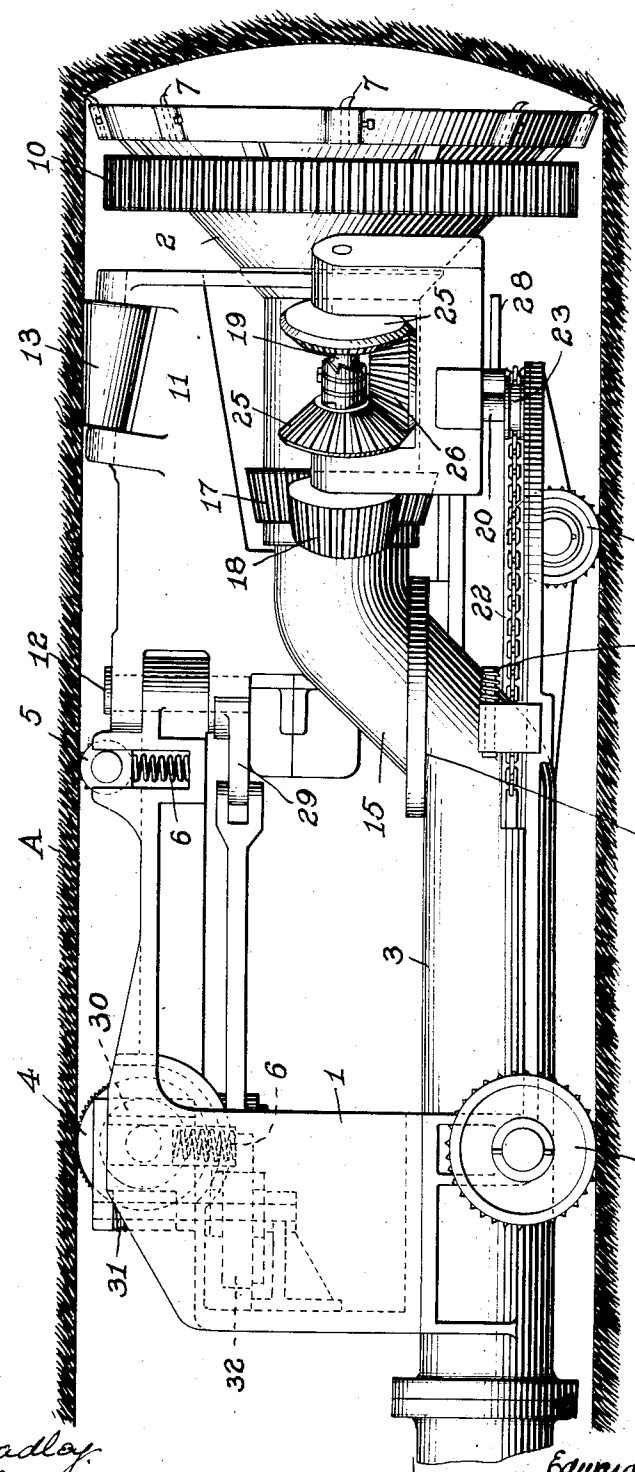
6 SHEETS—SHEET 2.

FIG. 2.



