(No Model.) 3 Sheets—Sheet 1.

R. STANLEY.

TUNNELING MACHINE.

No. 524,149. Patented Aug. 7, 1894.

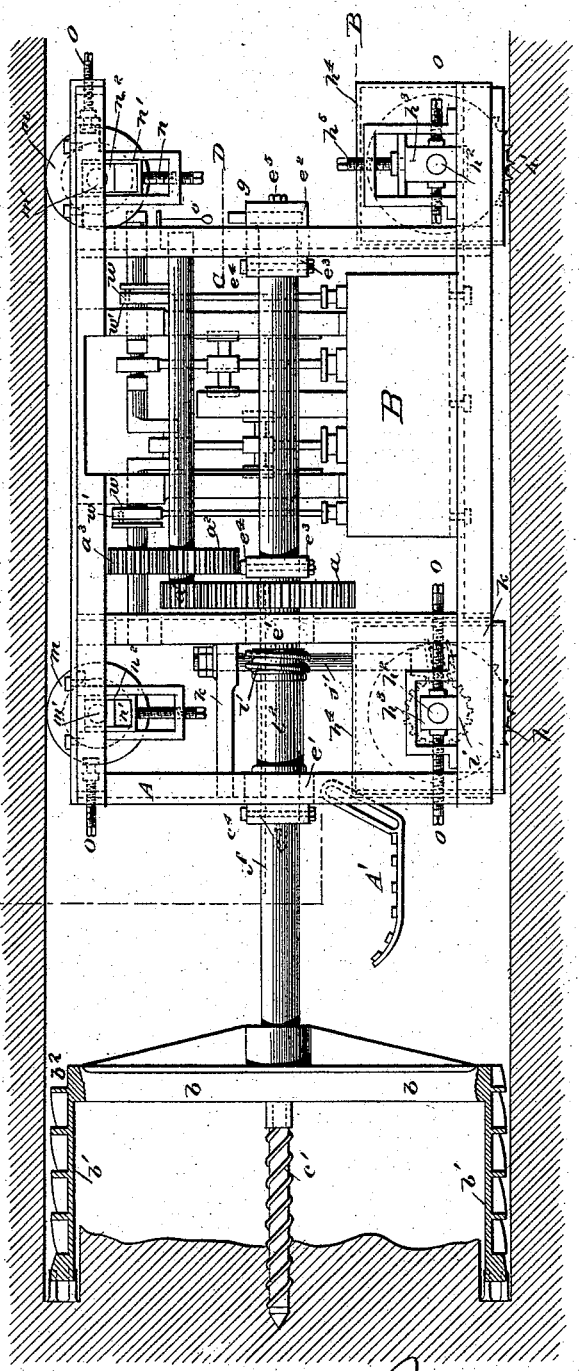

Fig. 1.

