

F. L. DANA.
TUNNELING MACHINE.
APPLICATION FILED MAY 27, 1918.

1,326,480.

Patented Dec. 30, 1919.

3 SHEETS—SHEET 1.

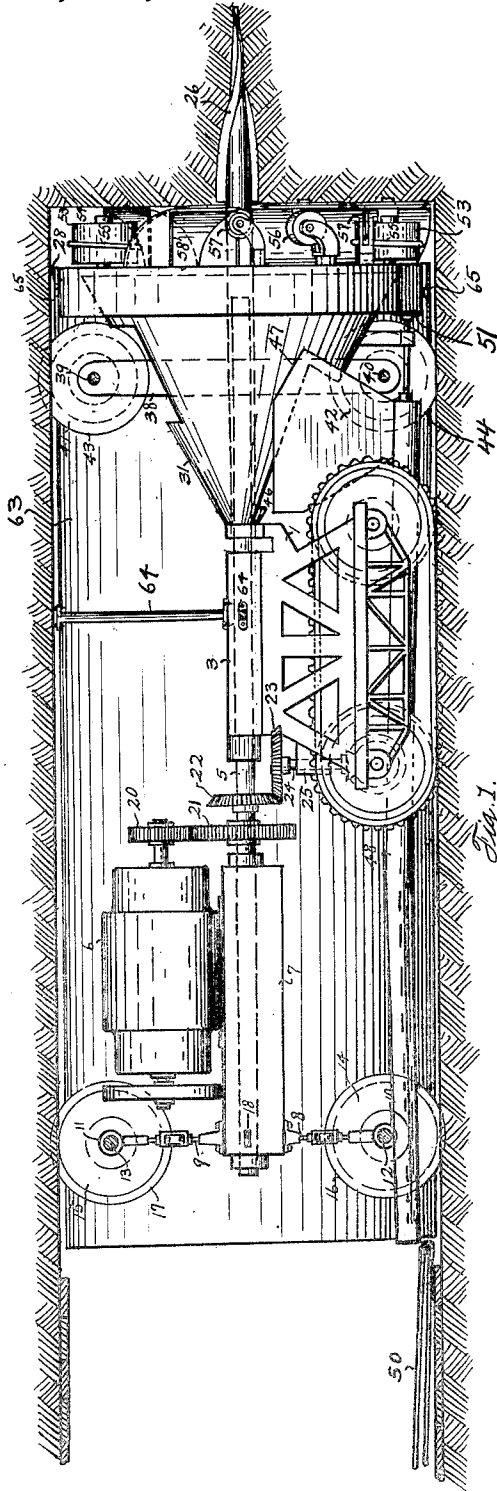


Fig. 1.

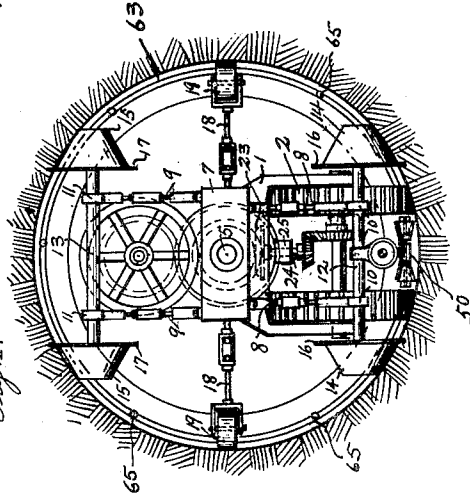


Fig. 2.

INVENTOR
Frank L. Dana
BY
Hardway C. Cathey
ATTORNEYS

F. L. DANA.
TUNNELING MACHINE.
APPLICATION FILED MAY 27, 1918.

1,326,480.

Patented Dec. 30, 1919.

