(No Model.)

J. H. VERING.

APPARATUS FOR DRIVING TUNNELS IN WATER BEARING SOIL.

No. 438,509. Patented Oct. 14, 1890.

Fig. 2.

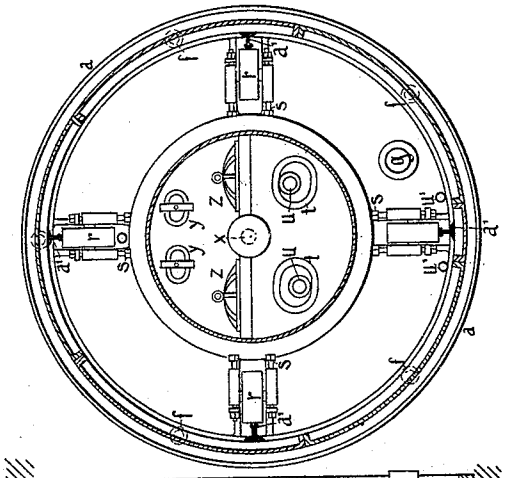
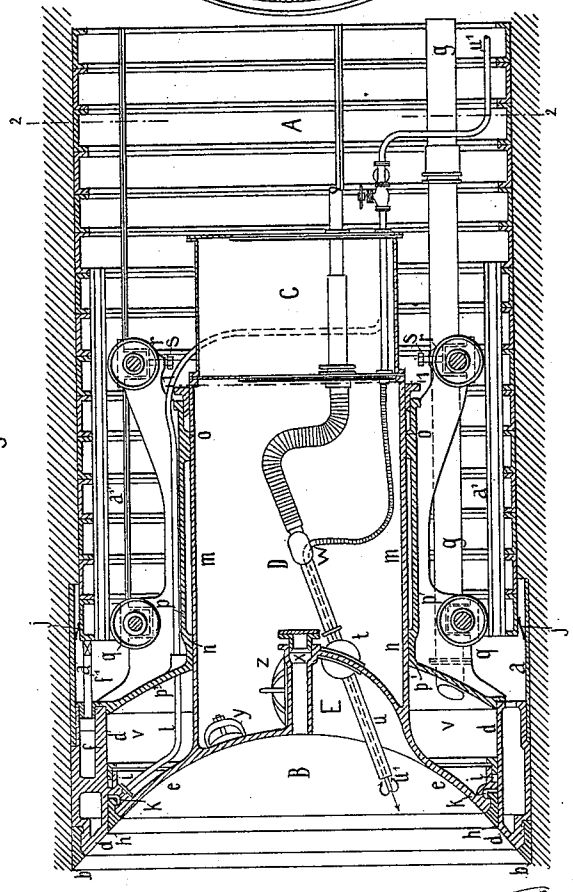


Fig. 1.



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UNITED STATES PATENT OFFICE.

JOHANN HERMANN VERING, OF HAMBURG, GERMANY.

APPARATUS FOR DRIVING TUNNELS IN WATER-BEARING SOIL.

SPECIFICATION forming part of Letters Patent No. 438,509, dated October 14, 1890.

Application filed June 2, 1888. Serial No. 275,874. (No model.) Patented in Germany April 21, 1888, No. 45,562, and in England May 18, 1888, No. 7,380.

To all whom it may concern:

Be it known that I, JOHANN HERMANN VERING, a citizen of the State of Hamburg, residing in the city of Hamburg, German Empire, have invented new and useful Improvements in Apparatus for Driving Tunnels in Water-Bearing Soil, (for which I have obtained British Letters Patent No. 7,380, dated May 18, 1888, and German Letters Patent No. 45,562, dated April 21, 1888,) whereof the following is a specification.

My invention relates to apparatus for driving tunnels in water-bearing soil.

The improved apparatus forming the subject of the invention consists, mainly, in a shield composed of an outer annular part or ring, an inner part or piston adapted to slide in the former, and means for alternately pushing the two parts forward while the soil is being removed or displaced. Besides, the invention comprises contrivances for guiding the shield and imparting to the same the required direction and for scouring the surfaces of contact between the two aforesaid parts by means of a current of water, and the combination, with the shield, of an air-chamber and an air-lock for allowing the excavating work to be carried out under air-pressure.

On the annexed sheet of drawings, Figure 1 represents in longitudinal section an apparatus of my invention in working position within a tunnel. Fig. 2 is a transverse section on the lines 1 1 and 2 2.

In Fig. 1, *d* is the annular part or ring, and *e* the inner part or piston sliding in the former. The ring *d* has at its rear end a cylindrical extension *a*, being flush on the outside with the ring. Within this extension the lining A of the tunnel (supposed in the drawings to consist of iron rings cast in segments) is built up.

For preventing an influx of water between the lining and the cylinder *a* the latter is provided with a sleeve *j*, of india-rubber or leather.

