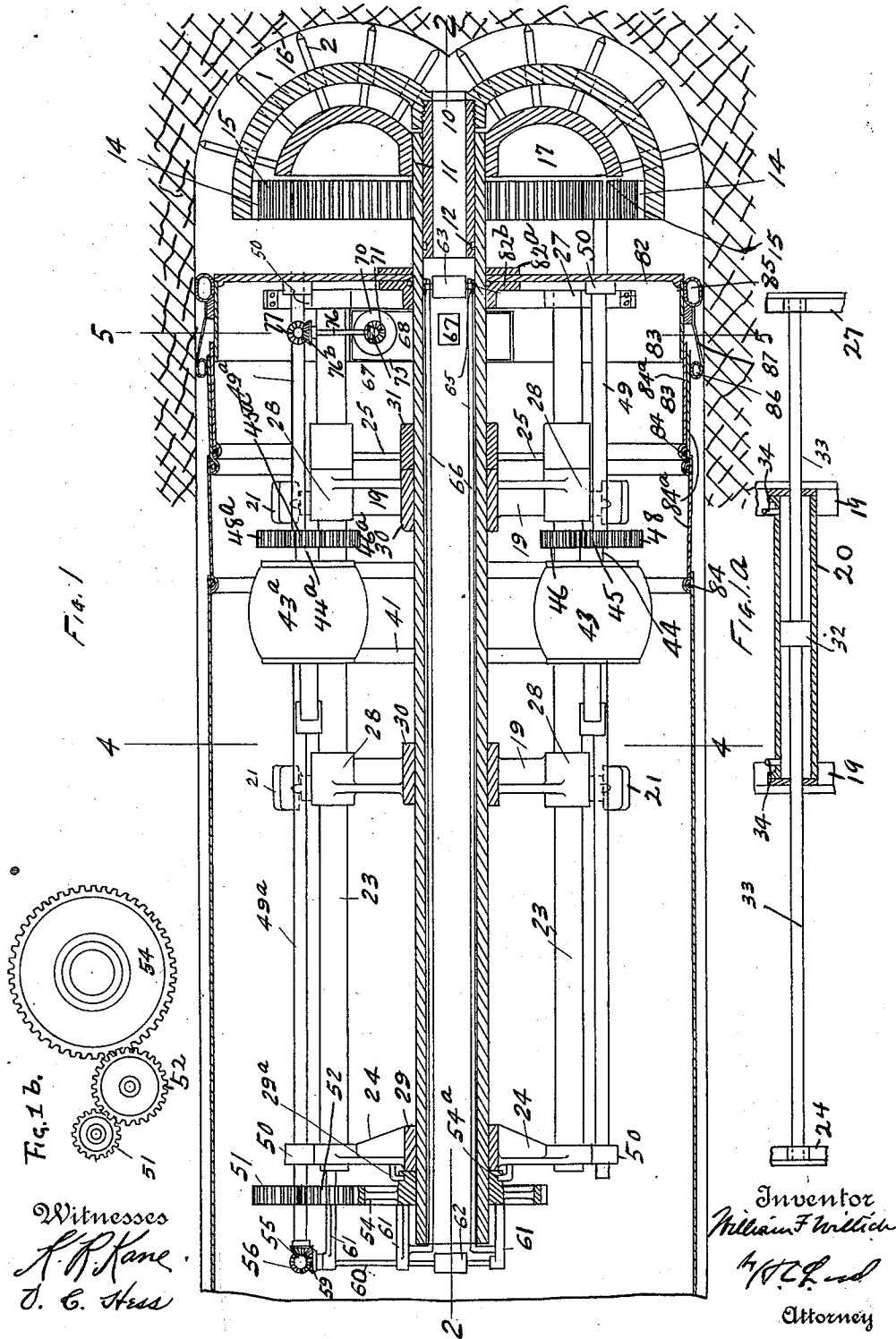


W. F. WITTICH.
SHAFT BORING AND TUNNELING MACHINE.
APPLICATION FILED NOV. 27, 1908.

1,043,185.

Patented Nov. 5, 1912.