Witnesses

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Fig. 2

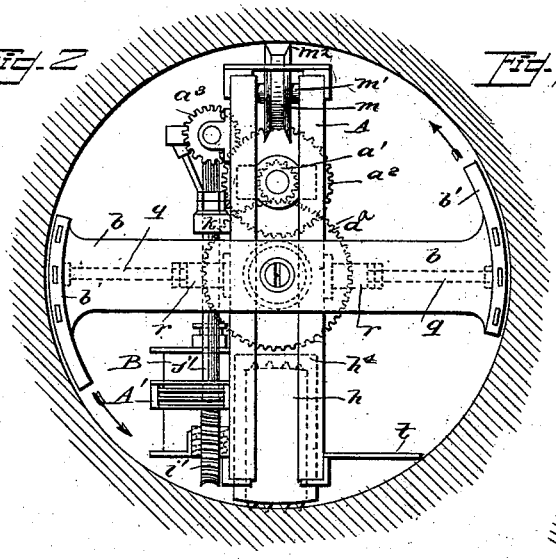


Fig. 7

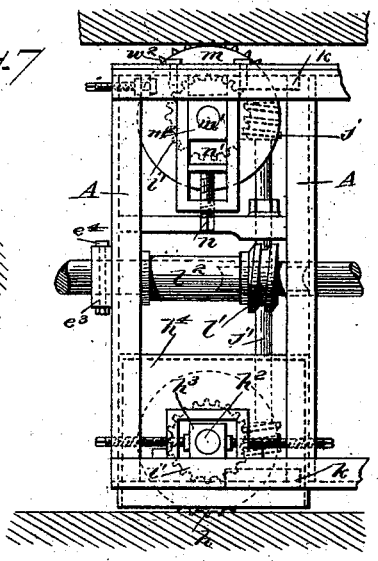


Fig. 4

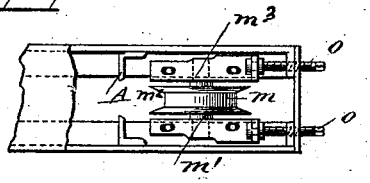


Fig. 5

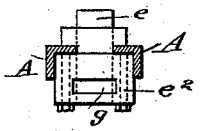


Fig. 6

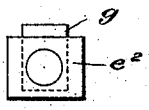


Fig. 8

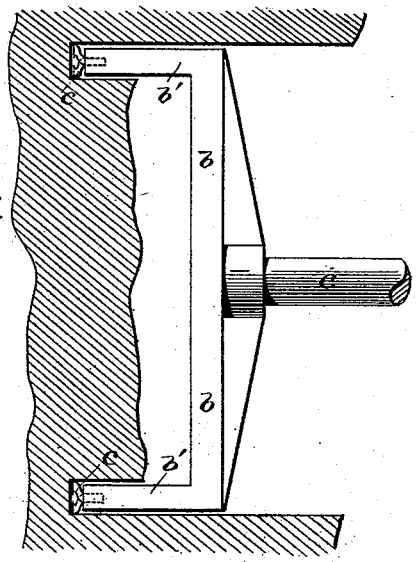


Fig. 9

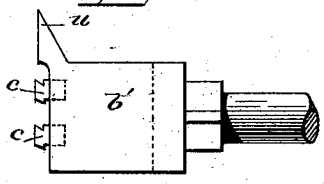
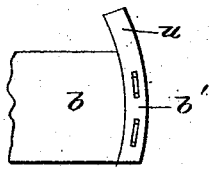


Fig. 10



Witnesses

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R. STANLEY.

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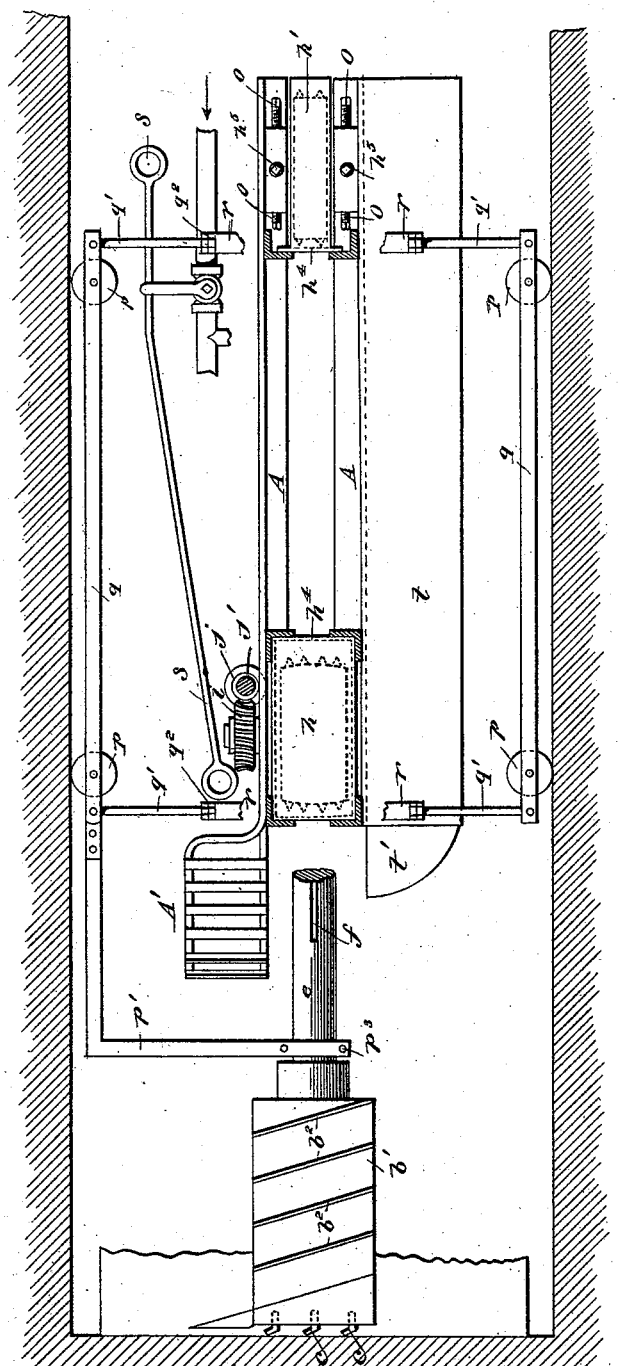

