March 25, 1924. 1,488,066

A. SCHMIDT

TUNNELING OR MINING MACHINE

Filed Dec. 30, 1921 2 Sheets-Sheet 1

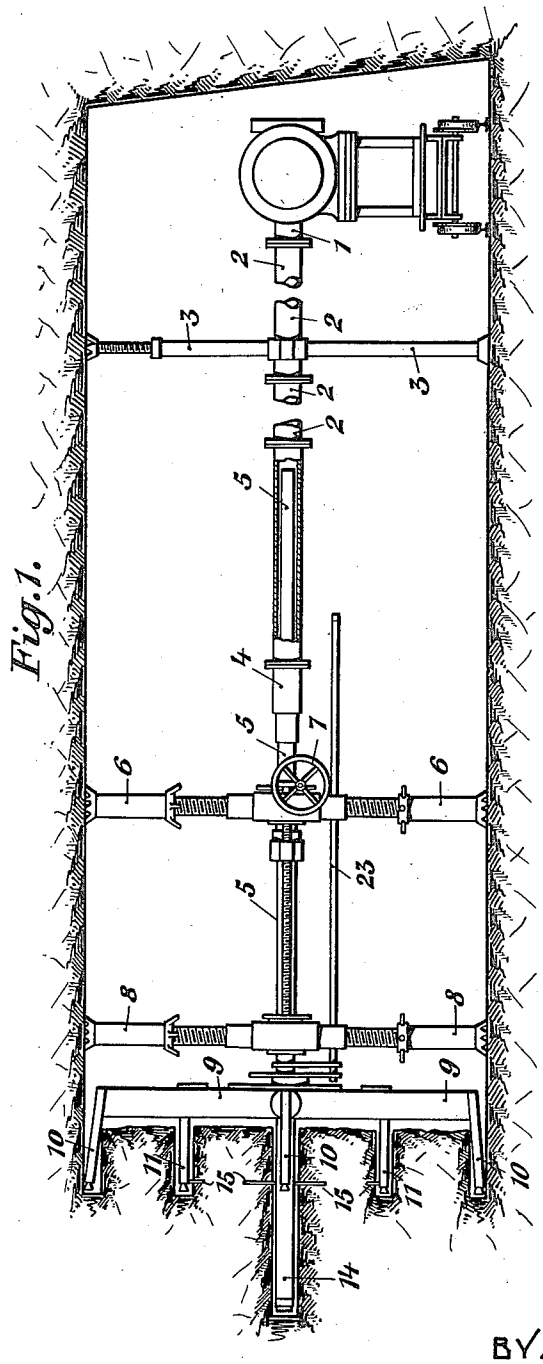


Fig. 1.

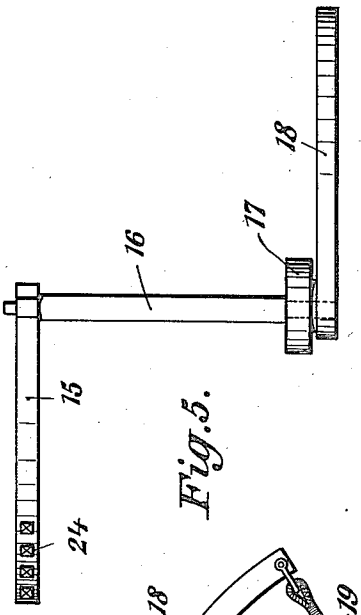


Fig. 5.

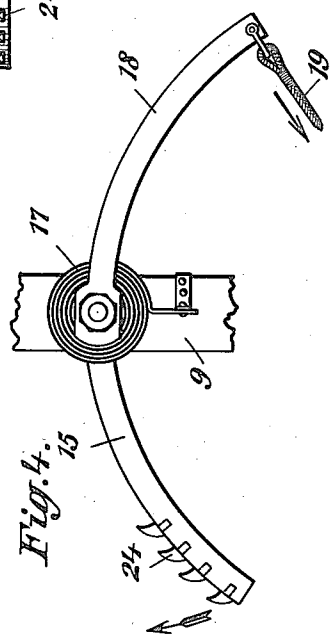


Fig. 4.