4 SHEETS—SHEET 1.

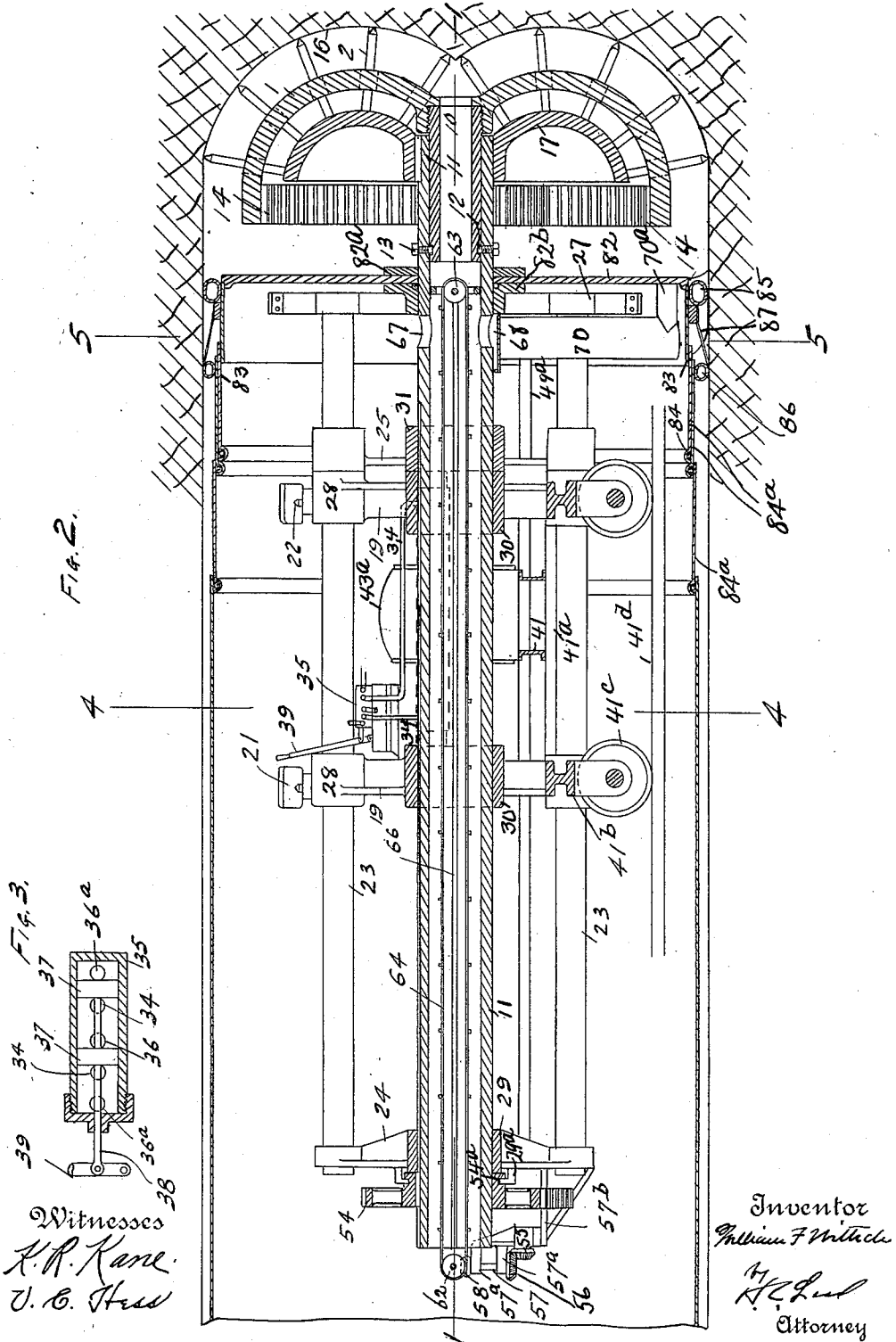


W. F. WITTICH.
SHAFT BORING AND TUNNELING MACHINE.
APPLICATION FILED NOV. 27, 1908.

1,043,185.

Patented Nov. 5, 1912.

4 SHEETS—SHEET 2.



W. F. WITTICH.
SHAFT BORING AND TUNNELING MACHINE.
APPLICATION FILED NOV. 27, 1908.

1,043,185.

Patented Nov. 5, 1912.

4 SHEETS—SHEET 3.

Fig. 5.

