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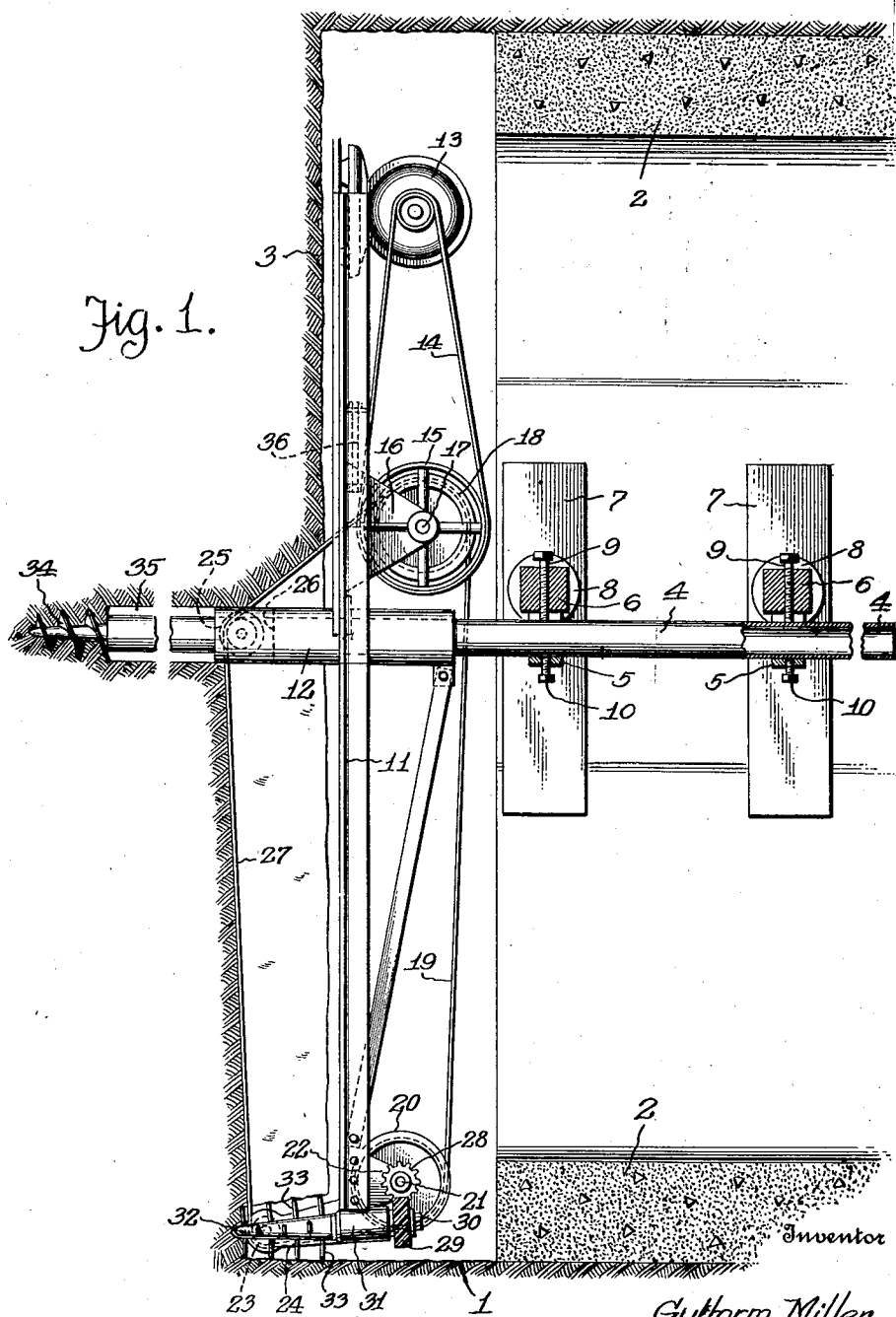
1,500,411