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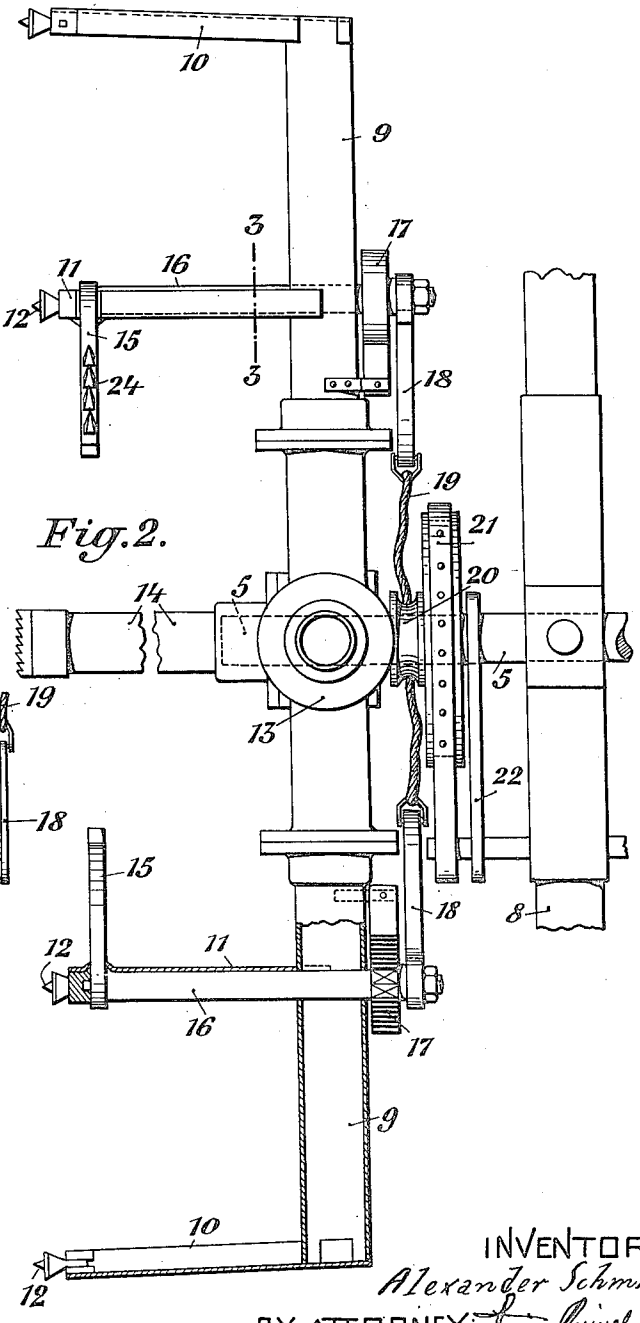



Fig. 2.

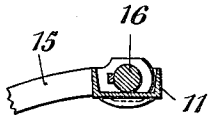



Fig. 3.

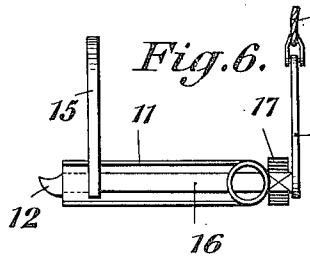



Fig. 6.

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Patented Mar. 25, 1924. 1,488,066

# UNITED STATES PATENT OFFICE.

ALEXANDER SCHMIDT, OF DOROG, HUNGARY, ASSIGNOR TO THE FIRM OF MASCHINENBAU-AKTIENGESELLSCHAFT H. FLOTTMAN & COMP., OF HERNE, GERMANY.

## TUNNELING OR MINING MACHINE.

Application filed December 30, 1921. Serial No. 525,963.