Fig. 3.

Witnesses

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UNITED STATES PATENT OFFICE.

REGINALD STANLEY, OF NUNEATON, ENGLAND.

TUNNELING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 524,149, dated August 7, 1894.

Application filed December 11, 1891. Serial No. 414,708. (No model.) Patented in England February 1, 1886, No. 1,449.

To all whom it may concern:

Be it known that I, REGINALD STANLEY, a subject of the Queen of Great Britain, residing at Nuneaton, in the county of Warwick, England, have invented certain new and useful Improvements in Tunneling-Machines, (for which I have received British Letters Patent No. 1,449, dated February 1, 1886,) of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a side elevation showing the essential parts of a machine embodying my invention. Fig. 2 is a front view of the machine. Fig. 3 is a horizontal section on the broken lines A, B, of Fig. 1, the engine for driving the machine being removed. Fig. 4 is a plan of the top at the rear end showing one of the forms of roller or wheel. Fig. 5 is a horizontal section on the line C, D, Fig. 1, showing the rear bearing of the central shaft. Fig. 6 represents an end view of the end bearing. Fig. 7 shows parts of a machine like that in Fig. 1, except that the upper wheel is spurred and is connected to the transporting devices. Fig. 8 is a side view of one, and the preferred, form of cutters and cutter carrying arms. Fig. 9 is a plan of the same. Fig. 10 is a front view of a part at the end of one of the cutter arms.

A represents the frame of the machine.

B is the motor or engine, and a, a', a^2, and a^3, the gear wheels for driving the central horizontal shaft.

b, b are the radial arms, and b', b' are the horizontal arms extending forward from the radial arms and carrying scrapers b^2.

c, c are the cutters fixed on the ends of the arms b', b'.

c' is the drill for boring the central hole in the tunnel.

All the foregoing parts except the central shaft and the cutting arms are somewhat similar to those in earlier machines which I have devised.

e is the central shaft which is mounted in bearings e', e', and e^2 on the frame A, the shaft being extended beyond the front of the frame as shown in Figs. 1 and 3, and to it are fixed the radial arms b, b. A space can be provided between the arms b and the bed frame or main frame A to allow a man to work therein, there being a seat or platform A′ pivoted to the frame A for supporting him. Or the radial arms can be brought back close to the frame A, in which case the seat or platform A′ can be turned up out of the way.

Collars e^3 are fastened to the shaft e by bolts e^4 to keep the shaft in position, said bolts e^4 being withdrawn when it is required to move the shaft back in the frame A. f is a longitudinal slot in the shaft e in which fits a key in the gear wheel a, thereby allowing the shaft e to be drawn back or pushed forward without disengaging it from the wheel a. The shaft e is revolved in the direction of the arrows, Fig. 2.

