(No Model.)

2 Sheets—Sheet 1.

# S. MATTSON.

## METHOD OF AND APPARATUS FOR TUNNELING.

No. 427,339. Patented May 6, 1890.

Fig. 1.

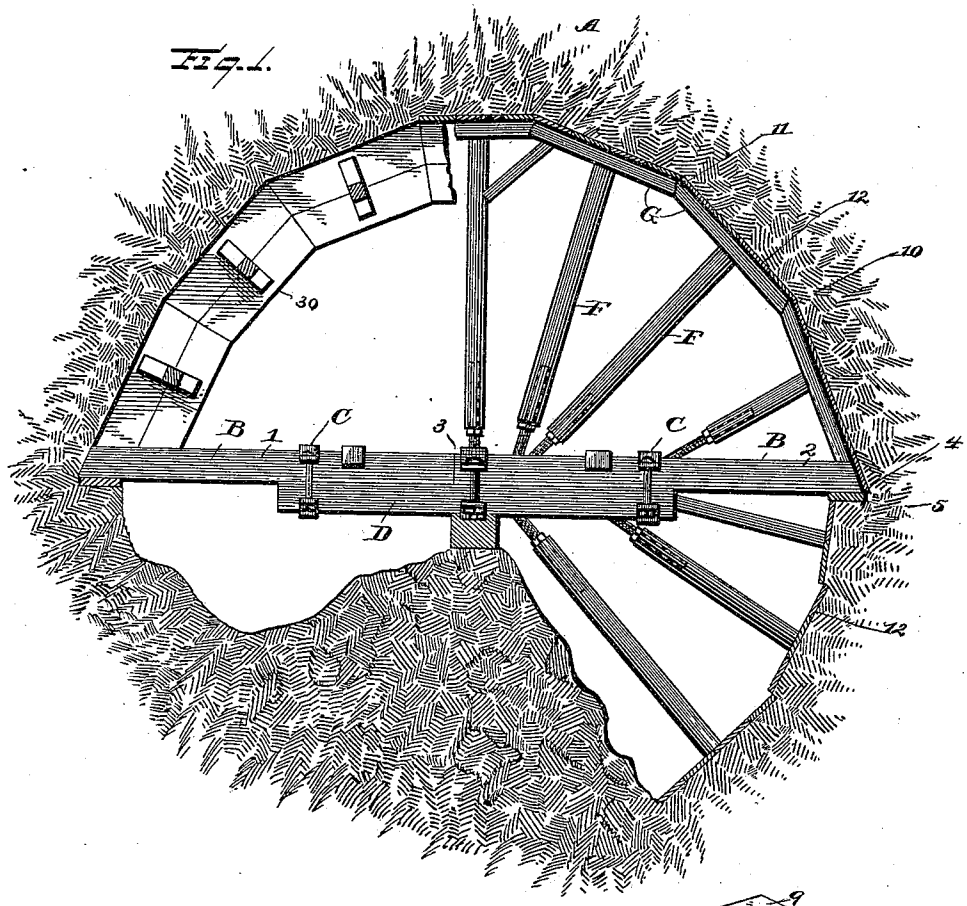



Fig. 6.

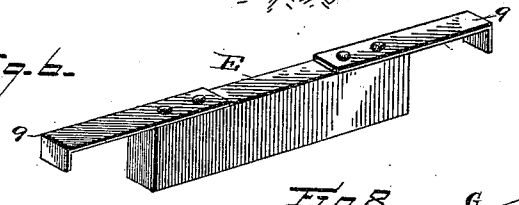



Fig. 8.

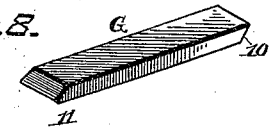
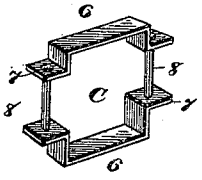



Fig. 7.




WITNESSES:

E. Hardeman

E. E. Higdon

INVENTOR

Samuel Mattson.

BY Higdon & Higdon

HIS ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 2 Sheets—Sheet 2.

# S. MATTSON.

## METHOD OF AND APPARATUS FOR TUNNELING.

No. 427,339. Patented May 6, 1890.

Fig. 2.