*To all whom it may concern:*

Be it known that I, ALEXANDER SCHMIDT, a citizen of Hungary, residing at Dorog, Hungary, have invented certain new and useful Improvements in Tunneling or Mining Machines, of which the following is a specification.

In tunneling or mining machines hitherto known there are provided either several crown cutters arranged on special shafts, or two cutting knives arranged in a frame, whereby in the first place by rotating and advancing the frame a circular or otherwise shaped cut or several of them are made, and thereupon the kernels thus formed are removed by means of special crown drills actuated by hand, or by means of blasting. These mining apparatus were made transportable on more or less suitable carriages and had to be advanced each time in the trench, after the material had been cut at a length corresponding to that of the shafts.

A great disadvantage of these mining or tunneling machines is to be seen in that the machines must be pulled back in the trench previous to removing the kernels of rock and then advanced again, which was necessary for two reasons, viz: since the kernels as already mentioned had to be removed by means of special processes and arrangements, for which the necessary space had first to be provided, and secondly because these devices had to be advanced proportionally to the length of their shafts towards the rock to be cut.

The present invention has for its object to provide a mining machine which first produces the kernels and then removes the latter without it being necessary to shift its position, whereby this working is repeated until a certain section has been cut down.

Accordingly the mining or tunneling machine after this invention consists of a shaft for preliminary boring and two groups of cutting tools employed successively, one of which is cutting circular rings while the other one will cut vertically the circular rings thus obtained, whereby the shaft with the preliminary cutter will produce in the rock a bore hole of any desired diameter beyond said vertical cutting surface, and thus afford guidance and bearing of the whole cutting device.

The driving device is secured in the space from which the cutting of the trench is commenced, while the mining machine is kept in touch with the rock by a corresponding extension of the shifting spindle by means of lengthening pieces.

In the annexed drawing the mining or tunneling machine according to the present invention is allustrated in one mode of construction showing a central crown cutter and two carving or cutting devices producing concentric cuts.

Fig. 1 is a side view of the whole machine.

Fig. 2 is partially a side view, and a partial section of the mining device, in which only one of the two beams forming the cross shaped frame carrying the cutter arms is illustrated.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a rear view of a part of the device for cutting the kernels.

Fig. 5 is a perspective view with the frame removed.

Fig. 6 is a diagrammatic view of another part of the kernel cutting machine.

The hollow shifting spindle 2 composed of lengthening pieces is connected with the hollow driving shaft 1 of the driving device (Fig. 1); the lengthening pieces consist of Mannesmann tubes; and the shifting spindle is journaled at suitable distances in a prop 3 provided with an adjustable bearing, and which can be tightened or slackened.

The lengthening piece connects with the end piece 4 through which extends the shaft 5 of the mining device keyed to said piece 4; and if necessary the shaft 5 may also extend into the next lengthening piece.

In proximity of the end piece 4 there is arranged a travelling prop 6, likewise provided with an adjustable bearing, and which may be likewise tightened or slackened and which carries a support, advancing and returning the drilling shaft 5. A hand wheel 7 is arranged for actuating said support.

At a suitable distance from the travelling

prop 6 the prop 8 is arranged and also provided with a bearing, which may also be tightened or slackened. Behind this prop the cutting device is mounted on the shaft 5.

The frame 9 of the cutting arrangement consists of two adjustable beams made of Mannesmann pipes disposed perpendicularly upon one another, at the ends of which there are welded four cutter arms 10, and intermediate thereof and the center four inner cutter arms 11. Said cutter arms 10 and 11 are adapted to receive the cutting tools 12 (Fig. 2).

The central part of the frame 9 that is to say the crossing point of the beams is constructed as a head mounted on the shaft 5. To the said head 13 there is secured by means of screws the crown cutter 14, which latter on the one hand makes the mining operation work easier and on the other hand serves in guiding the shaft 5.