3 SHEETS—SHEET 2.

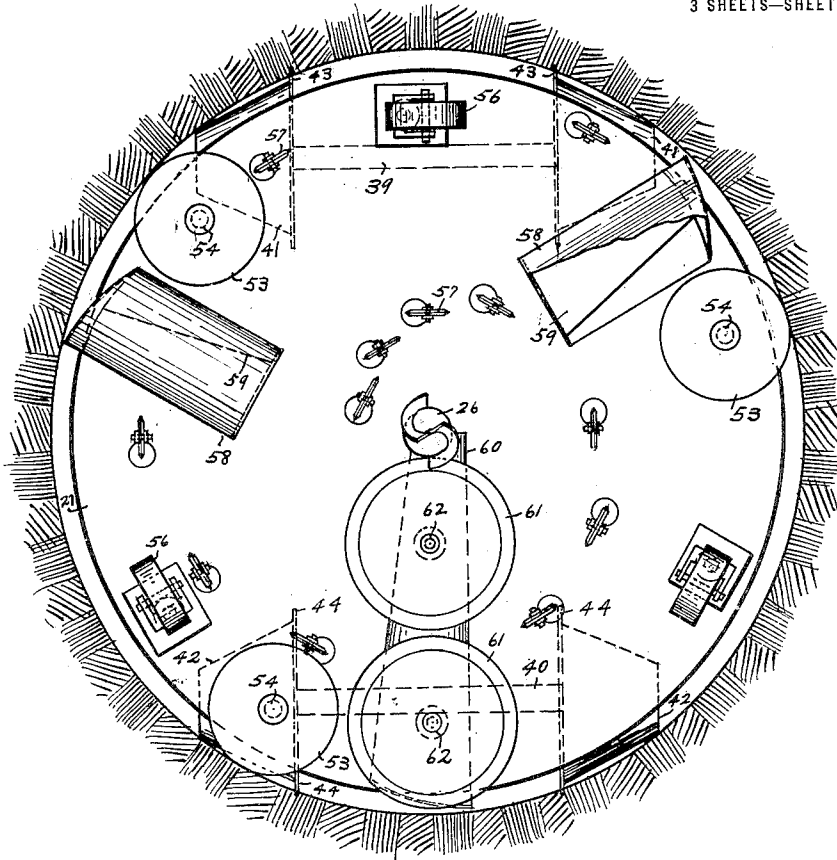


Fig. 3.

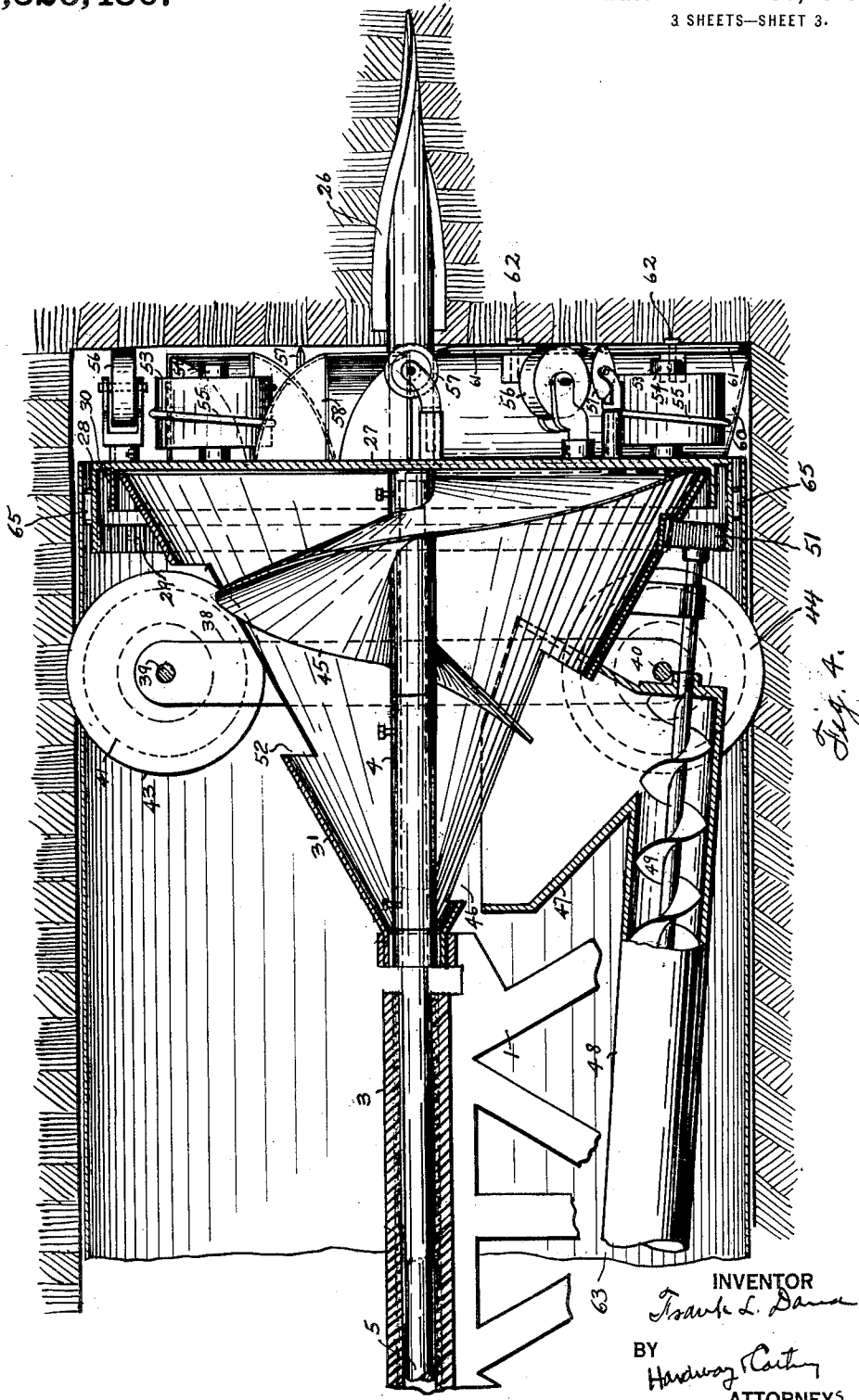
INVENTOR
Frank L. Dana
BY
Hardway C. C. C.
ATTORNEYS