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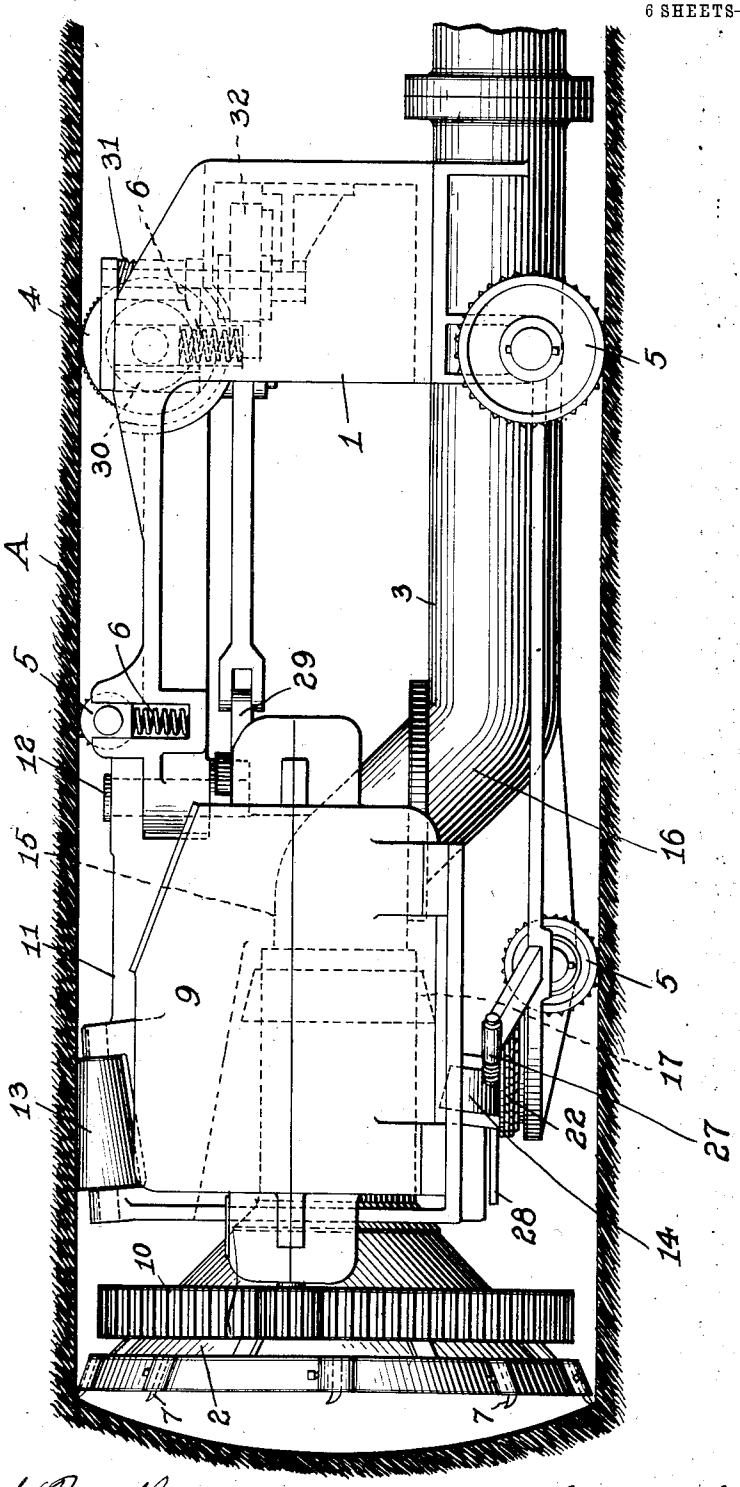
6 SHEETS—SHEET 3.

FIG. 3.