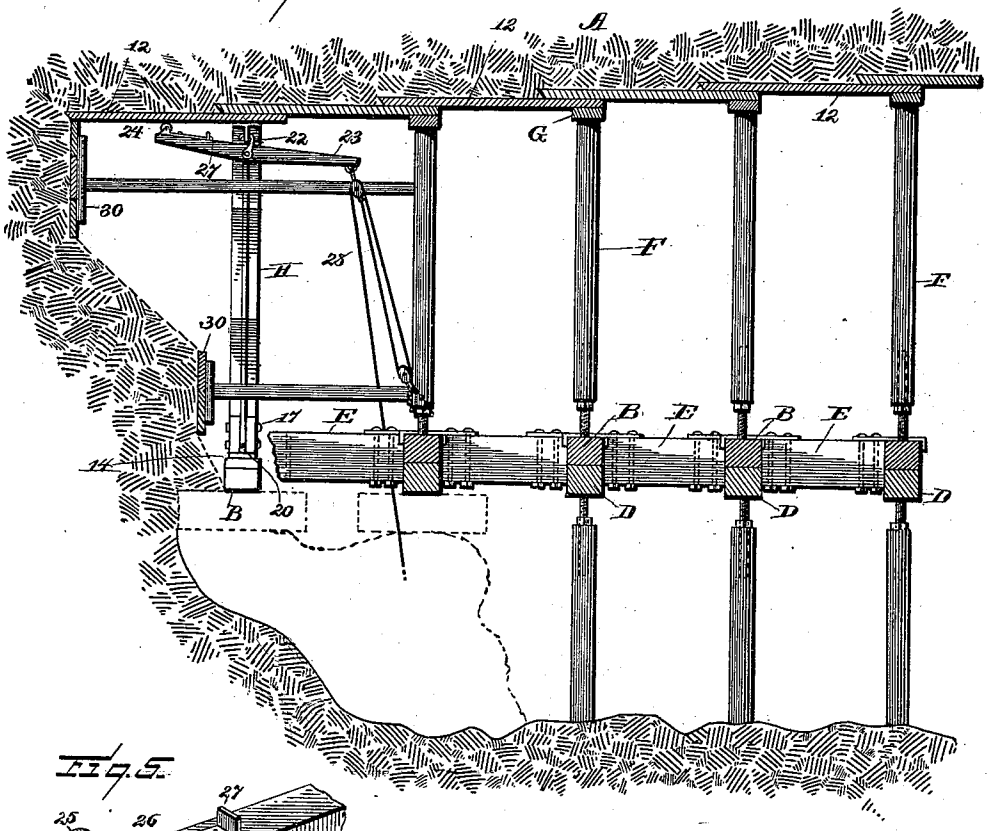



Fig. 5.

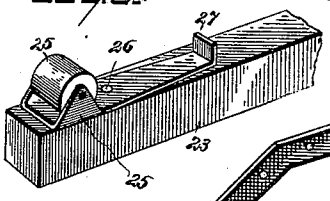



Fig. 3.

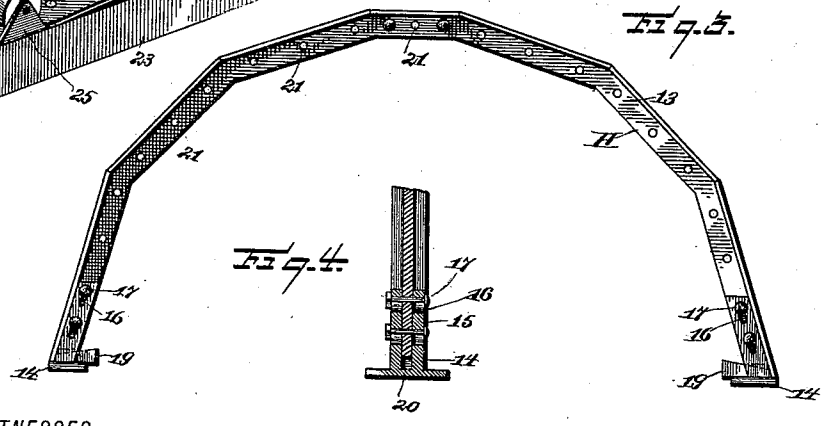



Fig. 4.




WITNESSES:

E. C. Hurdeman

E. E. Higdon

INVENTOR

Samuel Mattson

BY Higdon & Higdon

HIS ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

SAMUEL MATTSON, OF JERSEY CITY, NEW JERSEY.

## METHOD OF AND APPARATUS FOR TUNNELING.

SPECIFICATION forming part of Letters Patent No. 427,339, dated May 6, 1890.

Application filed January 25, 1890. Serial No. 338,060. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL MATTSON, of Jersey City, Hudson county, State of New Jersey, have invented certain new and useful Improvements in Methods of and Apparatus for Tunneling, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to tunneling; and it consists in the improved method or process and devices and combination and arrangement of devices hereinafter set forth, and pointed out in the annexed claims.

