No. 860,301. PATENTED JULY 16, 1907.

G. W. JACKSON.

MACHINE FOR EXCAVATING TUNNELS.

APPLICATION FILED JAN. 5, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

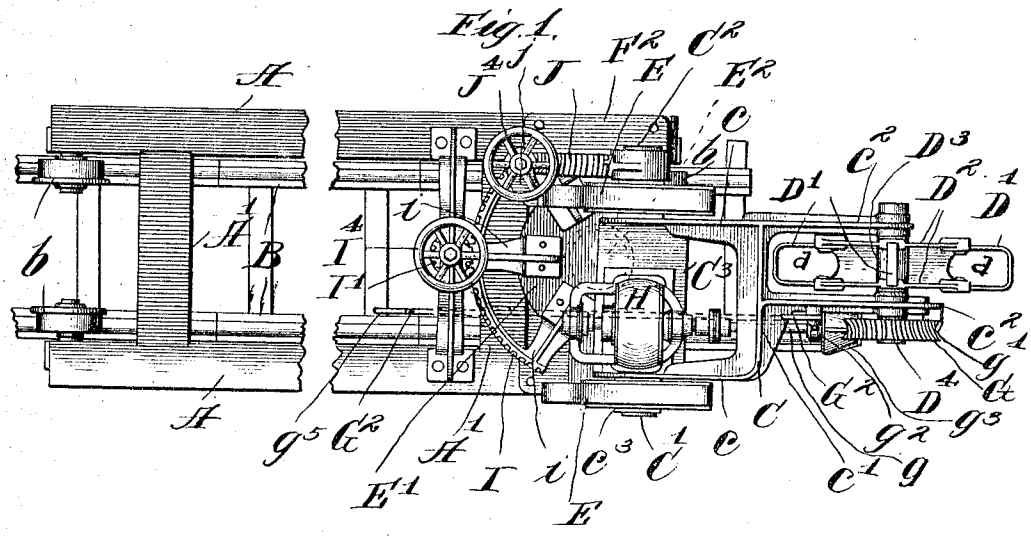
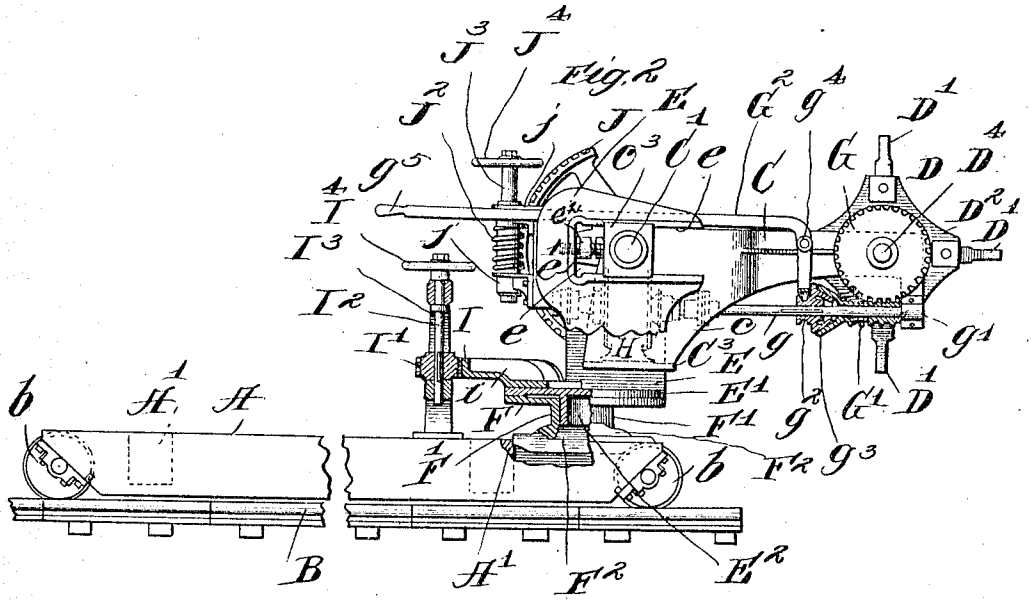


Fig. 2.