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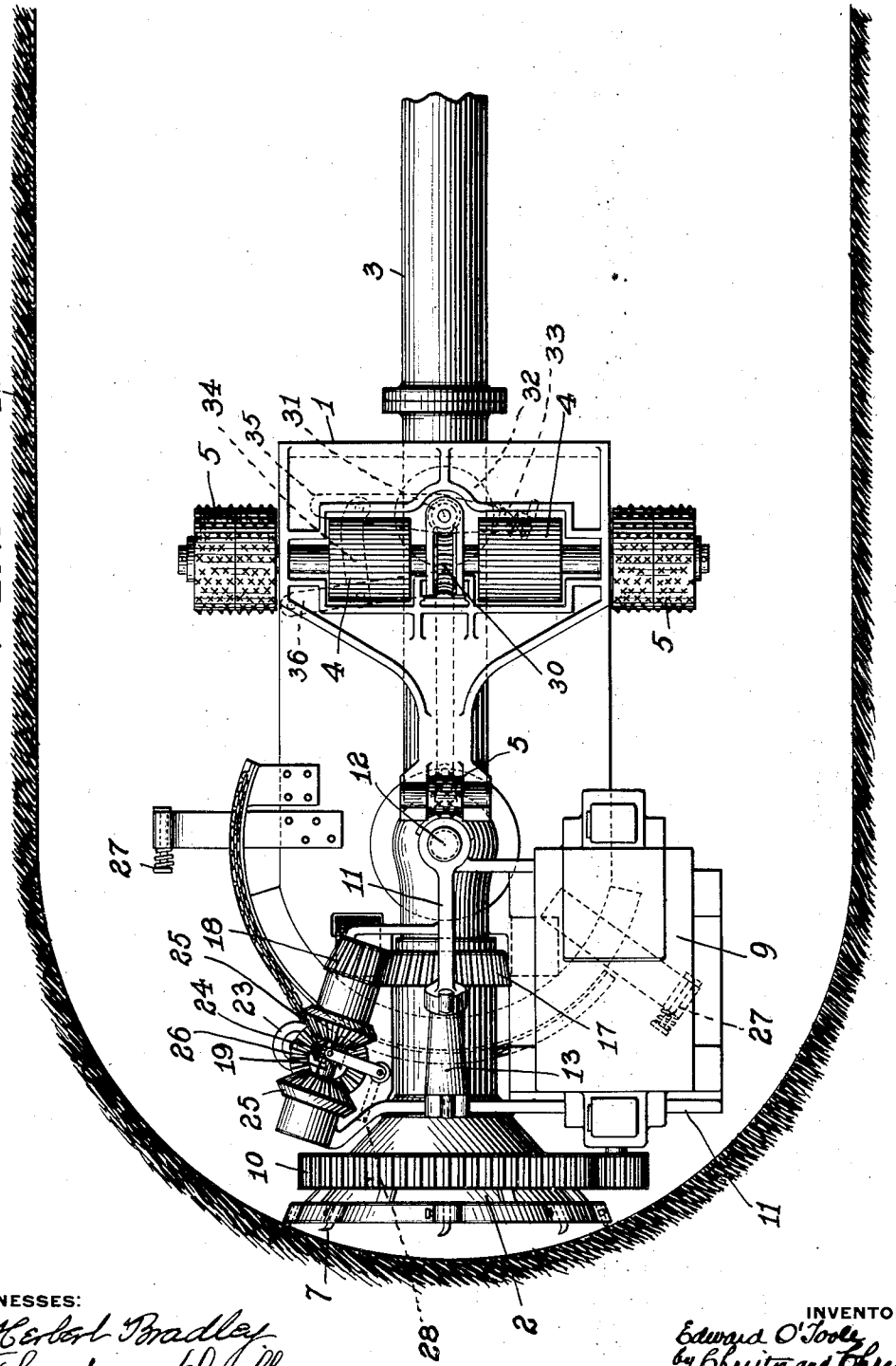
6 SHEETS—SHEET 4.

FIG. 4.



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6 SHEETS—SHEET 5.

FIG. 5.