F. L. DANA.
TUNNELING MACHINE.
APPLICATION FILED MAY 27, 1918.

1,326,480.

Patented Dec. 30, 1919.

3 SHEETS—SHEET 3.



INVENTOR
Frank L. Dana
BY *Hardway C. Carter*
ATTORNEYS

UNITED STATES PATENT OFFICE.

FRANK L. DANA, OF HOUSTON, TEXAS.

TUNNELING-MACHINE.

1,326,480.

Specification of Letters Patent.

Patented Dec. 30, 1919.

Application filed May 27, 1918. Serial No. 236,841.

To all whom it may concern:

Be it known that I, FRANK L. DANA, a citizen of the United States, residing at Houston, in the county of Harris and State of Texas, have invented certain new and useful Improvements in Tunneling-Machines, of which the following is a specification.

This invention relates to new and useful improvements in a tunneling machine.

10 The object of the invention is to provide a cutter head which carries suitable cutting means and associated with which is a conical shaped shell, which receives the loose earth and directs the same to a conveyer by means of which the earth is conveyed to the mouth of the tunnel.

Another object of the invention resides in the provision of means for rotating the head, said means being also operatively connected with a carrying vehicle, by means of which the machine is supported and driven forward against the breast of the tunnel being cut away.

20 A further feature of the invention resides in the provision of means whereby the direction of the machine may be varied, thus permitting a change in the course of the tunnel being excavated.

With the above and other objects in view, 30 the invention has particular relation to certain novel features of construction, operation, and arrangement of parts, an example of which is given in this specification, and illustrated in the accompanying drawings, wherein:

35 Figure 1, is a side elevation of the machine.

Fig. 2, is a rear end view, thereof.

Fig. 3, is a front end view, and

40 Fig. 4, is a vertical sectional view.

Referring now more particularly to the drawings, wherein like numerals of reference designate similar parts in each of the figures, the numeral 1, refers to a tractor frame supported by a caterpillar tractor 2. The upper part of this frame is formed into a long bearing 3, and extending through this bearing is the drive shaft 5, to which the sectional sleeve 4 is keyed. The numeral 6, refers to a motor, having a base 7, which is provided with a long bearing through which the rear, or outer end of the shaft extends. Secured to the motor base, and depending therefrom, are the supporting arms 8, 8, and secured thereto and extending upwardly are the arms 9, 9, the said arms be-