The thrust of the shaft upon the back uprights of the machine is taken by a movable thrust block g in the bearing e^3 fixed to said upright, against which movable thrust block the rear end of the shaft bears and works, when the shaft is in the position shown in Figs. 1 and 3. The said movable cleat g can be removed, and the shaft e moved back until the radial arms b are close to the front of the bed A, thereby allowing room for a man to work in front of the radial arms b when necessary to remove a cutter, or to remove the cuttings, or the core of coal, or for other purposes.

h, h' are the wheels or rollers mounted on axles h^2, h^3, which run in bearings or blocks h^3. These wheels carry the whole machine and run on the floor of the heading or roadway. They are protected from the débris from the cutters by means of covers h^4. I find it advantageous in many cases to use only the one roller h for the propulsion of the machine. This wheel or roller h, as shown in Fig. 3, is broader on the face than the other wheel h'. The periphery of the said wheel is toothed or spiked, as shown. In some cases the wheels are ribbed or roughened, and sometimes a wheel covered with an adhesive substance, like hard india rubber, will suffice for the purpose of biting or gripping the floor of the heading when the wheel is turned. For turning the said wheel h I provide its axle h^2 with a worm wheel i which gears with a worm j on the lower end of a vertical shaft j' mounted in bearings k on the bed A.

On the upper end of the shaft j' is fixed a

worm wheel l which gears with a thread or worm at l', with which the shaft e is formed or provided. When the machine is constructed in the way shown, this thread or worm l' on the shaft e is preferably feathered by a spline fitting in the slot f, so that the thread will not interfere with the movements longitudinally of the shaft e.

l^2 is a spacing washer or thimble placed between the thread or worm and one of the bearings e'. The wheel or roller h' is also toothed or spurred and arranged so that it can be adjusted vertically in relation to the bed by means of screw h^5.

m, m are wheels or rollers at the top of the bed and provided with wall engaging projections of the nature of flanges as at m^2 in Figs. 1, 2 and 4, or of the nature of spurs or teeth as in Fig. 7. The axles m' of these top wheels are arranged in adjustable bearings m^3 at the top of the bed A so that the said wheels can revolve against or penetrate the roof of the heading or tunnel. n, n are screws with which the said bearings are provided for adjusting the wheels m relatively to the bed and the tunnel wall. Blocks of elastic material n' may be placed between the screws n and the bearings n^2, thus allowing the wheels to yield to slight inequalities in the tunnel wall, when the machine is being moved. By this arrangement if the wheels m be adjusted so as to grip or bite into the roof, and if the wheel h be also adjusted so as to grip or bite into the floor, and the central shaft e be revolved, the wheel h' will also be caused to revolve and the whole machine will move forward, the cutters at the same time forming an annular groove, and the central drill c' forming the bore hole.

For the purpose of guiding, or altering the direction of, the machine, I provide the bearings of the wheels h, h' and m, m, with screws o in front and in the rear of each bearing, so that by adjusting the said screws o the direction of the wheels can be altered as desired, the movements of the wheel bearings or blocks being regulated by pins and slots.

p, p are guiding or steadying wheels or rollers, mounted on bars or rods q having extensions q' adjustable as to their length and fixed by nuts q^2 in brackets r on the sides of the bed.

p', Fig. 3, is a bar arranged at the front of the machine to protect the operator from falling coal when the machine is being worked. It can be withdrawn by removing the pins or screws at p^3.

s is a handle for operating the motor or engine B, which may be so arranged that it can be worked either from the front or the rear of the machine.

t is a plate hinged to the bed at one side, and resting against the wall of the tunnel over which the débris or cuttings can be passed, there being an inclined plate t', in front of this plate t to prevent the material from getting under the machine.

A small plumb weight v may be hung on the back of the bed A to show when the machine is upright.

When it is required to move the machine to some distance the wheels h and h' can be lifted up or removed and axles and flanged wheels may be attached, adapted to run on track rails. But ordinarily I find that all the necessary locomotion can be attained by means of the wheels h, h'.