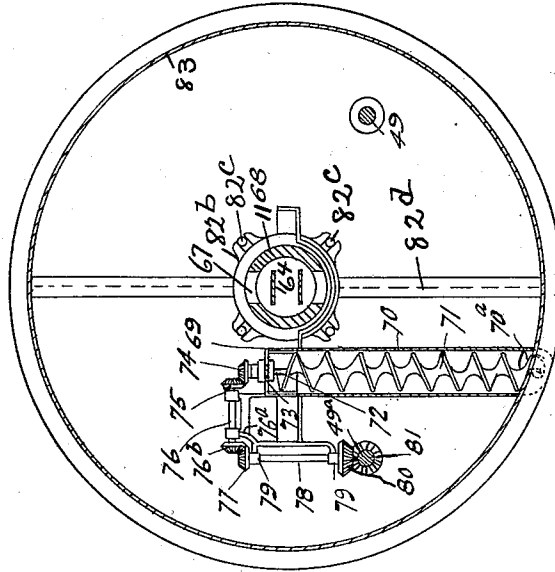
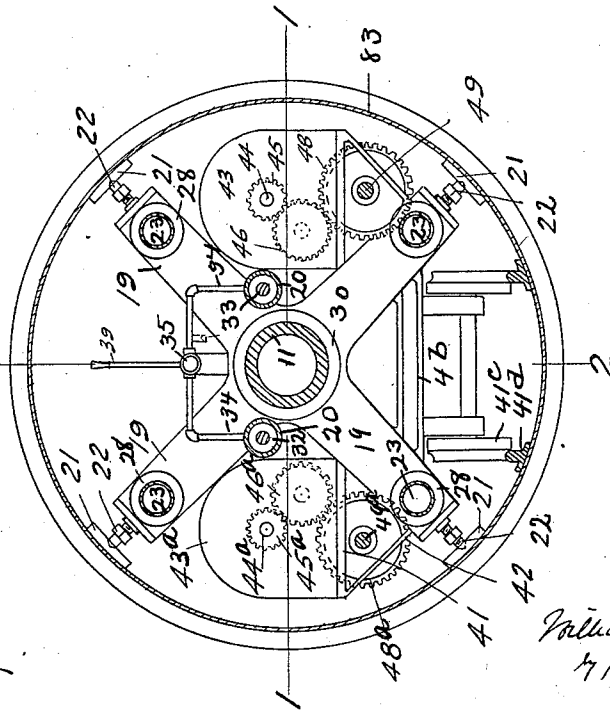


Fig. 4.



Witnesses
K. R. Kane
V. C. Hew

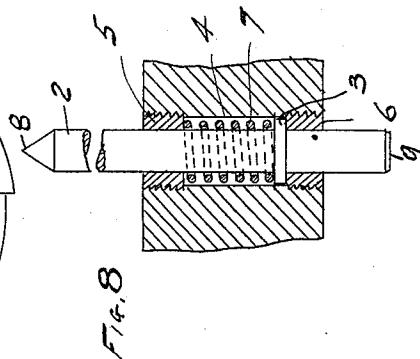
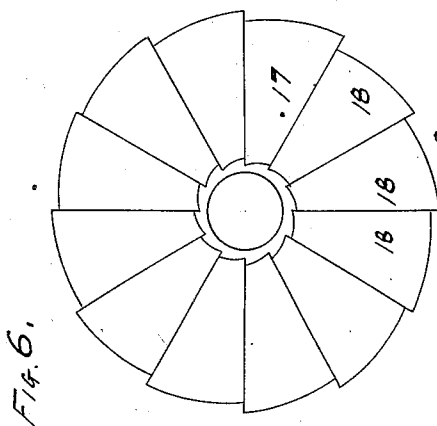
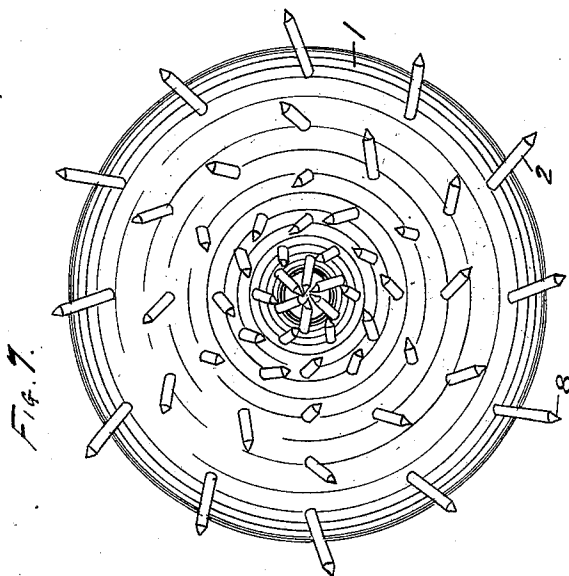
Inventor
William F. Wittich
W. F. Wittich
Attorney

W. F. WITTICH.
SHAFT BORING AND TUNNELING MACHINE.
APPLICATION FILED NOV. 27, 1908.

1,043,185.