ing formed into bearings 10, 10, and 11, 11, in which the respective axles 12 and 13 rotate. Fixed to these axles are frusto-conical shaped guidewheels 14, 14, and 15, 15, which 60 have the annular flanges 16, 16, and 17, 17. The wheels 14 and 15 bear against the walls of the tunnel and the flanges cut into said wall as the machine moves forwardly. The motor base has the lateral arms 18, 18, extending therefrom on opposite sides, and whose free ends carry the rollers 19, 19, which bear against the sides of the tunnel. The arms 8, 9, and 18 are adjustable, thus providing for the vertical and lateral ad- 70 justment of the rear end of the machine, and thus providing means for guiding the machine and determining the course of the tunnel, as well as providing means for supporting the motor and the rear end of the drive shaft. Fixed to the motor shaft is a spur gear wheel 20, which is in mesh with the corresponding spur gear wheel 21, which is fixed on the shaft 5, through which rotation is imparted from the motor to the said 80 shaft. The drive shaft 5 also carries a beveled gear wheel 22, which is fixed thereon, and is in mesh with the pinion 23, which is fixed to the upper end of the vertical shaft 24. This last mentioned shaft is rotatable in a vertical bearing carried by the frame 1, and is operatively connected with and drives the tractor 2. The forward end of the shaft 5 terminates in a spiraled point 26, which to some extent directs the course 90 to the tunnel and steadies the machine and also cuts out the center of the bore. A circular cutter head 27 is mounted on the shaft 5, the required distance behind the point 26. This cutter head is formed of a heavy circular metallic plate, whose outer edge carries an annular flange 28, formed into the internal gear face 29. Within the flange 28, is an annular bearing rim 30, which is carried by the head, and within which fits the 100 enlarged end of a conical shaped shell 31. The apex of this shell is formed into a bearing 32, into which the outer end of the sleeve 4 extends, the rim 30 and the bearing 32, forming anchors, which fix the shell in position, and hold it in its proper relation 105 to the cutter head 27; and suitable anti-friction means between the rim 30 and the shell 31 may be provided if found necessary.

The cutter head may be rotated by any suitable mechanism, which may be found 110 best adapted to rotate the same. Ordinarily

said head may be fixed to the shaft 5, and rotated thereby.

A plurality of the shafts 35 may be provided if desired for the purpose specified. Arranged on opposite sides of the shell 31, and secured thereto are the vertical supporting braces 38, 38, whose upper and lower ends, respectively, are provided with bearings through which the respective transverse shafts 39 and 40 extend, said shafts forming axles, to the ends of which the conical shaped wheels 41, 41, and 42, 42, are respectively fixed, said wheels being provided with flanges 43, 43, and 44, 44, which cut into the walls of the tunnel above and below. These wheels support the forward end of the conical shell 31, and steady the same and the flanges 43, and 44, prevent the conical shell from rotating with the cutter head and assist in imparting a uniform course to the machine as the same progresses. Within the shell 31, and fixed to the sleeve 4, is a spiraled vane or screw 45, which receives the loose earth discharged into the shell, and forces the same rearwardly through the discharge opening 46, in the underside of the shell, and into the hopper 47, which is carried by the forward end of the conveyer casing 48. The earth is admitted through said hopper into said casing and is carried toward the mouth of the bore by means of the screw conveyer 49; any other form of conveyer as a belt conveyer may be used if desired. The conveyer 49 rotates within said casing and the earth is discharged by it onto a belt conveyer 50, of the usual construction and thereby delivered to the mouth of the tunnel. The forward end of the conveyer shaft has a gear wheel 51, fixed thereto, which is in mesh with the gear face 29, forming an operative mechanism through which the conveyer 49 is rotated. The upper side of the shell 31 has an opening 52, to provide access to the interior of the shell, and the cutter head has openings hereinafter described, through which workmen may pass to gain access to the work, for repairs and the like. The cutter head has a plurality of bearing rollers 53, which are rotatably mounted upon bearing pins 54, projecting forwardly from said head, and these rollers bear against the walls of the tunnel, as the cutter head rotates to bear the weight of the head and to steady the rotation thereof. Each roller is provided with a spiraled rib 55, which guides the roller and eliminates the friction thereof against the walls of the bore. The cutter head also has a plurality of forwardly projecting swiveling casters, or idler wheels 56, which bear against the breast of the tunnel and regulate the depth at which the cutters hereinafter described may operate.

Cutting disks 57 are mounted on the cutter head and project forwardly therefrom.