The piston *e* is tightened against the ring *d* by means of the stuffing-box *i*. The said parts *d* and *e* may be alternately moved forward by any suitable means. For moving the ring *d* the drawings show the same provided with hydraulic jacks *f*, having pistons, the rods *f'* whereof abut against the lining A, so that after the pistons have been pushed inward in the cylinders of the jacks and the lining has been completed up to the outer ends of the piston-rods the ring *d* may be pushed forward by forcing water into the jacks. Instead of these hydraulic jacks, screw-jacks or other like devices may, however, be employed.

The piston *e* is fitted at the rear with a cylinder *m*, forming a chamber D, from which the operations required for loosening and removing the soil in front of the shield are carried out. This cylinder is inclosed and arranged to slide in a cylinder *p*, connected by a flange *p'* to the ring *d*, a space *v* being thereby formed, which is put in communication by a pipe *g* with a pump or an air-compressor (not shown in the drawings,) so that when water or air is forced into the space *v* the piston *e* will be driven forward.

For keeping the joint between the ring *d* and the piston *e* clean of sand the latter is fitted with a channel *k*, communicating by a pipe *l* with the water-supply pipe *w* and by holes with the said joint, this arrangement allowing the joint to be scoured by a current of water.

The whole apparatus is guided in the finished portion of the tunnel by means of eight rollers *q* and *r*, running on or bearing against rails *a'*, the rollers *q* having bearings with fixed brasses, while the brasses of the bearings for the rollers *r* are adjustable by means of the screws *s*, in order that the direction in which the apparatus is moved forward may be regulated and that it may be changed in case the tunnel is to be driven in a curve.

The ring *d* is beveled at the inside of its front end, so as to present at its periphery a sharp edge *b*, adapted to penetrate with facility into the soil. The piston *e*, whose face B is concave, has a like edge *h*.

The soil in front of the shield may be removed by any suitable means. The drawings show for this purpose two pipes *u* passing through the shield and made movable therein by means of balls *t*, turning in sockets, the said pipes being connected to a suction-pump.

(Not shown in the drawings.) Through the pipes u are passed smaller pipes u' for forcing water or air outward, and thus loosening the soil round about the end of the pipes u.

In view of allowing rotating stirrers to be employed for the loosening operation, the shield is provided in its center with a stuffing-box x, forming a bearing for the shaft of the stirrers.

As it may happen that for carrying out certain parts of the excavating work—such as the removal of stones—the shield has to be opened, and as in water-bearing soil this can only be done under air-pressure, the chamber D is provided with an air-lock C, and it is under these circumstances supplied with compressed air. The communication between the chamber D and the outside of the shield is established by means of apertures at the top of inward extension E of the shield, which in the usual course of the work are closed by the covers z.

At y y holes are arranged, designed to have inserted thereinto, in case of need, perforated balls alike to the balls t, and through which rods may be passed for stirring the soil. Ordinarily the said holes are, however, closed by covers.

The operation by means of the described apparatus is carried out by first pushing forward the ring d, the piston e meanwhile remaining stationary or being allowed to recede in the measure as the soil is displaced by the ring. Thereupon the piston is advanced while the soil is removed. In case a tunnel is driven at but a small depth below the bed of a river the soil may be simply forced upward into the river subsequent to its being loosened.

I claim as my invention—

1. In a tunneling apparatus, the combination together of a ring d, having a beveled front end and a cylindrical extension a at its rear end, a piston e, adapted to slide in the said ring, and means for separately pushing the ring and the piston forward, substantially as and for the purpose specified.

2. In a tunneling apparatus, the combination together of a ring d, carrying a cylinder p, fixed thereto by a flange p', a piston e, sliding in the ring d and having the cylinder m arranged to slide in the cylinder p, means for pushing the ring forward, and pipe g, for introducing a fluid under pressure into the space v, formed between the flange p' and the piston e, substantially as and for the purpose set forth.

3. In a tunneling apparatus, the combination together of a ring d, carrying bearings, rollers q and r, mounted in the said bearings, brasses for the bearings of the rollers r, that are adjustable therein, screws s, for adjusting the said brasses, rails a', piston e, and means for separately advancing the ring and the piston, substantially as and for the purpose described.

4. In a tunneling apparatus, the combination together of a ring d, a piston e, having a stuffing-box i, channel k, and perforations extending therefrom to the periphery of the piston, and water-supply pipe l, connected with the channel k, substantially as and for the purpose specified.

5. In a tunneling apparatus, the combination together of a ring d, a piston e, with cylinder m, forming an air-chamber, the air-lock C, and means for forcing air into the cylinder m, substantially as and for the purpose set forth.

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

JOHANN HERMANN VERING.

Witnesses:

CHAS. H. BURKE,

J. ERWING BUCK.