Patented Nov. 5, 1912.

4 SHEETS—SHEET 4.



Witnesses
R. P. Kane
V. C. Hall

Inventor
William F. Wittich
by
A. L. Lind
Attorney

UNITED STATES PATENT OFFICE.

WILLIAM F. WITTICH, OF ERIE, PENNSYLVANIA.

SHAFT BORING AND TUNNELING MACHINE.

1,043,185.

Specification of Letters Patent.

Patented Nov. 5, 1912.

Application filed November 27, 1908. Serial No. 464,689.

To all whom it may concern:

Be it known that I, WILLIAM F. WITTICH, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented new and useful Improvements in Shaft Boring and Tunneling Machines, of which the following is a specification.

This invention relates to shaft boring or tunneling machines, and consists in certain improvements in the construction thereof as will be hereinafter fully described and pointed out in the claims.

In carrying out my invention I utilize a head which is rotated. In this head I mount a series of cutters, and actuate these cutters preferably independently of the head, so that the head may be advanced slowly or rapidly depending on the material being operated upon, and the cutters given a speed which will assure the greatest efficiency. In the preferred form of the machine also, the head is separated from the driving parts of the mechanisms, so that the machine may be utilized and rapidly advanced where there is considerable leakage through the walls. The invention also contemplates a suitable mounting or frame for carrying the working parts, taking away the muck and driving the several parts.

Figure 1 is a section on the line 1—1 in Figs. 2 and 4. Fig. 1^a is a detail in section of the hydraulic feeding device. Fig. 1^b is a detail of the driving gears for cutter actuating wheel. Fig. 2 is a section on the line 2—2 in Figs. 1 and 4. Fig. 3 is a section showing the valve mechanism for controlling the hydraulic feeding device. Fig. 4 is a section on the line 4—4 in Figs. 1 and 2. Fig. 5 is a section on the line 5—5 in Figs. 1 and 2. Fig. 6 is an elevation of the cam wheel. Fig. 7 an elevation of the head. Fig. 8 an enlarged section showing the manner of mounting the cutters in the head.

1 marks the head; 2 the cutters. The shank of the cutter is provided with the shoulder 3, which is arranged in the cavity 4 in the head. The cavity is formed by the plugs 5 and 6 screwed into the head and forming a bearing for the cutter. A spring 7 is tensioned between the plug 5 and shoulder 3 and tends to retract the cutter after it has been driven forward to deliver a blow. The cutter is provided with a point 8 of any desired shape. These cutters are arranged in the head in a direction to give the most

effective blow to the face 16 of the tunnel or shaft, and in consequence are arranged out of parallel some of the cutters extending somewhat in a radial direction, so that the tunnel or shaft may be of sufficient size to give ample clearance to the cutter. I prefer to form the head with a shape somewhat spherical so as to properly position the cutters for this purpose. The head is mounted on a shaft 10, and this is journaled in the end of the hollow driving shaft 11. The shaft 10 has the groove 12 and set screws 13 extend into this groove to lock the shaft 10 in place. An internal gear 14 is arranged in the inside of the head and a gear or pinion 15 meshes this internal gear on the head. The pinion 15 is supplied with devices (hereinafter described) for rotating it and the head is driven in this manner. The face 16 is therefore circular, and the machine forms a cylindrical bore or tunnel.

The cam wheel 17 is provided with a series of cam surfaces 18. The wheel is shaped to conform to the shape of the head as clearly shown in Figs. 1 and 2. This cam wheel is mounted concentrically with the head, and is fixed on the shaft 11. Independent driving mechanism is supplied for the shaft 11 and the pinion 15, so that the relative speeds of the head and cam wheel may be varied. In other words the head may be advanced very slowly while the cam wheel is kept at its normal speed. The cam surfaces 18 engage the cam ends 9 of the cutters and force them forward, so as to deliver a cutting blow on the face 16. These blows may be delivered as rapidly as desired or as is expedient to get the greatest efficiency from the machine.