Witnesses:

G. A. Nauberschmidt

W. L. Hall

Inventor

George W. Jackson,

By Poole & Broun

Attys

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2 SHEETS—SHEET 2.

Fig. 3.

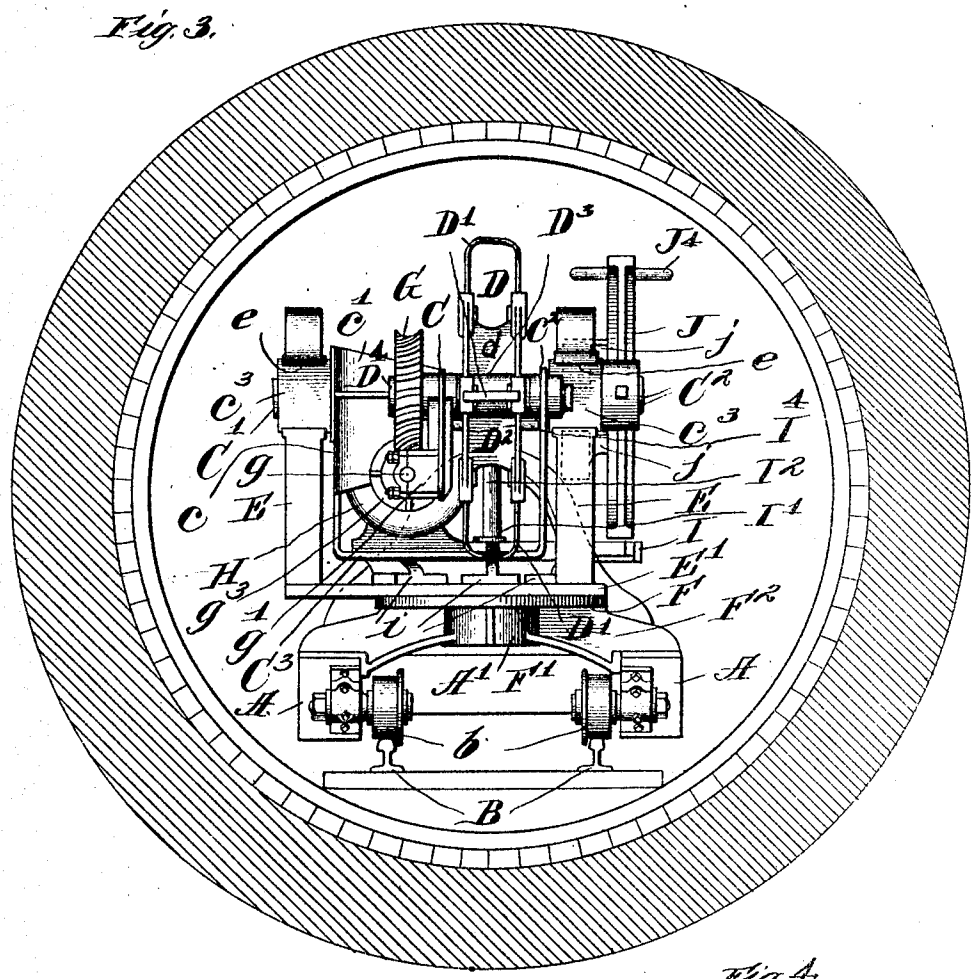
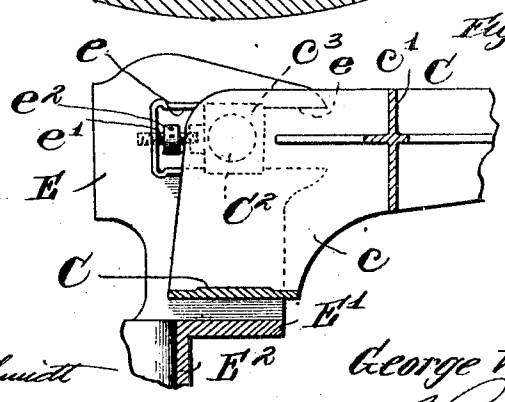


Fig. 4.