G. MILLER

TUNNELING MACHINE

Filed Jan. 17, 1921

2 Sheets-Sheet 1



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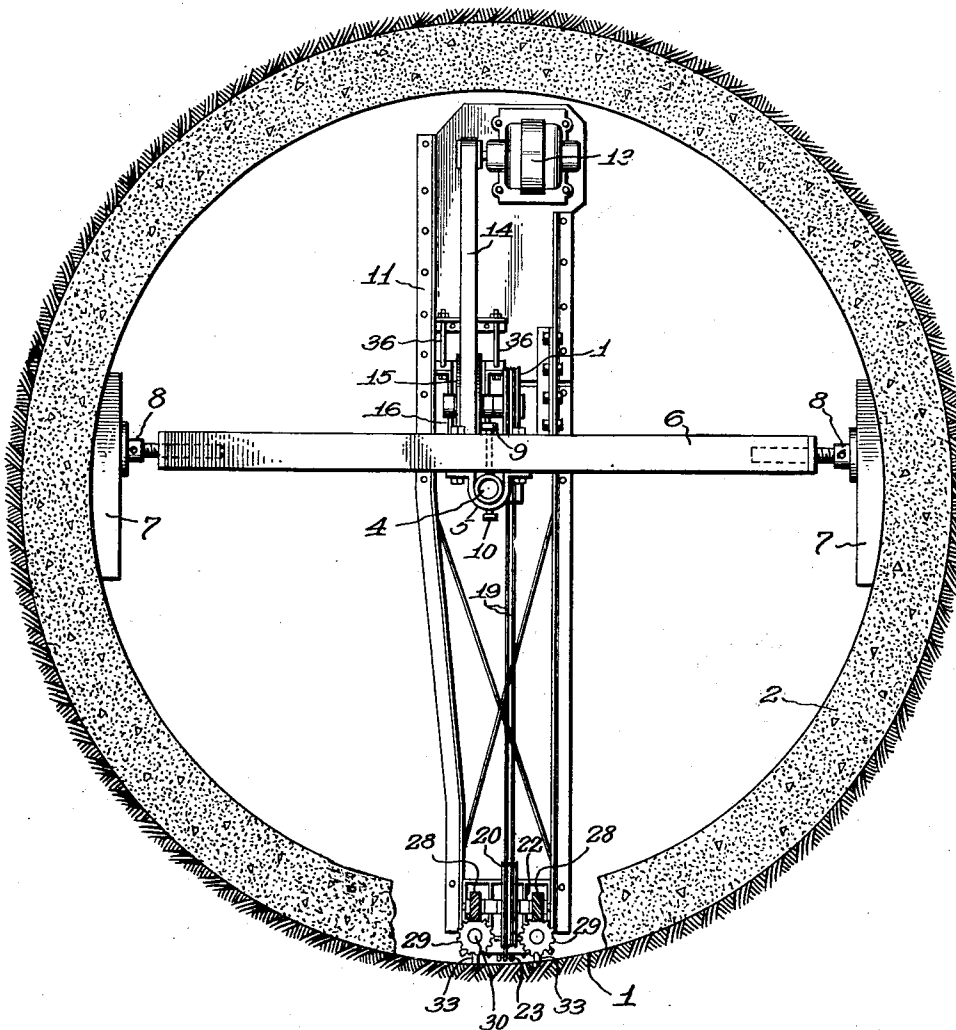


Fig. 2

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UNITED STATES PATENT OFFICE.

GUTTORM MILLER, OF GLENS FALLS, NEW YORK.

TUNNELING MACHINE.

Application filed January 17, 1921. Serial No. 437,776.

To all whom it may concern:

Be it known that I, GUTTORM MILLER, a citizen of the United States of America, residing at Glens Falls, in the county of Warren and State of New York, have invented certain new and useful Improvements in Tunneling Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

The digging of bores of trunk sewers and other tunnels is an arduous task and requires the work of expert miners where the work is done by hand. Machines have been devised for doing such work but they usually embody a rotary member having knives or similar cutting means which require high power to operate the same, and such machines are therefore so very heavy and bulky that they cannot be moved about with facility and they practically fill the space within the end of the tunnel or bore, obstructing the work of removing the detached earth and the manipulation of the machine.