The cutting arrangement for the kernels is connected with the inner cutter arm 11. Similarly constructed parts of the kernel cutting device are mounted together on two opposite cutter arms, so that one serves for cutting off the outer and the other one for cutting off the inner kernel.

In the cutter arm 11 (Fig. 3) constructed of U-shaped iron is disposed the cutter shaft 16 keyed to the kernel cutting arm 15, and upon which shaft after passing it through a corresponding opening of the frame 9 (Fig. 2), the spiral spring 17 and the regulator arm 18 are mounted. To this latter the regulating rope 19 is attached which is manipulated in the following manner. The end of the regulating rope is fixed on a drum 20, which is mounted free to move on the shaft 5 together with the braking disc of the brake 21, rigidly connected with said drum. Upon the shaft 5 there is mounted likewise free to move, the guiding bar 22, through which the brake bar 23 is extended so that the miner near the hand wheel 7 can also manipulate said brake bar 23.

The kernel cutter arm 15 (Fig. 4) provided with the cutting tools 24 is constructed in the form of a curve, which exactly corresponds to the curvature of the cut to be made in the rock. The cutter arm 15 (Fig. 5) and the regulating arm 18 extend in opposite directions beyond the cutter shaft 16, so that, if the regulating rope 19 (Fig. 4) is pulled in the direction of the arrow, the cutter arm 15 will move in the direction of the arrow, that is to say, in a direction opposite to the movement of the regulating arm 18.

The part of the kernel cutting device just described serves for cutting off the outer kernel. Each of such parts, as already mentioned, is in connection with two oppositely disposed cutter arms, while the two other cutter arms likewise oppositely disposed, are in connection with a constructional part each serving for cutting off the inner kernel, and which are constructed like those serving for cutting off the outer kernel, with the exception that here the kernel cutting tools are arranged on the lower side of the cutter arm 15 (Fig. 6), and that the latter as well as the regulating bar 18 are arranged at the same side of the cutter shaft 16. When manipulating the rope 19 the regulating arm 18 will move the cutter arm 15 by means of the shaft 16 in the direction of movement of the regulating arm 18.

The mounting and operation of the machine is effected in the following manner:

The electromotor driving the device is mounted together with the latter upon a truck which latter can be moved on a track arranged in longitudinal direction of the trench. As the trenches, for the purpose of an easier mounting, washing and so on, are cut at a level rising about from 22 to 24 per cent, the mining machine is fixed by means of a tackle at a point of the prepared track, to the head wall of the trench. The driving device is attached to the truck by means of a segment, allowing the driving mechanism to be adjusted independently of the angle of inclination of the trench.

After the truck has been fixed at the desired place in the track of the trench and the driving mechanism adjusted, the end-piece 4 (Fig. 1) is fixed on the hollow driving shaft 1 of the driving mechanism, when with the aid of the travelling prop 6 and the prop 8 the cutting device is brought into position, the shaft 5 of the latter being connected with the driving shaft or keyed upon the end piece 4 respectively.

The crown cutter 14 now is in close proximity to the rock or other surface to be cut. The regulating ropes 19 (Fig. 2) fixed to the drum 20 are loose on the shaft 5, and the spiral springs 17 are not under tension. The horizontal projection of the centre points of the kernel cutter arms 15, whose curvature is the same as that of the cut to be made, coincides with the centre point of the circular cut to be made by the cutter arm 11 pertaining each time to the kernel cutter arm.

The driving mechanism is set in motion by means of the electromotor, whereby the driving shaft 1 (Fig. 1) rotates the end-piece 4 and by means of the cutter shaft 5 the cutting device.

The cutting machine, which is not moved in a longitudinal direction, now rotates together with the shaft 5. With this shaft the loosely mounted braking disc of the brake 21 (Fig. 2) as well as the drum 20 rigidly connected with said braking disc is rotated, and in consequence the regulating ropes 19 suspend freely, that is to say, they rotate together with the regulating arms 18 as well as with the drum 20. The ten-

sioning device for the brake 21 loosely disposed on the brake disc and the guiding bar 22 loosely mounted on the shaft 5 and of course the braking rod 23 extending through the two latter parts does not take part in the rotation of said shaft 5.