These disks have a swiveling connection with said head so as to readily accommodate themselves to the rotation of the cutter head in either direction, and to be at all times in operative position. These disks are spaced a uniform distance apart from the center to the circumference of the cutter head, and cut into the breast of the tunnel as the cutter head rotates, and said head is also provided with two radial scrapers 58, which project forwardly from the head and are formed into scoops which gather up loose earth formed by the disks 57, and deliver the same through the adjacent openings 59, through the cutter head and into the shell 31. A radially extending shear 60 is provided which extends from the center to the circumference of the head. This is scoop-like in form, and has a sharp cutting edge, and carries two circular cutters 61, 61, which are rotatably mounted on the bearings 62, 62, and which project forwardly from said shear. These cutters shear off the breast of the tunnel which has been left in a rough and uneven condition by the disks 57, and the scoop-like shear 60 follows said cutters and gathers up the earth sheared off by them and discharges the same through a suitable opening in the cutter head into the shell 31.

In case it is desired the entire machine may be surrounded by means of a portable lining 63 preferably of sheet metal. This lining is cylindrical in form and is secured in fixed position relative to the machine by means of suitable braces 64 which are fastened at their inner ends to the tractor frame and at their outer ends to the lining. This lining has suitable openings through which the wheels, 15, 16, 41 and 42 and the rollers 19, project, and the bottom of the lining has an opening to permit the caterpillar tractor to travel along the bottom of the tunnel. This lining prevents the loose earth from falling into the mechanism of the machine and interfering with the work.

For the purpose of holding the forward ends of the lining, spaced uniformly from the cutter head, and for minimizing the friction there between, I have provided anti-friction rollers 65, which are interposed between them.

What I claim is:

1. A tunneling machine including a rotatable cutter head, provided with an opening, means for rotating the same, a plurality of independent cutting disks having a swiveling connection with the head and projecting forwardly therefrom, said disks operating against the breast of the tunnel and a scoop-like shear arranged adjacent said opening and following the disks and adapted to gather the earth loosened by said disks and force the same through the opening in said head.

2. A tunneling machine including a rotatable cutter head, means for rotating the same, independent cutting disks having a swiveling connection with said head, a scoop-like shear carried by the head and extending radially relative thereto, circular cutters carried by said shear, roller bearings having a swiveling connection with the head and adapted to operate against the breast of the tunnel to regulate the depth at which said cutting disks can operate and bearing rollers carried by the head and operating against the wall of the tunnel and provided with peripheral spiraled ribs.

3. A tunneling machine including a rotatable cutter head, provided with an inlet opening, means for rotating the same, a stationary shell provided with a discharge opening, a conveyer arranged to receive the earth discharged through said discharge opening, bearing rollers carried by the head and bearing against the walls of the tunnel, as the cutter head rotates, cutting means carried by the head, and operating against the breast of the tunnel, rotatable bearing members carried by the head and bearing against the breast of the tunnel to regulate the feed of the cutting means, a scoop like scraper carried by the head and adapted to gather up the earth loosened by said cutting means and to discharge the same through the opening in the head into said shell, and a spiraled vane within the shell which engages with the loose earth therein and forces the same through said discharge opening into the conveyer.

4. A tunneling machine, including a rotatable cutter head provided with an opening, means for rotating the same, a conical shaped shell provided with a discharge opening, and arranged behind said head, means for fixing said shell against rotation, said shell being adapted to receive the loose earth cut from the breast of the tunnel by said head and delivered by it through the opening of said head, a spiraled vane fixed to the head-rotating means and fitted within the shell and conforming to the contour thereof, and a conveyer driven by the head arranged to receive the earth delivered by said vane through the opening of the shell and to carry the same backward toward the mouth of the tunnel.

5. A tunneling machine including a rotatable cutter head, means for rotating the same, a conical shaped shell arranged behind the head and provided with a discharge opening, a rotatable spiraled vane formed to fit within the shell and mounted on the exterior of and rotated by the head-rotating means whereby the loose earth discharged into said shell is collected together and delivered through the discharge opening of the shell, and a conveyer operatively connect-

ed with and driven by the head and arranged to receive the earth discharged from the shell and convey the same backwardly toward the mouth of the tunnel.

6. A device of the character described including a drive shaft, a rotatable cutter head fixed thereon, and provided with an inlet opening, said shaft terminating in a guide point in front of the head, a stationary shell through which said shaft extends, said shell being provided with a discharge opening, a conveyer arranged to receive material delivered through said discharge opening, cutting means carried by the cutter head and operating against the breast of the tunnel being bored, means adapted to receive the loose earth cut from said breast, and to discharge the same through the opening in said head, into said shell, means fixed upon the shaft within the shell, and adapted to force the earth through the discharge opening into the conveyer, a traction mechanism adapted to support and drive the machine forward against the breast of the tunnel, and adjustable guiding means through which the course of the machine may be varied.