The object of this invention is to provide a machine for the purpose which is simple and compact in its construction and of such dimensions and weight as to be readily manipulated and to take up a minimum of space.

A further object is to provide a novel and efficient means for severing or cutting away the earth to advance the bore of the tunnel and to provide a construction wherein the machine comprises such cutting and severing means, together with power means for operating the same, whereby a self contained unit is provided which may be readily adjusted, manipulated, and handled within the limited space of the tunnel bore.

A further object is to provide means for severing or cutting away the earth, which means requires a minimum of power to operate the same, is positive in its action, and is such that stones or other obstructions encountered in the operation of the machine will offer a minimum of interference with its progress.

It is also an object of the invention to provide a machine for the purpose having certain other new and useful features in the construction and arrangement of parts, all as hereinafter more fully set forth.

With the above and other ends in view, the invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims, reference being

had to the accompanying drawings, in which—

Figure 1 is a side elevation of a machine illustrative of the invention, and showing the same in operative position within the end of the bore of a tunnel, and

Fig. 2 is an end elevation of the same showing the tunnel in transverse section.

In the drawings, 1 indicates the bore of the tunnel in the earth and 2 the usual lining of concrete or other material. 3 indicates the end wall of earth at the end of the tunnel bore which is to be cut away in advancing the bore, and the machine for cutting away this end wall of earth is supported axially of the bore upon a stationary shaft or tube 4 mounted in suitable bearings 5 carried by transverse supporting bars 6 arranged transversely of the bore and supported therein by suitable blocks 7 engaging the lining of the tunnel and in turn engaged by suitable jacks 8 carried by the ends of the supporting bars. Adjusting screws 9 and 10 carried by the bars 6 and bearings 5 respectively, engage opposite sides of the tube or shaft 4 for the purpose of adjusting said shaft within its bearings and for holding said shaft against rotation.

A suitably trussed frame 11 is provided intermediate its ends with a bearing sleeve 12 adapted to be sleeved upon the shaft 4 and to turn freely thereon. Mounted upon one end of the frame 11 is a suitable electric motor 13 and power is transmitted from this motor by means of a belt 14 to a pulley 15 mounted in suitable bearing brackets 16 which are adjustable longitudinally upon the frame adjacent the bearing sleeve 12. Upon the shaft 17 of the pulley 15, is secured a sheave 18 having a plurality of grooves to receive the turns of a wire cable 19 which passes from the sheave 18 to the sheave 20 mounted on a shaft 21 carried in brackets 22 upon the extreme outer end of the frame 11 at the end thereof opposite that upon which the motor 13 is mounted. The sheaves 18 and 20 are provided with a double groove and the cable 19 is given a double wrap around these pulleys, that is, the cable passes from the pulley 18 to the pulley 20, over said pulley and back to the pulley 18, around this pulley and then back again to the pulley 20. From the pulley 20 the cable is led laterally of the frame or in the direction of advance of the machine in its operation, to a pulley or sheave 23 mounted within a suitable hol-

low bracket arm 24 which projects forwardly from the end of the frame 11. This bracket arm 24 forms a casing to enclose the sheave 23 and the run of the cable in passing to and over this sheave.

From the sheave 23 the cable 19 leads to a similar sheave 25 mounted to rotate freely within a chamber provided therefor by an enlargement of the forward end of the bearing sleeve 12, said chamber or enlargement 26 for the sheave being formed at one side of the sleeve 12 so that the shaft 4 may pass through the sleeve and have a bearing therein throughout the length of the sleeve. From the shaft 25 the cable 19 passes back to the sheave 18, the cable being endless to provide a continuous travel of the cable over the several sheaves, with the run 27 of the cable between the sheaves 23 and 25, in advance of the frame 11 in the direction of the progress of the machine in cutting away the earth at the end of the tunnel bore. Slack in this cable is taken up by adjusting the brackets 16 on the frame by means of adjusting screws 36, so that the run 27 of the cable will always be taut.