The manner of operating the machine will be readily understood. It is first properly placed in relation to the face of the material in which the tunnel is to be formed. The diameter of the tunnel will of course be equal to the distance between the outermost cutters c. The shaft e is adjusted forward or back relatively to the bed, as desired, and the wheels h, h', m, m, are set for the direction in which the cutters c are to be guided. For instance if it is required to direct the cutters toward the right the propelling wheel h, and the top wheel m are set with a slight inclination to the right, and the back wheels m and h' are set with a slight inclination in an opposite direction; or in some cases the rear wheels m and h' can be used alone for guiding. Under such adjustment the cutters will work toward the right and the whole machine will follow. Any deviation from the vertical will be indicated by the plumb v, and the machine can be righted by adjusting the top wheels m, m, slightly in one direction, while the bottom ones h, h' are set slightly in the opposite direction; or one pair only can be adjusted.

To obtain the right elevation of the cutters c, the screw h^5 is used to raise or lower the bearing block of wheel h'. For instance, if it is desired to lower the direction of the cut, the pin h^5 is screwed down so as to raise the rear end of the machine, the screws n being slackened to correspond. After these adjustments are attained for direction and elevation screws n are turned to force the wheels m against the tunnel wall so that they shall have the necessary bite or hold thereon. One of the operatives (ordinarily) now takes his position on the seat or platform A', and by handle s starts the engine or motor. Shaft b is revolved and in turn actuates the cutters c through the arms b, b'. In this construction the bed is advanced simultaneously with the cutters, the advancing being effected by the thread at l', wheel l, worm j, wheel i on axle h^2 and wheel h. The scrapers on the cutter arms bring the cuttings from the annular groove and are, by the operative in front, placed on the support or plate t, whence they are conveyed to the rear of the machine in any suitable way.

When necessary to loosen the core, or remove any large parts of it, or for other purpose, the arms b can be drawn back, either by loosening the shaft e and moving it back relatively to the bed, or by moving the whole machine, including the bed, backward, for which the engine can be reversed. A convenient

method for such reversal is provided by fixing a loose eccentric block w with a stud w' on its side, driven by a fixed cam so arranged that when the crank shaft is turned back part of a revolution, either by a spanner or by the squared end of the shaft, the action of the engine will be reversed when power is applied. The backward motion of the machine can be faster than the feed and can be made so by suitably speeded gearing, which can be independent of the feed gearing if desired.

The wheel m may be used to assist in the propulsion of the machine, and for such purpose I prefer to form it with spurs or spikes, as shown in Fig. 7, and to connect it to the propelling mechanism by extending upward the vertical shaft j', and combining with it a worm j which gears with a worm wheel i on the axle m'.

By examining Figs. 1 and 3 it will be seen that the scrapers for the cutters are situated outside of the arms b' proper, and lie in paths of rotation different from those of said arms. In order to make a stronger cutter carrying arm I prefer to construct these parts as shown in Figs. 8 to 10. In this case the scraper lies in the path of rotation of the cutter and the cutter arm, it projecting laterally from the latter, and also forward, and lying in the annular groove directly ahead of the cutters. It is formed with a beveled or inclined outer face for throwing the cuttings backward.

I am aware of the fact that it has been heretofore proposed to construct a mining machine with a bed, supporting and transporting wheels, an engine, and a bar provided with cutters, projecting laterally from the frame. The machine referred to was intended for the forming of a "kerf" or "under-cut" of the sort produced by "mining" machines, proper. The cutter-bar projected laterally from the machine, that is to say, was so arranged that it was supported at one end only and consequently all of the side or re-actionary thrust exerted upon it was experienced by the machine in such way as to twist or turn the latter, as is the common experience with all side cut machines for forming kerfs. These machines are readily and materially distinguished from those of the class to which belongs the one herein. The present machine has its parts all so co-related that an aperture can be cut in the material directly ahead of the machine and which is of such dimensions in relation to those of the machine that the latter can be bodily passed through it. The re-actionary thrust from the cutters is directly backward, and to meet this I do not depend (as has been customary heretofore with self-propelling machines) upon merely the weight of the machine itself, but I provide a positively acting abutment which prevents the machine from retracting when the cutters are at work. Such an abutment can be provided in any one of numerous ways. As shown the spurs or wall-engaging projections on the bottom wheels h and h' provide an abutment for the machine. When the re-action is severe, it may be met also by the wheel shown in Fig. 7 for the upper or top part of the bed, this wheel also having spurs or wall-engaging projections to prevent the machine from retracting under the strain from the cutters. When the abutment comprises spurs or projections carried by rotatable wheels, the latter of course must be locked against backward rotation. In the construction shown such backward rotation is prevented by the connection with the power-transmitting devices carried by the engine, but I do not wish to be limited thereto.