The stationary frame is formed of the spiders 19. These spiders are connected by the cylinders 20 of the hydraulic feeding apparatus, which form a connection between the spiders 19. The spiders are supplied with the shoes 21 for engaging the walls of the tunnel and the expanding devices 22. The expanding devices have screws extending from the spider. By means of these expanding devices, the shoes 21 may be forced into contact with the walls of the tunnel, so as to securely anchor the stationary frame.

The sliding or movable frame is made up of longitudinal rods 23 which extend from spider 24 at the rear of the machine through the spider 25 near the front of the machine

and a spider 27. These rods 23 extend through bearings 28 in the spiders 19, the rods being free to slide in the bearings 28. The hollow shaft 11 passes through the bearings 29 in the spider 24, the bearings 30 and spiders 19, the bearing 31 and the spider 25.

The hydraulic feeding apparatus comprises the cylinders 20 in which are arranged the pistons 32. These pistons are connected by the rods 33 with the spiders 24 and 27 (see Fig. 1^a). The cylinders are of course stationary being mounted on the spiders 19, and as the piston is driven from one end or the other of the cylinder it, acting through the rods 33, forces the sliding frame forward or backward as desired. A pipe 34 leads to each end of each cylinder, and extends back to a valve case 35. The valve case has the inlet 36, for water or fluid under pressure and the exhaust passages 36^a—36^b. The valve comprises the plugs 37 connected by the stem 38. The stem 38 extends out of the valve case 35, and is secured to the handle 39 by means of which the valve may be actuated. It will readily be seen that as the valve is thrown to a central position, the water is cut off from the passages 34. When in position shown in Fig. 3, water passes from the inlet 36 to the pipe 34 at the right, while water exhausts from the pipe 34 at the left. By reversing the valve this action may be reversed. A motor frame 41 provided with a web 42 is mounted on the lower rod 23. A motor 43 is mounted on the frame and has the drive shaft 44. A gear 45 is fixed on this shaft and drives an intermediate gear 46. The intermediate gear 46 drives a gear 48 fixed on the shaft 49. The gear 15 is fixed on the shaft 49. By this means the head 1 may be driven by the motor 43 and controlled through the speed of the motor to any speed desired. The motor 43^a is also mounted on the frame 41, and drives the shaft 49^a through the shaft 44^a, gear 45^a, gear 46^a and gear 48^a in the same manner that the similar gears drive the shaft 49. The shafts 49 and 49^a are mounted in bearings 50 in the spiders 24 and 27. A gear 51 is fixed on the shaft 49^a. It meshes an intermediate gear 52. This intermediate gear is carried by the spider 24 and meshes a gear 54. The gear 54 is fixed on the hollow shaft 11. Through this mechanism the power from the motor 43 is transmitted from the shaft 11 and consequently to the cam wheel 17. The gear 54 has a groove 54^a which is engaged by a flange 29^a on the spider 24 to take the end thrust on the shaft. A bevel gear 55 on the end of the shaft 49^a meshes a beveled gear 56. The beveled gear 56 is mounted on the shaft 57, the shaft being carried in bearings 57^a arranged on a bracket 57^b extending from the spider 24 (see Fig. 2). A beveled gear 58 is arranged

on the shaft 57 and meshes a gear 59 on the shaft 60. The shaft 60 is carried in the bearings 61 extending from the spider 24. A pulley 62 is fixed on the shaft 60. A pulley 63 is mounted within the hollow shaft 11, and a conveyer belt 64 extends from the pulley 62 to the pulley 63 to convey the muck through the hollow shaft. The pulley 63 is mounted in a collar 65, and a frame 66 extends from the bearings 61 to the collar 65 to maintain the pulley 63 in alinement with the pulley 62. The hollow shaft 11 is provided with the openings 67, and a trough 68 leads to these openings, so as to carry the muck delivered to the trough to the openings. The trough 68 is in position to receive material through an opening 69 from an upright spout 70. A screw 71 is arranged in the spout 70. An opening 70^a leads to the spout 70 through which the muck may reach the spout 70. The screw 71 is mounted on the shaft 72, which is provided with a bearing 73. A gear 74 is fixed on the shaft 72 and meshes a gear 75. The gear 75 is fixed on the shaft 76. The shaft 76 is mounted in the bearings 76^a. It has a gear 76^b which meshes a gear 77. The gear 77 is fixed on the shaft 78, and this shaft is mounted in the bearings 79. A gear 80 on the shaft 78 meshes a gear 81 on the shaft 49^a. The screw 71 is driven from the shaft 49^a and consequently from the motor 43^a. The screw must of course be driven at a sufficient speed to carry the muck to the trough 68, its action on the muck being made effective by the inertia of the muck. In other words the elevation is accomplished before the muck acquires sufficient rotary motion to neutralize the action of the screw.