In the drawings, Figure 1 is a sectional end elevation showing a tunnel partly constructed according to my invention; and Fig. 2 is a longitudinal sectional view of same, exhibiting the improved mechanism. Fig. 3 is a side view of a curved rib or metallic arch-bar used in making up the invention. Fig. 4 is a detail section of the foot or lower ends of said rib or arch-bar, showing the construction thereof. Fig. 5 is a detail view in perspective of the forward end of a traveling lever having a swiveling roller mounted thereon. Fig. 6 is a detail view of a bracing-block. Fig. 7 is a perspective view of a clamp, and Fig. 8 is a similar view of my improved head-block.

A indicates the earth or material through which the excavation is to be made, the method and mechanism being more particularly adapted for use in sandy regions, or where the material is liable to cave or drift.

B are a series of heavy sills of wood, though of course they may be of channel-iron, which are made in two sections 1 and 2, having a joint 3 at about the center of their length, and adapted to be placed transversely across the tunnel and be removed from time to time during the progress of the work, the outer ends of said sections resting in suitable recesses 4 in the tunnel-walls and having shores or planks 5 located beneath them to form a footing for same.

C are a series of clamps, having opposite jaws 6, provided with apertured ends 7 and bolts 8, which embrace the sections of the sills B, and also a supplemental sill D, located beneath the sections of said sills B, so as to break joints therewith and form a very adequate support therefor, such construction not only making the sills almost as strong as if they were integral from end to end, but also permitting their placement and removal with the expenditure of the least amount of labor, as before referred to.

E are a series of bracing-blocks, having hooks 9 at each end and at the upper side thereof only, said hooks being turned downwardly at their outer ends, said blocks being adapted to be dropped or placed between contiguous sills with their hooks extending over the upper surface of same, for the purpose of bracing or firmly binding together said series of sills, and yet being capable of ready displacement, when required, by simply lifting them upward, as will readily be understood.

F are a series of screw-braces, having a jack-screw at their lower or inner ends, which is adapted to engage the sills upon both upper and lower sides, and the upper ends of which are to engage the earth or head-blocks—such as G—in the well-known way. Said blocks G have beveled or angular ends 10 and 11, for purposes which will be explained further on, and their function is to support and prevent warping and inward bulging of the sheathing-boards by the material pressing upon their exterior surface.

H is a curved rib or metallic arch-bar bent to the radius of the tunnel-bore, or a little smaller, for permitting insertion of sheathing-boards 12 between it and the walls of the tunnel. It may have a continuous and uninterrupted curve imparted to it, or it may be angularly bent, with straight portions 13 throughout its length, accordingly as the tunnel-bore is smooth or angular. If angular, then the arch-bar should be bent into sections or segments, and, likewise, if circular in cross-section the arch-bar should be correspondingly bent.

The foot or lower end of each end of the arch-bar H is provided with an extensible or telescopic attachment, whereby it may first be located and then urged upwardly into place, such attachment comprising foot-piece 14, having one or more upwardly-projecting

ribs or flanges 15, which flanges are slotted or provided with slots 16 for passage of fastening-bolts 17, and the lower ends of said arch-bar are apertured for passage of these same bolts. (See Fig. 4.) A wedge 19 is to be driven into the space 20 between the lower ends of said arch-bar and said extension's foot-piece after the bolts have been set up to the more firmly support the device. This arch-bar is preferably made of iron or steel, having a cross-section that is T-shaped, and a series of holes 21 are punched through the inner web thereof, which holes are to be engaged by a hook—such as 22—for the purpose of suspending from said bar a supporting-lever 23, as will be immediately described.

The supporting-lever 23 has a hook or other suitable device attached to it at a proper point intermediate of its length, said hook constituting the fulcrum-point of said lever, whereby it may be suspended from any of the several holes 21 in the arch-bar, and upon its forward or free end a swiveling roller is mounted in the following manner, viz: 24 is said roller, which is journaled in a frame 25, that is pivoted at 26 to the upper side of the lever, so as to be turned by means of the projection 27 in any suitable direction. The purpose of this is to guide or direct the sheathing-boards in driving same in any direction desired, as will more fully appear hereinafter. Ordinary tackle (composed of two or more blocks and a rope) 28 is attached to the end of lever 23, that is opposite the roller 24, for the purpose of urging said roller forcibly up against the sheathing-boards. If preferred, however, any other suitable device or mechanism may be employed for this purpose last named. It will be observed that the sills B are diametrically located with respect to the cylindrical bore of the excavation, being adjusted according to the diameter of the said bore. It will also be noted that they form supports for the inner ends of the radially-located braces F F. It will be further observed that the lever 23 is a "suspended support" for the sheathing during insertion or driving of the latter, and that said suspended support is capable of being gradually moved forward as the heading recedes during the excavating operation.