The cutting operation commences as soon as the miner in attendance turns the hand-wheel 7 towards the material to be cut, the rotating cutting device entering the rock to be cut. During a continuous turning of the hand-wheel 7 only the crown cutter will work for a certain period, and then while the latter instrument is progressing also the cutting device will come into contact with the material to be cut. The cutting arms 10 provided with the cutting tools will carve an outer and the cutter arms 11 an inner cut which are concentric so that the rock between them forms the outer kernel. The material remaining between the boring made by the crown cutter 14 and the inner cut made by the cutter arms 11 forms the inner kernel.

The hand-wheel 7 is turned as long as the lengths of the cutter arms chosen according to local conditions, will admit. As soon as the cutter arms have reached their limit, the miner stops turning the hand wheel 7 and locks the latter. The mining device will then continue its rotation about its shaft, without requiring an advance movement, since the driving mechanism was not stopped. Now the crown cutter 14 is turning in the boring, the cutter arms 10 in the outer cut and the cutter arms 11 as well as the kernel cutting arms 15 in the inner cut; the curvature of the kernel cutter arms is equal to that of the circular cut made; the kernel cutter arms as already mentioned, being mounted in such a manner, that the horizontal projection of their center points will coincide with the centre point of the corresponding circular cut. The remaining constructional parts, especially the regulating bars 18, the loosely suspending regulating ropes 19, the drum 20 and the braking disc of the brake 21 continue rotation in the manner described.

As now the cutting process according to the conditions given, especially corresponding to the lengths of the cutter arms, is finished, the outer and inner kernels formed must be removed. For this purpose the miner turns the brake rod 23 and in consequence the band of the brake 21 (Fig. 2) will gradually press upon the braking disc and gradually prevent the latter turning in conjunction with the shaft 5. The drum 20 rigidly connected with the braking disc is also braked when a braking action is exerted upon the braking disc, and thus the regulating ropes attached to the said drum 20 are tensioned, because the regulating arms 18 continue rotation together with the whole cutting device, as already mentioned, but the regulating ropes 19 are held back by the drum 20 or are wound upon the latter respectively. The taut regulating ropes 19 proportionate to the extent of their being wound upon said drum 20, will pull the regulating arms 18 and remove the latter gradually from their inoperative position in respect of the cutter arms 11. The movement of the regulating arms 18 aided by the kernel cutting shafts 16 cause the cutter arms 15 to move correspondingly. In consequence of the continuous rotation of the cutter arms 15 the horizontal projection of the centers of curvature of these arms no longer coincides with the centre of curvature of the inner cut, whereby the kernel cutting arms now enter the material of the outer and inner kernels in respect to their outward and inward directed motion, namely to such an extent to which the opposite cutter arms 15 (Fig. 5) are turned inside or outside, while at the same time the spiral springs 17 are tensioned more and more (Fig. 2).

In consequence of the continuous totation of the cutting device the kernels are continuously cut off, so that the broken material will drop down in lumps of greater or lesser size and is conveyed from thence by means of a rocking chute or similar device, not illustrated.

After the kernels have been cut off the braking bar 23 is gradually moved back. By this the braking disc 21 of the hand brake is gradually released of the pressure of the braking device in consequence of further rotation of the cutting machine, whereupon it again rotates with the shaft 5, while the part of the regulating rope 19 wound upon the drum 20 is unreeled from the latter, and the pressure exerted upon the regulating arms 18 ceases, but the regulating ropes 19 are freely suspending just as before the cutting of the kernels. The spiral springs 17 move the regulating arms 18 and consequently also the cutter arms 15 in the inoperative position with respect to the cutter arms 11.