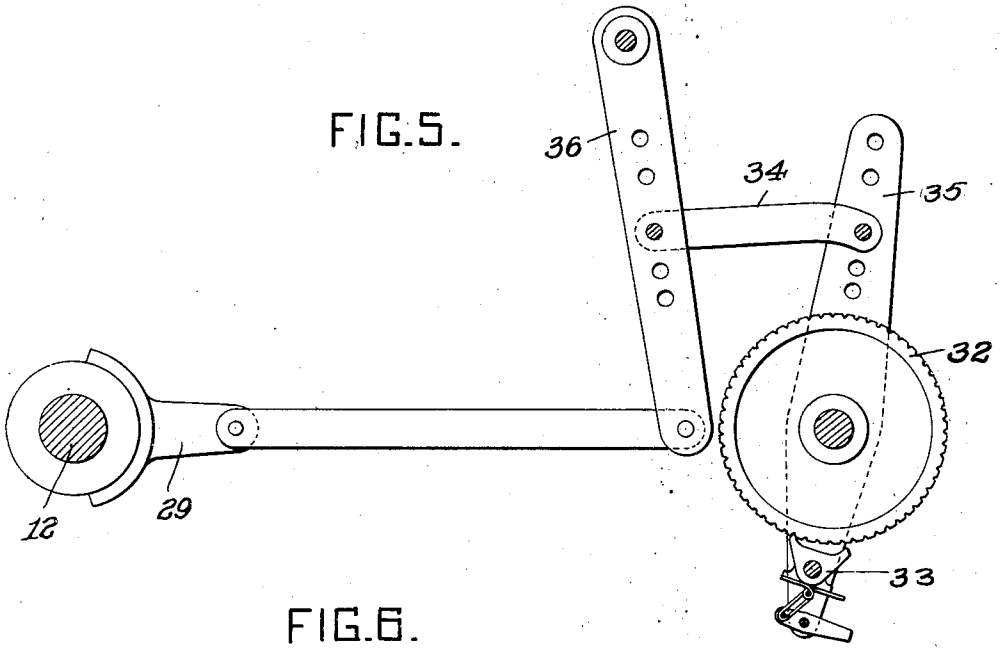


FIG. 6.

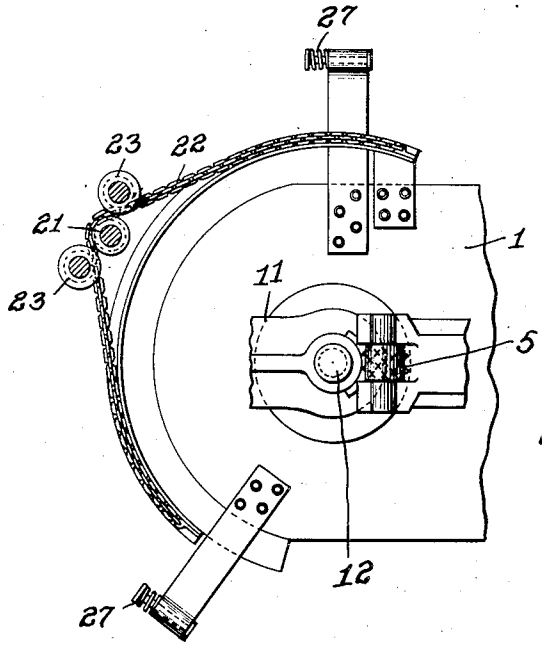
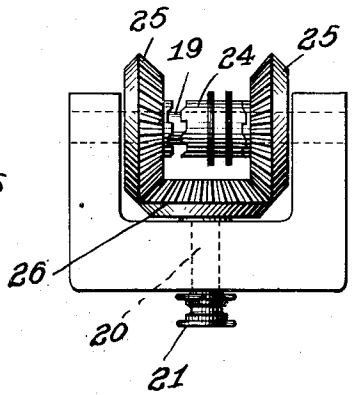


FIG. 7.



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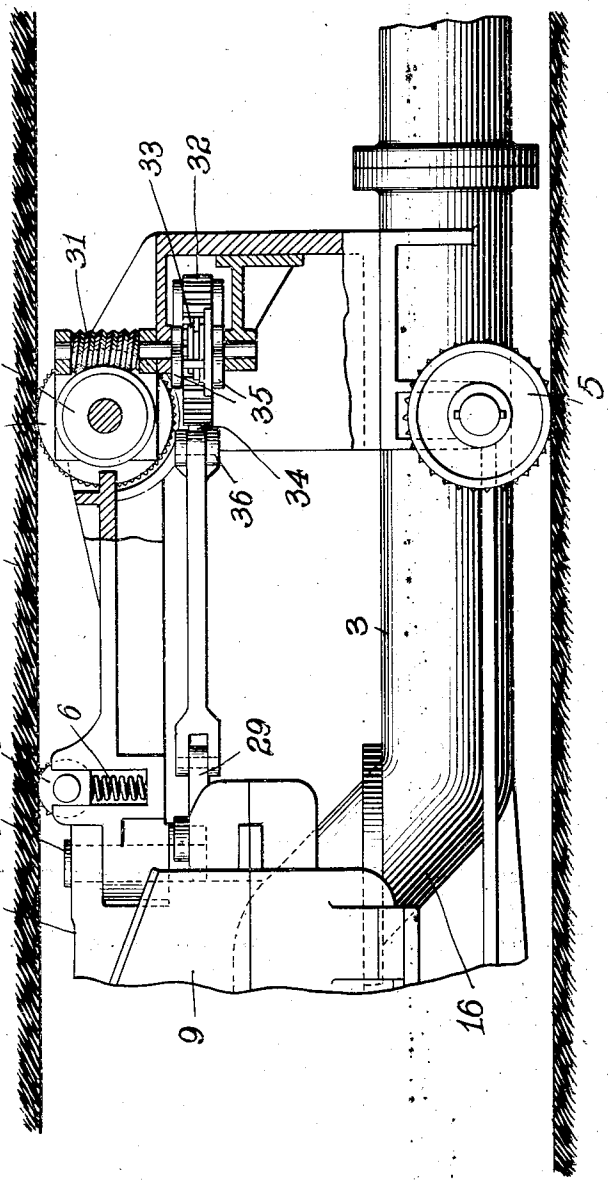
6 SHEETS—SHEET 6