The operation is as follows: An excavation is first made at the upper portion of the heading—that is, the upper part of the tunnel is always excavated in advance of the lower part. Then the arch-bar H is set in place with its extensions resting upon suitable blocks, which operation is accomplished by first loosening up the bolts 17 and making the arch-bar occupy less vertical space, then urging it up firmly against the roof of the excavation by driving wedges 19 or otherwise, and then screwing up the nuts of said bolts, so as to lock the extensions rigidly to the ends of said arch-bar. Then the lever 23 is suspended from hook 22, which hook is caused to engage a suitable one of the holes 21 in the arch-bar and the tackle is placed in position; or other equivalent means are provided for depressing the free end of said lever, such as a compound lever. Meanwhile bulkheads 30, of usual construction, may be placed in position to support the heading in case it be loose and liable to crumble. Thus it is that the upper portion of the heading is excavated first. Then sheathing-boards 12 are placed above the lever 23, so that the roller it carries will bear upon their exterior surface, and said boards are driven forward to proper place by means of sledge-hammers or mauls or other suitable devices, the hook 22 being changed from one hole to another of the arch-bar, so as to permit driving of sheathing throughout the entire upper surface of the excavation and at same time support the weight of the overhanging material during the driving operation. After one course of sheathing has been driven to place then farther forward excavation is made, and the arch-bar and its attachments are moved forward and the operation repeated, and so on. Meanwhile a series of the sectional sills B are placed in position, as before described, the brace-blocks E, having hooks 9 at their ends, being used to brace said sills intermediate of their lengths and bind them all firmly together. Screw-braces F are located with their inner ends engaging said series of sills and with their outer ends engaging head-blocks G (or it may be the sheathing-boards direct) to support the sheathing-boards as they are driven to place, and so on until the tunnel has been completed. The ends of some of the head-blocks G being cut off at an angle at opposite ends 10 and 11, the inclines thereof being in the same direction with respect to their faces, their removal without disturbing the one next adjacent is greatly facilitated. In fact, it is apparent that ordinary blocks could not be removed at all without driving out sidewise, this sidewise driving being the usual way in which these head-blocks (devoid of my angular ends) have been removed from their positions. Therefore it is evident that by so beveling or inclining their ends they may be removed without recourse to side driving, but may simply be withdrawn in a line with the sills B without disturbing the one next adjacent, which is a considerable improvement over the old construction. Of course as the upper portion of the excavation progresses the lower portion is also carried forward, but always at some distance in rear of the upper portion, so as to permit the use of ground for supports for the arch-bar and the sills and other devices used in carrying on the work.

By the use of my improved suspended support the labor of a considerable number of men which were heretofore required to be present is dispensed with, one man being sufficient to operate the tackle and lever. The use of the diametrically-located sills having adjustable and removable sections also obviates the expenditure of much excavating in placing them.

Having thus described my invention, what I claim is—

1. The curved rib or arch-bar bent to the radius of the tunnel-bore and having extensible ends formed by a foot-piece having two upwardly-projecting flanges provided with slots, through which a bolt passes, thus adjustably securing the foot-piece to the arch-bar, substantially as described.

2. The bracing-blocks E, having hooks at each end or at one end, said hooks turned down at their outer ends, substantially as specified.

3. The curved rib or arch-bar T-shaped in cross-section, having a series of holes at suitable distances apart, adapted to be engaged by a hook which supports a suspended support, movable along the bore of the tunnel, for use in driving sheathing or linings in place, said rib or arch having an extensible foot-piece provided with one or more flanges provided with slots, through which a bolt passes to secure the extensible foot-piece to the rib or arch-bar, the whole resting on a suitable base-piece B, substantially as hereinbefore described.

4. In a tunneling apparatus, a suspended support for linings, in combination with a metallic arch-bar, from which said support is adapted to be suspended.

5. The rib or arch-bar having a series of apertures, in combination with a hook adapted to engage these apertures and a lever adapted to be suspended from said hook.

6. The suspended support provided with a swiveling roller.

7. The head G, having its ends cut off at an angle, the incline at each end being in the same direction, substantially as described.

8. In a tunneling system, the improvement in the art of excavating and lining, which consists in first excavating the upper portion of a heading, and, second, in supporting from above the linings during the driving operation, substantially as herein set forth.

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

SAMUEL MATTSON.

Witnesses:
C. K. JONES,
JNO. C. HIGDON.