7. A tunneling machine including a rotatable cutter head, means for rotating the same, bearing rollers carried by the head, which bear against the walls of the tunnel as the cutter head rotates, a peripheral, spiraled rib carried by each roller, cutting means projecting forwardly from the cutter head, a stationary shell arranged behind said head and provided with a discharge opening, means carried by the head and adapted to collect the loose earth cut from the breast of the tunnel, and discharge the same through said head into said shell, a conveyer, and means operating within the shell adapted to force the earth therein through said discharge opening into said conveyer.

8. A tunneling machine, including a rotatable cutter head, provided with a plurality of openings, a drive shaft whereon said head is mounted, independent cutting disks having a swiveling connection with said head, scoop-like shears carried by the head and arranged adjacent said openings and adapted to gather up the loose earth cut from the tunnel by said disks and discharge the same through said head, depth regulating rollers, having a swiveling connection with the head, rollers carried by the head and operating against the walls of the tunnel, a stationary conical shaped shell arranged behind the head and provided with a discharge opening, a spiraled vane arranged within the shell and driven by said shaft, a tractor operatively connected with and driven by said shaft, a guiding device supporting the rear end of the shaft, said guiding device including flanged beveled

wheels which operate against the walls of the tunnel above and below and roller bearings which operate against the sides of the tunnel.

- 5 9. A tunneling machine including a shaft extending axially relative to the tunnel, a rotatable cutter head mounted on the shaft, means for rotating said head, a conical shaped shell fixed against rotation behind
10 the head and having a common axis with said shaft, means for delivering the cuttings from said head into said shell, the outer end of the shell being provided with a discharge opening, a conveyer, one end of which is
15 arranged underneath the opening of the shell, and a spiraled vane mounted on the exterior of the shaft and rotated thereby and fitted within the shell and formed to sweep around the walls of the shell, and adapted to
20 gather up the loose earth delivered into the shell and to collect the same together and force it upwardly along the bottom wall of the shell, and discharge the same through the opening thereof into the conveyer.
- 25 10. A tunneling machine including a rotatable cutter head provided with an inlet opening, a shaft whereon said head is mounted, a conical shaped shell fixed behind the head and having a common axis with said
30 shaft, the outer end of said shell being provided with a discharge opening underneath, means carried by the head to gather up the loose earth cut from the breast of the tunnel by said head, and to discharge the same
15 through said inlet opening into said shell, a conveyer operatively connected with and driven by the head, one end of which is arranged underneath the discharge opening, a spiraled vane fixed to and surrounding the
0 shaft fitted within the shell and conforming to the contour thereof, and adapted to sweep around the walls of the shell and to collect the loose earth therein, and force the same upwardly along the bottom wall of the shell

to said discharge opening for delivery 45 through said opening into the conveyer.

11. A tunneling machine including a rotatable cutter head provided with inlet openings, a conical shaped shell behind the head, and having a common axis therewith, the 50 outer end of said shell being provided with a discharge opening, underneath, means carried by the head adapted to gather up the cuttings from the breast of the tunnel, and to discharge the same through said inlet 55 opening into said shell, a conveyer operatively connected with and driven by the head, and arranged to receive the material discharged through said discharge opening, a spiraled vane fitted within the shell and 60 adapted to engage with the material therein and force the same through said discharge opening into the conveyer and means for rotating said head and vane.

12. A tunneling machine including a rotatable cutter head, having an inlet opening, means for rotating the same, cutters carried by the head and operating against the breast of the tunnel, a conical shaped shell arranged behind the head, and provided with 70 a discharge opening, a rotatable spiraled vane formed to fit within the shell and mounted on the exterior of and rotated by the head-rotating means, whereby the loose earth discharged from said cutters through 75 said inlet opening into the shell is collected together and delivered through the discharge opening of the shell and a conveyer arranged to receive the earth discharged from the shell and convey the same backwardly toward the 80 mouth of the tunnel.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRANK L. DANA.

Witnesses:

J. W. WOODS,
IRENE BRUNS.