Witnesses:

G. A. Paubenschmidt

F. W. Hall

Inventor

George W. Jackson,

By Poole & Brown

Attys

UNITED STATES PATENT OFFICE.

GEORGE W. JACKSON, OF CHICAGO, ILLINOIS.

MACHINE FOR EXCAVATING TUNNELS.

No. 860,301. Specification of Letters Patent. Patented July 16, 1907.

Application filed January 5, 1906. Serial No. 294,758.

To all whom it may concern:

Be it known that I, GEORGE W. JACKSON, a citizen of the United States, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Excavating Tunnels; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in excavating machines for constructing tunnels, mining purposes and like uses and the invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims.

An excavating machine embodying my invention embraces, in general terms, a swinging arm carrying at its forward end a suitable cutter, a revolving cutter as herein shown, and a supporting frame upon which the arm is pivoted, said supporting frame embodying in its construction a pivot, the axis of which is disposed perpendicularly to the pivotal axis of the swinging arm, whereby both the vertical and horizontal angles of presentation of the cutter to the tunnel breast may be varied as is required to present the cutter to all parts of the breast of the tunnel from the central position of the supporting frame. The machine is mounted on a carriage by which it is advanced towards the tunnel breast as the work of excavation proceeds.

As shown in the drawings:—Figure 1 is a plan view, with parts broken away, of an excavating machine made in accordance with my invention. Fig. 2 is a view partially in side elevation and partially in section thereof. Fig. 3 is a front end view of the machine. Fig. 4 is a detail illustrating the rear end of the swinging cutter supporting arm, and one of the standards to which it is pivoted or hinged.

As shown in said drawings, A A designate the longitudinal members, and A^1 the transverse members of a horizontal carriage which supports the machine, and B B designate track-rails upon which the wheels *b* of the carriage rest and roll. C designates a swinging arm which is pivotally supported at its rear end upon a supporting frame and carries at its forward end a cutting device, indicated as a whole by D. The supporting frame for the swinging arm comprises upright standards E E, rising from a horizontal plate E^2, which latter plate is supported on a horizontal platform F formed on the upper end of a standard F^1 that constitutes part of a frame F^2 which spans the side members of the carriage and is supported thereon, as shown in Fig. 3. The said horizontal plate E^1 and platform F constitute parts of a turn-table, the plate being provided with a central, vertical, pivot stud E^2 (Fig. 2), and the standard F^1 is made hollow to receive said pivot stud. The particular form of the cutter carrying arm herein shown embraces two web-shaped, laterally separated members *c c* connected by a transverse member c^1 and provided at its front or free end with two forwardly directed, laterally separated members c^2 c^2 between which the rotary cutter is mounted as will hereinafter appear. Said cutter carrying arm is provided at its rear end with oppositely directed trunnions C^1 C^2 which are mounted in bearing blocks c^3 c^3 that fit in horizontal forwardly opening recesses or sockets *e e* formed in the upper ends of the standards E. The said trunnions or bearing blocks may be held stationary in said recesses by means of right and left hand screw-bolts e^1 which have screw-threaded engagement with screw-threaded hollow bosses on the blocks and the bottoms of said recesses, respectively. Said screws are provided with central enlargements e^2 adapted for engagement by a suitable implement by which the bolt may be turned to adjust the positions of the trunnion blocks.