I arrange a bulk head 82 back of the head and in front of the motors and actuating mechanisms. The bulk head is connected with a tubular sealing device 83, made up of the telescoping rings or tubes 84^a, the joints being closed between the telescoping tubular parts by gaskets 84. I provide the hollow gasket 85 between the bulk head and the walls of the tunnel. The gasket 85 is expanded by liquid or air, so as to form a joint.

A similar gasket 86 is arranged on the second tubular joint to supplement the action of the gasket 85. It is connected with the first tubular joint by the strips 87 arranged upon the bulk head.

I prefer to form the bulk head 82 in sections, preferably two sections as clearly shown in Fig. 5. The sections are secured together by means of the collars 82^a and 82^b which are clamped together with the bolts 82^c thus closing the joint 82^d in the bulk head. The joint being of any desired form, one section preferably overlaps the other as clearly shown in Fig. 5, wherein the dotted line along the joint 82^d shows the edge of

one section and the parallel solid lines the outbend and overlapping portion of the other section. When it is desired to get at the cutters, the bolts 82^c are loosened. The section at the right of the bulk head as seen in Fig. 5, can then be pushed forward sufficiently to clear the section at the left. It is then free to be swung around the shaft sufficiently to permit of an entrance through the opening thus made.

I prefer to provide the stationary frame with a means of support, so that in shifting position it can be readily handled. For this purpose I form a truck made up of the parts 41^a extending longitudinally of the machine to cross pieces 41^b and wheels 41^c. The wheels rest on the tracks 41^d.

It will be noted that the bulk head is carried with the spider 27, and moves forward with the movable frame, the telescopic joint permitting this forward movement without breaking the seal.

What I claim as new is.

1. In a shaft boring or tunneling machine, the combination of a head; cutters mounted in the head; means for rotating the head; and devices for actuating the cutters, said means and devices being arranged to have their relative speeds varied.

2. In a shaft boring or tunneling machine, the combination of a head; cutters mounted in the head; means for rotating the head; and devices for actuating the cutters independently of the movement of the head.

3. In a shaft boring or tunneling machine, the combination of a head; cutters mounted in the head; means for rotating the head; and devices for actuating the cutters independently of said means.

4. In a shaft boring or tunneling machine, the combination of a head; cutters extending from the head in a radial direction beyond the periphery of the head, and directed to drive a shaft or tunnel to give clearance to the head and in the direction of the axis of the head; and devices for giving to said cutters a reciprocating motion.

5. In a shaft boring or tunneling machine, the combination of a head; cutters extending from the head in a radial direction beyond the periphery of the head, and directed to drive a shaft or tunnel to give clearance to the head and in the direction of the axis of the head; and a cam for reciprocating the cutters in one direction.

6. In a shaft boring or tunneling machine, the combination of a head; a series of cutters slidably mounted in said head, said cutters being out of parallel; and a cam wheel having a curved surface the general trend of which is at right angles to the direction of movement of the cutters operated upon for actuating said cutters.

7. In a shaft boring or tunneling machine, the combination of a head; a gear arranged

at the periphery of the head; cutters slidably mounted in the head; and means concentric with the head for reciprocating the cutters.

8. In a shaft boring or tunneling machine, the combination of a head; a gear arranged at the periphery of the head; cutters mounted in the head; and a cam wheel mounted concentrically with the head for actuating said cutters.

9. In a shaft boring or tunneling machine, the combination of a head; a gear at the periphery of the head; cutters slidably mounted in the head; a cam wheel having a plurality of cam surfaces for actuating said cutters, said cam wheel being mounted concentrically with the head; means for driving the cam wheel; and means acting on the gear for driving the head.

10. In a shaft boring or tunneling machine, the combination of a head having a series of openings therein; a cutter having a shoulder mounted in the opening; closures around the cutter near the ends of the opening; and a spring tensioned between the shoulder and one of the closures for moving the cutter in one direction.

11. In a shaft boring or tunneling machine, the combination of a head; cutters mounted on the head; and means for actuating the head and cutter independently.