FIG.8.



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UNITED STATES PATENT OFFICE.

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EXCAVATING-MACHINE.

1,011,994. Specification of Letters Patent. Patented Dec. 19, 1911.

Application filed June 28, 1910. Serial No. 569,360.

To all whom it may concern:

Be it known that I, EDWARD O'TOOLE, residing at Gary, in the county of McDowell and State of West Virginia, a citizen of the United States, have invented or discovered certain new and useful Improvements in Excavating-Machines, of which improvements the following is a specification.

My invention relates to improvements in excavating machines, and while, in the specific form which is shown in the drawings, the machine is a coal-mining machine, it will be understood that my invention is not, in its broader aspect, limited to such a specific application.

In the accompanying drawings which form part of this specification, Figure 1, shows the machine in front elevation, Fig. 2 is an elevation taken on the side on which the motor is mounted; Fig. 3 is an elevation on the side opposite the motor; Fig. 4 is a plan view of the machine. Fig. 5 shows the operative connection between the head and the traction elements of the carriage, whereby the swinging of the head imparts a forward movement to the carriage. In this figure, this interposed mechanism is for the sake of clearness dissected out from the rest of the machine. Fig. 6 illustrates the mechanism for causing the cutter-head to swing upon its pivot as it rotates, and here again parts of the machine are cut away for the sake of clearness of illustration of the remaining parts. Fig. 7 is a detail view, illustrating the movable clutch, through which the rotation of the head and the swinging of the head upon its pivot are interdependent, one upon another. Fig. 8 is an elevation partly in section showing the complete mechanism for advancing the machine.

Parts which are repeated in the several figures bear the same reference numerals in each case.

Referring particularly to Figs. 1 and 2, the machine which is shown therein will be seen to consist essentially of a carriage 1, a cutter-head 2, and a conveyer-pipe 3. The cutter-head and conveyer-pipe are carried in the frame of the carriage, and the carriage is provided with traction-wheels 4 and with supporting-wheels 5 by which it is driven, supported, and held in position to the work. It will be observed that these traction and supporting wheels, whose peripheries are properly formed with serrations, are arranged upon both the upper and the lower side of the carriage body or frame, and have purchase both on the floor of the mine below and on the roof of the mine above, to the end that the machine may be properly held in position. It will further be observed that the journals of the traction and supporting wheels on one side (and in this case on the upper side) of the carriage-frame are backed by heavy springs, 6, whose purpose is to rigidly hold the carriage in the position to which it is brought.

The cutter-head 2 is preferably funnel-shaped, and is mounted to rotate upon its axis. The rim of the funnel, or the periphery of the head, is armed with cutter-teeth 7 which, as the cutter-head rotates, engage the breast of coal, and bite or cut fragments therefrom. The central opening of the cutter-head forms a discharge orifice, through which the fragments of coal are carried to the conveyer-pipe 3.