Secured upon the ends of the shaft 21 of the sheave 20 are worm gears 28 in mesh with like gears 29 upon the ends of spaced parallel shafts 30 mounted in bearings 31 on the end of the frame 11 and extending laterally of the frame forwardly in the direction of progress of the machine. Secured upon the forward end of each shaft 30 is a cutter head 32 provided with a series of laterally extending knives 33 arranged in longitudinal rows with the knives of one row in staggered relation to those of adjacent rows. Rotary cutter heads are therefore provided, one at each side of the sheave 23, to bore into and cut away the earth at the circumference of the tunnel bore, said cutter heads being forced longitudinally into the wall of earth by an advancing movement of the machine, or the sliding of the supporting frame 11 longitudinally of its supporting shaft 4. The transverse bars 6 forming the supports for the supporting shaft 4 are positioned rearwardly of the frame 11 and to form a support and guide for the forward end of the shaft and sleeve 12, said shaft is provided with a boring or cutting member 34 on its forward end to bore into the earth in advance of the tunnel bore and thus form an axial opening or chamber 35 in advance of the tunnel bore and in exact longitudinal axial alignment therewith to receive the forward end of the supporting or bearing sleeve 12 of the frame 11.

In mounting the machine in operative position within the tunnel bore, the supporting bars 6 are first placed in position at any suitable distance apart to form a rigid support for the supporting shaft 4 which is

then placed within the bearings 5 with the machine mounted thereon. The shaft 4 is then properly aligned with the axis of the tunnel bore and by any suitable means (not shown) applied to the rear end of said shaft, the same is turned in its bearings to drive the boring tool carried by its forward end, into the wall of earth at the end of the tunnel bore. After this boring tool has been driven in a sufficient distance to provide a desired length of axial bore 35, the extreme forward end of the sleeve 12 is entered into this bore by sliding the frame of the machine longitudinally of the supporting shaft 4. The set screws 9 and 10 are then turned up to hold the shaft 4 against turning within its bearings and the motor 13 is started by turning on the electric current which is supplied in any suitable manner, as by a cable (not shown).

Motion is transmitted from the motor to drive the driving sheave 18 and thus a continuous endwise travel of the cable 19 over the several sheaves is effected. This cable in passing over the sheave 20 transmits motion to the shaft 21 and thence through the worm gears 28 and 29 drives the shafts 30 and causes a rapid rotation of the two parallel cutter heads 32. With the cable traveling continuously over its sheave and the cutter heads in rapid rotation, the machine, as a whole, is advanced toward the wall 3 of earth by moving the frame endwise of its supporting shaft 4 in any suitable manner until the cutter heads 32 and the cutting run 27 of the cable have cut their way into the wall of earth to the desired depth. The forward advance of the machine is then stopped and the machine as a whole is rotated upon the supporting shaft 4, a slow rotary motion being imparted to the frame in any suitable manner, as by manual power or otherwise. This rotation of the frame carries the cutting run 27 of the cable and the cutter heads laterally, thus causing the cutter heads to cut a circumferential groove in the wall 3 of earth at the periphery of the tunnel bore, and the run of the cable 27, which extends from the center bore 35 radially outward to the circumferential channel formed by the cutters 32, severing a disk or slab of earth from the wall 3 as the machine is swung upon the supporting shaft 4.

As indicated in the drawings, the starting position or the position in which the machine will be preferably advanced to enter the cutter heads 32 and cutting run 27 of the cable initially into the wall 3 of earth, will be with the machine in a substantially vertical position with said cutter heads at the lower side of the tunnel bore. The machine will then be swung from this position in either direction until the machine has again reached the vertical with the cutter heads at the upper side of the tunnel. The

machine will then preferably be swung back to the original position shown in the drawings and then will be swung from that position in a direction opposite to that in which it has just previously been swung, to cut away the semi-circular slab of earth at the other side of the tunnel bore. Therefore the slab of earth as it is cut away from the wall 3 will fall downwardly clear of the machine, the machine swinging upwardly from the lower side of the tunnel.