The form of rotary cutter D herein shown consists of a plurality of U-shaped cutting blades D^1 D^1 attached at their ends to laterally separated plates D^2 D^2 formed on or attached to a central hub D^3 that is fixed to a shaft D^4, rotatively mounted in the bearing members c^2 of the swinging cutter carrying arm. The looped or closed portions of the blades are sharpened to constitute the cutting edges of the blades and the side members or legs of said knives or blades are detachably fixed to the laterally separated plates D^2 D^2 referred to, in any suitable manner. The side plates D^2 of the cutting wheel are braced or reinforced by intermediate webs *d* affixed to and extending between the plates, as shown in Figs. 1 and 3. One end of said shaft D^4 extends beyond its bearing member c^2, and to said extended shaft end is affixed a worm-wheel G that meshes with a worm-screw G^1 which is rotated by a motor H through the medium of the shaft *g*. Said motor conveniently consists of an electric motor and is shown as supported on a shelf C^3 that is carried by the rear end of the cutter carrying arm below the pivot-trunnions thereof. As herein shown, said shelf extends between and is made integral with depending portions of the lateral members of the cutter carrying arm. Inasmuch as said motor H is carried by the arm C, the relation of the motor to the worm-wheel G is maintained without variation in all angular positions of the arm.

A stopping and starting clutch or power connecting and disconnecting device is associated with the shaft *g*, for controlling the rotation of the cutter while the motor is in motion. A suitable construction for this purpose may be made as follows:—The shaft *g* is journaled at its forward end in a bearing g^1 that is at-

tached to the front end of the cutter carrying arm. The worm-screw G is mounted on said shaft so that the shaft may rotate freely therein and is locked to the shaft by the clutch referred to. Said clutch consists, as herein shown, of a sleeve g^2 splined to the shaft and having an exteriorly conical faced part adapted to enter and frictionally engage the interiorly tapered surface of a socket in the enlarged rear end g^3 of the worm-screw G^1. The said starting clutch may be operated by an L-shaped lever G^2, pivoted near its angle to a stud g^4 extending laterally from the cutter-arm and loosely connected at its short end with the clutch sleeve g^2. The lever extends at its rear end beyond the rear end of the swinging knife-arm and is formed to provide a handle g^5 by which the lever is operated. Said clutch may be held in place by hand through the medium of the lever G^2 during the operation of the cutter or may be locked in position by a locking device associated with the lever, as desired. Said clutch is readily operated to promptly disconnect the cutter from the driving power, and, by reason of the frictional engagement of the clutch elements, said clutch may operate as a slip connection in case the cutter should strike an unexpected resistance, as a stone, and thus avoid the danger of breaking the cutter or driving connection therefor.

Next referring to the means herein shown for swinging the cutter carrying arm on its horizontal and vertical axis, said parts are made as follows: I designates a gear segment that is attached by arms *i* to the base-plate E^1 of the cutter-arm supporting frame, said segment extending rearwardly from said base plate. I^1 designates a gear pinion that is fixed to a vertical shaft I^2, mounted in a frame I^3 which rises from and is attached to the side members A A of the carriage. Said shaft is provided at its upper end with an operating wheel I^4. Through the medium of the devices described, the supporting frame, consisting of the plate E^1 and standards E, which carries the swinging knife arm, may be swung in a horizontal plane about the axis of the pivot stud E^2 of the turn-table, so as to present the cutter at varying horizontal angles to the tunnel breast. The means for swinging said cutter carrying arm vertically consists of a worm-gear segment J that is fixed to the trunnion C^2 outside of the standard E at the left-hand side of the machine, and said worm-segment engages a worm-gear J^2 formed on or attached to a vertical shaft J^3 that is mounted in bearings *j j* fixed to and extending laterally from the left-hand standard E, as shown in Figs. 1 and 2. The said shaft J^3 is provided with a hand-wheel J^4 by which the said shaft is rotated and therethrough the knife carrying arm swung in a vertical plane to vary the vertical angle of presentation of the cutter to the tunnel breast.

The operation of my improved excavating machine will be obvious from the foregoing but may be briefly stated as follows: The cutter carrying arm C is first adjusted, by means of the gear pinion I^1 and segment I, to present the cutter to the tunnel breast at the proper horizontal angle. The cutter carrying arm is then swung on its trunnions, through the medium of the segment and worm-gear J^2, so as to carry the cutter, which is driven by the motor during such swinging motion, in vertical contact with the breast of the tunnel and thereby remove a layer of the earth in each vertical swing of the arm. After each vertical layer of the tunnel breast has been thus removed, the cutter arm is swung horizontally to present the cutter at another horizontal angle to the tunnel breast and another layer thereof cut away during the subsequent vertical swing of the cutter carrying arm. This operation is repeated until a layer of the entire breast has been removed, after which the carriage is advanced to bring the cutter into position for removing another layer of the tunnel breast in the manner last described. The carriage may be advanced in any suitable manner and is chocked in place to hold it from rearward movement due to the cutting contact of the cutter with the tunnel breast. The dirt removed from the breast of the tunnel falls to the bottom of the tunnel and may be removed rearwardly past the machine in any suitable manner.