The inner face of the funnel-shaped cutter-head is provided with conveyer-blades 8, which extend inwardly from the periphery toward the discharge orifice and, as is particularly shown in Fig. 1 of the drawings, are preferably arranged spirally with respect to said discharge orifice. The spiral blades are so arranged that, as the head rotates to cut the coal, the concave side of the spiral blades is forward. It will be understood that the rotation of this head against the breast of coal will effect the tearing away of the fragments of the coal, and it will be understood that a suction exerted through the conveyer-pipe 3 will produce a draft to take the coal away from the machine through the conveyer-pipe, and it will be further understood that the shape of the conveyer-blades themselves will assist in this progress of the coal as it is cut rearward through the cutting-head and into the conveyer-pipe.

The rotation of the cutter-head may be effected in any desired manner, as by the motor 9, whose power shaft is geared to a gear-wheel 10 formed upon the outer side of the funnel-shaped cutter-head.

Not only does the cutter-head have a motion of revolution, as above described, but it has also a pivotal motion in the carriage which sustains it; and, for the purposes of coal-mining, this pivotal motion of the cutter-head will be in a horizontal plane, since the coal lies in substantially horizontal strata and the purpose of the machine is to work

out the coal as efficiently as possible. To this end, the cutter-head 2 is sustained and carried in the frame 11, which frame 11 is pivoted in the carriage as by a pivot-pin 12, and this frame so pivoted is provided with a thrust-roller 13 to bear upon the roof of the cutting above, and a second thrust-roller 14 to bear upon the underlying portion of the carriage-frame below. The head and its sustaining frame thus constitute together a cutting mechanism pivotally borne in the carriage. Further, to the end that the cutter-head may swing on its pivot 12, and that at the same time substantially tight communication may be maintained, from the discharge orifice of the cutter-head to the conveyer-pipe 3, the discharge orifice of the cutter-head is prolonged in a pipe-member 15 which engages the conveyer-pipe 3 in a joint 16, the plane of this joint lies parallel with the plane in which the cutter-head swings and at right angles to the axis of pivotal motion of the said head, and the opening from pipe member 15 into conveyer-pipe 3, is substantially concentric with the center of pivotal motion. The motor 9 may conveniently be mounted in the same swinging frame which carries the cutter-head, as is illustrated in the drawings. Mechanism is preferably provided for coördinating these two movements of the cutter-head, namely, the motion of rotation upon its axis and the motion of revolution or oscillation upon its pivot-point, to the end that the same power which causes the head to rotate to cut the coal may also cause it to swing laterally, so that the second motion shall be automatically effected as the cutting progresses. To this end, the rotating cutter-head 2 is provided with a second gear-wheel 17, which meshes with a gear-wheel 18 carried on a shaft 19, which in turn is geared to a shaft 20 (see Fig. 7), which carries a sheave 21, and this sheave 21 engages a chain 22, the opposite ends of which are secured to the frame of the carriage beyond the limits of oscillation of the head (see Fig. 6). Thus, a chain traction mechanism is formed, and by the rotation of the sheave 21, in response to the rotation of the cutter-head, a pull will be exerted upon the chain 22, and that pull will be effected to draw the head to one side or the other, causing it to swing upon its pivot-pin.