In order to continue cutting the rock, the operator unlocks the hand-wheel 7 and turns the latter forward again, when in consequence of the continuous and non-interrupted rotation of the cutting device the cycle of operation is repeated.

This working operation is repeated as often as the shaft 5 (Fig. 1) is advanced by means of the end-piece 4 connected with the driving shaft 1. If the limit of such connection is reached by the advances, the driving mechanism is stopped, the end-piece 4 removed and mounted again with the shifting spindle 2 consisting of only one lengthening piece for the time being, when the operation is continued. According to requirements the shifting spindle 2 is extended by

placing fresh lengthening pieces thereon, and the props 3, the travelling props 6 as well as the props 8 are mounted according to local conditions until the trench has been finished.

After the trench has been cut to its entire length, the cutting device as well as the props are dismounted, the truck together with the driving mechanism is shifted by the width of a new trench by means of the tackle, fixed in its new position and the process again repeated. In this manner the whole cutting operation is carried out.

The mining machine according to the present invention may of course be variously altered as regards its details without varying from the scope of the invention.

For instance, instead of the driving mechanism being equipped with an electromotor, it may be connected with a prime mover, and it is not absolutely necessary to construct the frame or bed as a vehicle.

Instead of the tackle any other suitable device for fixing the whole machine may be employed.

The lengthening pieces of the shifting spindle may, if desired, be interposed together with intermediate pieces between the driving and the cutter shaft.

The construction and arrangement of the props will vary according to local requirements.

The dimensions of the cutting device, especially of the frame may be chosen at will, but the frame proper will be constructed advantageously with beams adjustable longitudinally.

The use of crown cutters is advantageous with large machines, but with machines of small size such borers may be dispensed with.

The kernel cutting device, instead of a band brake, may be actuated by means of any other suitable device.

Instead of the regulating ropes regulating chains or other pulling members may be employed.

The mining machine may be employed for various purposes, for instance in mines, for cutting tunnels, pits and the like, and according to the mode of application the structural conditions of the machine are chosen.

I claim as my invention:—

1. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced.

2. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, the shaft actuating the preliminary drill drilling a hole of any desired diameter in the rock beyond said vertical cutting surface, and thus affording guidance and bearing to the whole cutting device.

3. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, both groups of cutting tools being arranged upon the same element, imparting driving motion to them at the same time.

4. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, the shaft provided with the preliminary drill simultaneously carrying the arms of the cutting tools and transmitting power from the driving shaft.

5. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, the support for the cutting tools consisting of cross-wise disposed arms, so that the material cut off may be removed without shifting back the device.

6. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, the frame for the cutting tools consisting of arms at right angles to each other and being adjustable.

7. In a mining or tunneling machine the combination of a shaft for preliminary boring with two groups of cutting tools, one of which is cutting circular rings while the other is cutting vertically the rings thus produced, the connection with the driving mechanism being effected by means of a power transmission shaft composed of interchangeable pieces.

8. A tunneling machine, comprising a frame; a series of cutter arms operatively mounted on said frame and adapted to cut, horizontally, concentric rings; and means on said cutter arms for vertically cutting said rings.

9. A tunneling machine, comprising a frame; a series of cutter arms operatively mounted on said frame and adapted to rotate to cut horizontally, concentric rings; kernel cutter arms on said cutter arms adapted to follow in the path of said rings; and cutter tools on said kernel cutter arms for vertically cutting said rings.

10. A tunneling machine, comprising a frame; a series of cutter arms operatively mounted on said frame for cutting horizontally, concentric rings, the frame being adapted to rotate; kernel cutter arms on said cutter arms adapted to follow in the path of said rings; cutter tools on said kernel cutter arms for cutting said rings; and means associated with said kernal cutting arms for vertically operating said last named arms.

In testimony whereof I have affixed my signature.

ALEXANDER SCHMIDT.

Witnesses:
ALWIN HANSCINANEY,
PAUL MASCOW.