I claim as my invention:—

1. A tunnel excavating machine comprising a swinging arm, a cutting device carried by the free end of said arm, a supporting frame on which said arm is hinged, a pivot for said frame, the axis of which is substantially at a right angle to the pivotal axis of the swinging arm, and a motor carried by the swinging arm for operating said cutting device.

2. A tunnel excavating machine comprising a swinging arm, a cutting device carried by the free end of said arm, a supporting frame on which said arm is hinged, a pivot for said frame, the axis of which is substantially at a right angle to the pivotal axis of the swinging arm, a motor carried by the swinging arm for operating said cutting device, and means carried by said arm for operatively disconnecting the motor from said cutting device.

3. A tunnel excavating machine comprising a carriage, a supporting frame thereon having a vertical pivot that is mounted on a part carried by the carriage, means for swinging said frame on its pivot comprising a segmental gear carried by the frame and a rotative gear mounted on the carriage engaging said segmental gear, a vertically swinging arm pivoted to said frame, a cutter mounted in the outer end of said arm, and means for swinging said arm on its pivot comprising a gear segment affixed to the arm and a rotative gear mounted on the supporting frame.

4. An excavating machine comprising a supporting frame pivoted to swing about a vertical axis, a cutter carrying arm pivoted to the supporting frame to swing about a horizontal axis, means operating to severally swing said frame and arm on their respective axes, a cutter carried by the free end of said arm, a motor carried by the arm for operating the cutter, and a starting and stopping clutch mechanism for connecting and disconnecting the cutter from the motor.

5. An excavating machine comprising a supporting frame pivoted to swing about a vertical axis, a cutter carrying arm pivoted to the supporting frame to swing about a horizontal axis, means operating to severally swing said frame and arm on their respective axes, a rotary cutter carried by the free end of said arm, a motor carried by the arm for operating the cutter, and a stopping and starting clutch constituting part of the connection between the motor and cutter, and constructed to constitute a slip connection between said parts.

6. An excavating machine comprising a supporting frame pivoted to swing about a vertical axis, a cutter carrying arm pivoted to the supporting frame to swing about a horizontal axis, means operating to severally swing said frame and arm on their respective axes, a cutter carried by the free end of said arm, a motor carried by the arm for operating the cutter, and a starting and stopping clutch mechanism for connecting and disconnecting the cutter from the motor, comprising, in combination, with the motor shaft, a worm-gear capable of rotation on said shaft, a worm-wheel rotating with the cutter and meshing with the worm-gear and an exteriorly conical faced sleeve splined on the shaft and adapted for frictional engagement with an interior conical friction surface of the worm-gear.

7. A tunnel excavating machine comprising a rotative support an overhanging, swinging arm supported solely at its pivotal end, a rotary cutter mounted in the outer or free end of the arm, said cutter rotating about an axis parallel with the swinging axis of said arm, and a motor carried by the arm for operating said cutter.

8. In an excavating machine, the combination with the swinging cutter carrying arm thereof, of a rotary cutter mounted thereon and turning about an axis transverse to said arm, and means for rotating said cutter, said cutter comprising a rotary frame and a plurality of U-shaped cutting blades, each attached at its ends to said frame and formed to constitute at its closed or loop portion the cutting edge of the blade.

In testimony, that I claim the foregoing as my invention I affix my signature in presence of two witnesses, this 29th day of December A. D. 1905.

GEORGE W. JACKSON.

Witnesses:
FRANK A. GETTLESON,
M. W. CLUXTON.