23, 23 (Fig. 6) are idler rollers coöperating with sheave 21 to engage the chain 22 to effect the shifting above described. To the end that this oscillation of the cutter-head upon its pivot shall be properly limited, and shall automatically reverse itself—that is, to the end that in the operation of the machine the head shall automatically swing to and fro through a predetermined arc—a clutch 24 (see Fig. 7) is interposed between shaft 19 and shaft 20, and this clutch moves to and fro to engage one or the other of two oppositely placed bevel gears 25, both of which engage a corresponding beveled gear wheel 26, which is carried by the shaft 20. By this arrangement the sheave 21 will be turned in one direction or the other, depending upon whether clutch 24 engages one or the other of the beveled gear wheels 25. Stops 27, carried by the frame of the carriage 1, are arranged in such position that, as the swinging rotating head approaches the limit of its lateral traverse, one stop or the other will engage a lever device 28 (see Fig. 4), and by such engagement effect a shifting of the clutch 24, freeing it from engagement with one of the beveled gear wheels 25, and bringing it into engagement with the other. It will be understood that the lever 28 is a bell crank lever and is mounted on the framework that carries the wheels 25 and 26 in such a manner that its vertical portion will have only a motion of rotation. In this manner, the direction of rotation of the sheave 21, which has brought the swinging head to one limit of its traverse, is reversed, and the head is caused to swing in opposite direction, and that reversed motion will continue until the other stop 27, arranged at the opposite end of its path of traverse, engages the lever mechanism 28 again, and again shifts the clutch and reverses the direction of movement. It will be observed that, in consequence of the swinging of the head, each individual cutting tooth or pick describes a path upon the breast of coal which is not circular, but is cycloidal.

Mechanism is provided for causing the carriage itself to advance as a whole toward the breast of coal upon which the machine is working as the operation progresses, to the end that the machine may automatically cut its way into the breast of the coal, discharging the fragments of coal as it advances. A convenient mechanism to this end is particularly illustrated in Figs. 5 and 6 of the drawings, which figures, taken in connection with Fig. 4, will make the operation plain. A lever mechanism, interposed between the oscillating cutter-head 2 and the traction wheels 4 of the carriage, will effect the turning of the traction wheels, and a corresponding advance of the carriage, as the cutter-head swings on its pivot, and this interposed lever mechanism may contain an adjustable element, to the end that the speed of advance of the carriage as a whole may be properly correlated to the reciprocation of the cutter-head, and the operator may thus have it in his power to control the amount of bite which the machine will have upon the coal, as it progresses. It is further desirable in this regard, and the mechanism which I have shown and described so provides, that the carriage shall advance during

the first half of each side stroke and remain stationary, as to forward motion, during the last half of each side stroke. As shown in Fig. 5, the crank-arm 29 turns on the pivot-pin 12, and this crank-arm 29 may be rigidly carried by the head itself, or by the frame which sustains it as it swings. The axle of the traction wheel 4 is provided with a gear wheel 30 (see Figs. 4 and 8), and meshing, with this gear wheel 30, is a worm 31, and upon the shaft of this worm 31 is a ratchet wheel 32 (see Figs. 5 and 8). Coöperating with this ratchet wheel 32 is a pawl 33, carried in the frame of the machine, and this pawl 33 is shifted by the crank-arm 29, through the interposed lever mechanism which is shown in detail in Fig. 5. It will be observed that a link 34 in this lever mechanism is adjustable in its engagement with the lever arm 35 on the one hand which carries the pawl 33, and with the lever arm 36 on the other hand, which is indirectly connected with the crank-arm 29, to the end that the extent of the throw of the pawl as related to the swinging of the crank-arm 29 may be adjusted for the purpose above described. It will be apparent that by such mechanical arrangement, the carriage may be gradually advanced as the cutter head swings in one direction, and held stationary as the cutter head swings back in opposite direction, and that because of the gradual advance of the head on its forward swing, the head will continue to cut away more coal on its backward swing.

By such or equivalent means (and I do not limit myself to details of construction here described) the advance of the carriage may be correlated to the swinging of the head; and thus, from a single motor, the cutter-head may be rotated, reciprocated, and advanced, automatically—the cutter-head, which is the effective tool, performing all three of these motions without intervention of the operator, after the machine has once been set to its work.

The adaptability of the machine which I have now described to coal-mining is apparent to anyone who is familiar with that subject. The dimensions of the cutter-head may be such that it may eat into the breast of coal throughout the full vertical extent of the latter; the lateral traverse or pivotal swing of the head will afford a cut of very substantial width; and the automatic progress of the machine forward will effect a cutting into the breast of coal as the operation of the machine continues. In the drawings I have indicated by A the uncut portion of the coal, and it will be understood that the space in which the machine is shown to be located is the space which the machine itself has in its normal operation cut.