12. In a shaft boring or tunneling machine, the combination of a head; cutters mounted on the head; a cam wheel for actuating the cutters; and means for actuating the cam wheel and the head independently.

13. In a shaft boring or tunneling machine, the combination of a head; cutters mounted on the head; a cam wheel mounted concentrically with the head and adapted to actuate the cutters; and means for driving the head and cam wheel independently.

14. In a shaft boring or tunneling machine, the combination of a head; a mounting for the head comprising a closed bulk head having a peripheral sealing device; cutters on the head; and means for driving the cutters extending through the bulk head.

15. In a shaft boring or tunneling machine, the combination of a head; a mounting for the head comprising a bulk head having a peripheral sealing device comprising a telescopic tube; and expanding gaskets on the periphery of the tube.

16. In a shaft boring or tunneling machine, the combination of a cutting mechanism; driving devices for said mechanism comprising a hollow shaft; a bulk head through which the hollow shaft extends; and means arranged in the hollow shaft for conveying muck from the machine.

17. In a shaft boring or tunneling machine, the combination of a cutting mechanism; a driving device for said mechanism

comprising a hollow shaft; a bulk head through which the hollow shaft extends; means arranged in the hollow shaft for conveying muck from the machine; and a conveyer for withdrawing material from the face of the cut and discharging it to the conveyer in the hollow shaft.

18. In a shaft boring or tunneling machine, the combination of a cutting mechanism; a hollow shaft for actuating the cutting mechanism; a conveyer in the hollow shaft; a second conveyer leading to the hollow shaft comprising a spout and screw, the screw operating upon the material by inertia; and means for driving the screw and conveyer in the hollow shaft.

19. In a shaft boring or tunneling machine, the combination of a head; cutters mounted on the head; means for driving the cutters and means for driving the head independently of the cutters, one of said means comprising a hollow shaft; and a conveyer in the hollow shaft for carrying away muck.

20. In a shaft boring or tunneling machine, the combination of a head; cutters on the head; means for driving said head and means for driving said cutters independently of said head, one of said means comprising a hollow shaft on which the head is mounted; and a conveyer arranged in the shaft for carrying away muck.

21. In a shaft boring or tunneling machine, the combination of a head; cutters mounted in the head; a hollow shaft on which the head is mounted; means actuated by the shaft for actuating the cutters and independent means for actuating the head; and a conveyer in the shaft for carrying away muck.

22. In a shaft boring or tunneling machine, the combination of a cutting head; a stationary frame comprising two spiders, and means for anchoring the spiders on the walls of the bore; a movable frame comprising spiders connected by longitudinal rods; bearings on the stationary frame in which the longitudinal rods are slidingly mounted, said movable frame forming a mounting for the head; and means for actuating the movable frame.

23. In a shaft boring or tunneling machine, the combination of a cutting head; a stationary frame; means for anchoring

the stationary frame within the walls of the bore; a movable frame slidingly mounted in the stationary frame and carrying the head; a hydraulic feeding device acting between the stationary frame and the movable frame for actuating the movable frame.

24. In a shaft boring or tunneling machine, the combination of a head; cutters mounted on said head; a stationary frame; means for anchoring the stationary frame on the walls of the bore; a movable frame slidingly mounted on the stationary frame and carrying the head; and means mounted on the movable frame for actuating the head and cutters independently.

25. In a shaft boring or tunneling machine, the combination of a cutting head; a stationary frame; a movable frame; a hollow shaft carrying the head and mounted in the movable frame; a motor mounted on the movable frame; a conveyer in the hollow shaft for carrying away muck; and means for transmitting the movement of the motor to the conveyer.

26. In a shaft boring or tunneling machine, the combination with a cutting head of a hollow driving shaft; a conveyer in the form of a belt extending into the hollow shaft; a pulley for the belt within the shaft; a mounting for the pulley around which the shaft is free to rotate; and a frame extending from the mounting to an anchor without the shaft and said anchor.

27. In a shaft boring or tunneling machine, the combination of a cutting head; a telescopic sealing bulk head; and means for advancing the head and bulk head together.

28. In a shaft boring or tunneling machine, the combination of a cutting head; a stationary frame; means for anchoring the stationary frame; a movable frame mounted on the stationary frame and carrying said head; and a bulk head carried by the movable frame and moving with the frame.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM F. WITTICH.

Witnesses:

K. R. KANE,

CHARLES G. BREVILLIER.