As the traveling cable which severs the earth from the wall of the tunnel is continuously caused to travel endwise as the machine is swung about the longitudinal axis of the tunnel bore, the cutting run 27 of said cable will readily cut its way through the earth and any ordinary obstruction, such as a stone of comparatively small size will not interfere with the advance of the cable, said run either pushing the construction out of the way or cutting its way through it, and as the frame 11, upon which the entire mechanism of the machine is mounted, is comparatively narrow, a wide space is provided within the tunnel bore at each side of the frame for the removal of the earth which is being cut away. Further, as but comparatively little power is required to drive the cable and cutter heads 32, an electric motor of comparatively light weight may be mounted directly upon the machine frame and as all parts of the machine are mounted directly upon this frame, said machine may be quickly and easily removed as a unit should there be any occasion for doing so, such as in case of a cave-in or where a large rock or similar obstruction is encountered.

The unitary structure of the machine which makes the same extremely mobile is a particular feature of the construction, and further, the means for cutting away the earth consisting of an endless traveling cable which will require but little power to operate and will cut away the earth much faster and in a more convenient form than the common cutting knives or similar devices, is a particularly new and useful feature of the present invention.

The cable 19 may be utilized to transmit motion for driving the cutter heads 32, as illustrated, or these cutter heads may be driven in any suitable manner, and other changes in the construction, arrangement and combination of parts may be made within the scope of the appended claims without departing from the spirit of my invention.

What I claim is:—

1. A tunneling machine including a plain endless cable having a free run forming a cutter for severing portions of the earth wall at the end of a tunnel bore, means for holding taut said cutting run of the cable

during its cutting travel, and means for causing an endwise traveling movement of said cable.

2. A tunneling machine including a cutter for forming a circumferential channel in the wall of earth at the end of a tunnel bore, means for operating said cutter, and endless traveling means having a cutting run thereof movable in a plane transverse to the longitudinal axis of the tunnel bore for severing earth from said wall between said channel and bore axis.

3. A tunneling machine including a cutter for forming a circumferential channel in the wall of earth at the end of the channel bore, a supporting member for said cutter rotatable about an axis coincident with the tunnel axis, means for operating said cutter, and a continuously longitudinally movable member extending substantially radial of the bore axis and carried by said rotatable supporting member, for cutting away the earth wall inwardly from said channel during rotation of said supporting member about the tunnel axis.

4. In a tunneling machine, the combination of a frame rotatively mounted to turn upon an axis co-incident with the axis of a tunnel bore, a cutter carried by said frame for cutting a circumferential channel in the earth wall at the end of the bore, and means carried by the frame and extending from within said channel to substantially the axis of the bore for severing the earth wall in a plane transverse to the tunnel bore axis during the turning of said frame upon its axis of rotation.

5. In a tunneling machine, the combination of a frame, means for supporting said frame co-incident with the axis of a tunnel bore for rotative and longitudinal movement, an endless cable, pulleys on said frame over which the cable passes with a free run portion extending in a substantially radial direction inwardly from the periphery of said tunnel bore to form a cutter for severing the earth wall, and means for imparting an endwise traveling movement to said cable.

6. In a tunneling machine, the combination of a frame supported co-incident with the longitudinal axis of a tunnel bore for rotative movement about the bore axis and longitudinally thereof, a plain endless traveling wire cable on said frame having a cutting run extending in a direction substantially radial of the tunnel bore, and means on the frame for imparting a continuous endwise travelling movement to said cutting member.

7. In a tunneling machine, the combination of a frame, means for supporting said frame co-incident with the longitudinal axis of a tunnel bore for rotative and longitudinal movement, a cutter on the frame for forming a peripheral groove in the earth

wall at the end of the tunnel bore, an endless
 traveling cutting member having a cutting
 run for severing said earth wall inwardly
 from said groove toward the tunnel bore
 5 axis in a plane transverse to said axis upon
 rotation of said frame, means within said
 groove for leading said member into said
 groove and causing the cutting run thereof
 to operate radially inward from the bottom
 10 of said groove, and means for imparting a
 cutting movement to said cutter.