It will be understood that my invention in its broader aspect is not limited to the details of construction described. These matters admit of variations which will suggest themselves to one familiar with the art.

I claim herein as my invention:

1. In an excavating machine, the combination of a carriage, a cutter head rotatably and pivotally mounted in said carriage, means for rotating said cutter head and means operative by the rotation of said cutter head to pivotally swing said head on said carriage, substantially as described.

2. In an excavating machine, the combination of a carriage, a cutter head pivotally and rotatably mounted in said carriage and provided with a discharge orifice, means for rotating said cutter head, a suction pipe mounted in said carriage and making continuous connection with said head as the latter swings and rotates, substantially as described.

3. In an excavating machine, the combination of a carriage borne upon traction wheels, a cutter head rotatably and pivotally mounted in said carriage, means operative on the rotation of said cutter head for causing said cutter-head to swing pivotally in said carriage, and means operative on the rotation of said cutter-head for causing said carriage to advance upon its traction wheels, substantially as described.

4. In an excavating machine, the combination of a carriage, a cutter head rotatably and pivotally mounted in said carriage, and a motor, means for turning said cutter head upon its axis within the frame of said carriage, means for swinging said cutter head upon a pivot point within the frame of said carriage, and means for causing said carriage to advance in straight-line progression, substantially as described.

5. In an excavating machine the combination of a supporting carriage, a cutter-support pivoted in said carriage, a cutter-head on said support, means for causing said carriage to advance intermittently as said cutter-support swings to and fro on its pivot, substantially as described.

6. In an excavating machine, the combination of a cutter head rotatably and pivotally mounted in a carriage, means for rotating said cutter-head, a chain drive operative to cause said head to swing on its pivot, said chain drive being operated by the rotation of said head upon its axis, substantially as described.

7. In an excavating machine, the combination of a frame, a cutter head rotatably and pivotally carried in said frame, a chain secured at the opposite ends of said frame as related to the to and fro motion of said cutter head, a sheave carried pivotally in said cutter-head movable therewith and engaging said chain, said sheave being rotatable in opposite directions to advance upon said chain and cause said head to swing to and

fro on its pivot, a drive connection between said head and said sheave; said drive connection including a reversing clutch member, a stop carried by said frame and arranged to engage and shift said reversing clutch member as said head in swinging on its pivot approaches the limit of its traverse, substantially as described.

8. In an excavating machine, a carriage, an axle mounted for turning in said carriage, a traction wheel mounted on said axle, a cutter mechanism mounted for to and fro motion supported in said carriage, operating mechanism, including a pawl and ratchet, interposed between said cutter mechanism and the axle of said traction wheel and causing said traction wheel to turn as the said cutter mechanism swings on its pivot, and means for effecting to and fro motion of said cutter mechanism in said carriage, substantially as described.

9. In an excavating machine, the combination of a carriage provided with a traction wheel with an axle therefor, a cutter mechanism pivoted in said carriage, operating mechanism including lever connections interposed between said cutter mechanism and the axle of said traction wheel, said lever mechanism being adjustable, whereby the speed of advance of the carriage may be varied in relation to frequency of oscillation of said cutter mechanism, and means for effecting pivotal movement of said cutter mechanism in said carriage, substantially as described.

10. In an excavating machine, the combination of a carriage, an axle mounted for turning in said carriage, a traction wheel mounted on said axle, a gear wheel carried on said axle, a worm carried in the frame of said carriage and engaging said gear wheel, a ratchet wheel carried on the shaft of said worm, a pawl carried in the frame of said carriage, a cutter mechanism having to and fro motion upon said carriage, means operative by said mechanism as it moves for driving said pawl, and means for effecting to and fro motion of said cutter mechanism upon said carriage, substantially as described.

11. In an excavating machine the combination of a carriage, a laterally moving cutter-head mounted upon said carriage, means operative upon the lateral movement of the said cutter-head for causing the intermittent advance of the said carriage, substantially as described.

In testimony whereof, I have hereunto set my hand.

EDWARD O'TOOLE.

Witnesses:
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J. E. FLEXNER.