In the present machine the ground wheels, h h', not only support the whole mechanism when it is in operation, but also can support it when it is being transported from one place to another in the tunnel or heading although, as above said, these wheels may be removed, and track wheels more or less similar to those in my earlier machine can be substituted at times when the apparatus is to be transported bodily from one place to another. The wheels being arranged on or near the central longitudinal vertical plane of the tunnel and of the apparatus as a whole, permit readily the lateral adjustment of the upper part of the machine, which may be required for any purpose. As they lie in the said central plane, they rest upon the lowest part of the tunnel, and are therefore assisted in moving in the proper direction, without the aid of track rails. When wheels are employed each situated at some distance away from the said central vertical plane, it is more difficult to readily adjust the upper part of the machine laterally, for if the lateral pressure be exerted in either direction, the tendency is to lift up one or the other of the supporting wheels. By having therefore the ground support as near the said central plane as possible whatever oscillation or lateral movement may be necessary can be given without throwing any part of the machine out from its full ground support. Of course I do not limit myself to having the wheels exactly in the said center plane, as there may be some variation in this respect without departing from this part of the invention, especially so long as the ends aimed at are attained. The parts at p, q', q^2, i, &c., can be used to vary the positions of the upper parts of the bed relatively to the vertical, as may be desired, the ground wheels at such times serving as the fulcrum or pivotal support upon which the lateral movement can occur.

In the aforesaid earlier machine there were two sets of wheels, one having spurs or projections to be used when the machine was at work, and the other set having flanges for running upon track rails, to be used when the machine is to be transported from one place to another. The first set of wheels were rigid in their relation to the bed, the track-

wheels alone being vertically adjustable so as to throw them down far enough to take the weight of the machine upon the track.

I claim—

1. In a tunneling machine, the combination of the bed, the rotary cutters advancing under a uniform pressure at a fixed distance from the bed and rotating around the central longitudinal axis on a radius substantially as set forth, whereby they cut a tunnel adequate to receive the whole machine, a centrally arranged shaft for supporting and rotating said cutters, a spurred wheel mounted on the bed and extended upwardly therefrom and engaging with and penetrating the upper tunnel wall, a spurred wheel upon which said bed is mounted engaging with and penetrating the floor of the tunnel, an engine on the bed and gearing connecting the engine with both said wheels for rotating them, whereby they advance the bed and receive the backward thrust of the cutters.

2. In a tunneling machine of the class described, the combination of the bed, the rotary cutters advancing under a uniform pressure at a fixed distance from the bed, and rotating around the central longitudinal axis on a radius substantially as set forth, whereby they cut a tunnel adequate to receive the entire machine, a centrally arranged shaft supporting and rotating said cutters, an abutment mounted on said bed and extending upwardly into and penetrating the tunnel wall, bed supporting and feeding wheels, an engine mounted on said bed, gearing connecting the engine with the centrally arranged shaft and gearing connecting the engine with the feeding wheels, whereby the cutters are rotated and advanced with the bed and the upwardly extending abutment, substantially as set forth.

3. In a tunneling machine of the character described, the combination of the main frame or bed, the engine mounted thereon, the crank shaft, a centrally arranged rotatable tubular bearing having a thread, propelling wheels mounted on said bed, means connecting said thread with the propelling wheels for rotating them, the cutters projecting in front of said bed, a shaft mounted in said tubular bearing and supporting and rotating said cutters, gearing connecting the crank shaft with the said centrally arranged shaft and adjusting devices for adjusting said cutter supporting shaft relatively to said tubular bearing, substantially as set forth.

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

REGINALD STANLEY.

Witnesses:
W. H. HARRIS,
FREDERICK BAXTER.