8. In a tunneling machine, the combina-
 tion of a supporting shaft, means for sup-
 porting said shaft coincident with the axis
 15 of a tunnel bore, a frame mounted upon
 said shaft and rotatably and longitudinally
 movable thereon, a rotatable cutter carried
 by said frame at one end thereof for form-
 ing a peripheral groove in the earth wall
 20 at the end of the tunnel bore, an endless
 traveling member having a cutting portion
 for severing the earth wall between said
 groove and tunnel bore axis upon rotation of
 said frame, guiding and carrying means on
 25 said frame for said endless member, and
 power means on the frame for driving the
 endless member and the cutter.

9. In a tunneling machine, the combina-
 tion of a supporting shaft, means for sup-
 porting said shaft coincident with the longi-
 tudinal axis of a tunnel bore, a frame mount-
 ed upon said shaft for rotative and longi-
 tudinal movement thereon, said frame extend-
 ing laterally from said shaft in opposite
 35 directions, means carried by one end of said
 frame for severing the earth wall at the end
 of the tunnel bore upon relative movement
 of said frame, and a motor mounted upon
 the opposite end of said frame for driving
 40 said cutting means, whereby the weight of
 said motor counterbalances said cutting
 means during the rotation of said frame.

10. In a tunneling machine, the combina-
 tion of a supporting shaft, means for sup-
 porting said shaft coincident with the longi-
 tudinal axis of a tunnel bore, a frame
 45 mounted upon said shaft for longitudinal
 and rotative movement thereon, a pair of
 rotative cutters mounted upon one end of
 said frame for forming a peripheral groove
 in the end wall of the tunnel bore, a plurality
 50 of guide pulleys mounted upon the frame,
 a flexible endless member engaging said pul-
 leys and having a portion extending inward-

ly from between the rotative cutters toward
 the supporting shaft for severing the earth
 wall between the peripheral groove and the
 tunnel bore axis, and means for causing an
 endwise traveling movement of said endless
 member.

11. In a tunneling machine, the combina-
 tion of a supporting shaft, means for sup-
 porting said shaft coincident with the longi-
 tudinal axis of a tunnel bore, a frame
 mounted on said shaft for rotative and longi-
 tudinal movement thereon, a pair of ro-
 tatable cutters mounted upon said frame at
 one end thereof for forming a peripheral
 groove in the earth wall in the end of a
 tunnel bore, a plurality of guide pulleys
 70 mounted on said frame, a flexible endless
 traveling guide member engaging said pul-
 leys, certain of said pulleys being positioned
 to provide a cutting run of the endless mem-
 ber in advance of said frame and extending
 75 from a point between the rotative cutters
 of said pair inwardly toward said shaft to
 sever the earth wall between said peripheral
 groove and the tunnel bore axis, and power
 means mounted upon said frame for driving
 80 said endless cutting means and said cutters.

12. In a tunneling machine, the combina-
 tion of a supporting shaft, means for sup-
 porting said shaft coincident with the axis
 of a tunnel bore, a frame mounted on said
 shaft for rotative and longitudinal move-
 ment thereon and extending transversely of
 the shaft in opposite directions therefrom, a
 pair of rotative cutters mounted at one end
 of said frame, pulleys mounted upon the
 frame between said cutters, pulleys mounted
 upon the frame adjacent said shaft, an end-
 less flexible cutting member engaging said
 pulleys, gearing for transmitting motion to
 said pair of cutters, a motor mounted on said
 95 frame at the end thereof opposite that upon
 which the pair of cutters is mounted, and
 means for transmitting motion from said
 motor to rotate said pair of cutters and to
 cause a continuous endwise traveling move-
 100 ment of said flexible cutter.

In testimony whereof I affix my signature
 in presence of two witnesses.

GUTTORM MILLER.

Witnesses:

ELIJAH AMES LITTLE,
 ANDREW C. FICKES.