No. 867,520. PATENTED OCT. 1, 1907.

D. MAXWELL.

APPARATUS FOR TUNNELING.

APPLICATION FILED AUG. 25, 1904. RENEWED FEB. 4, 1907.

6 SHEETS—SHEET 1.

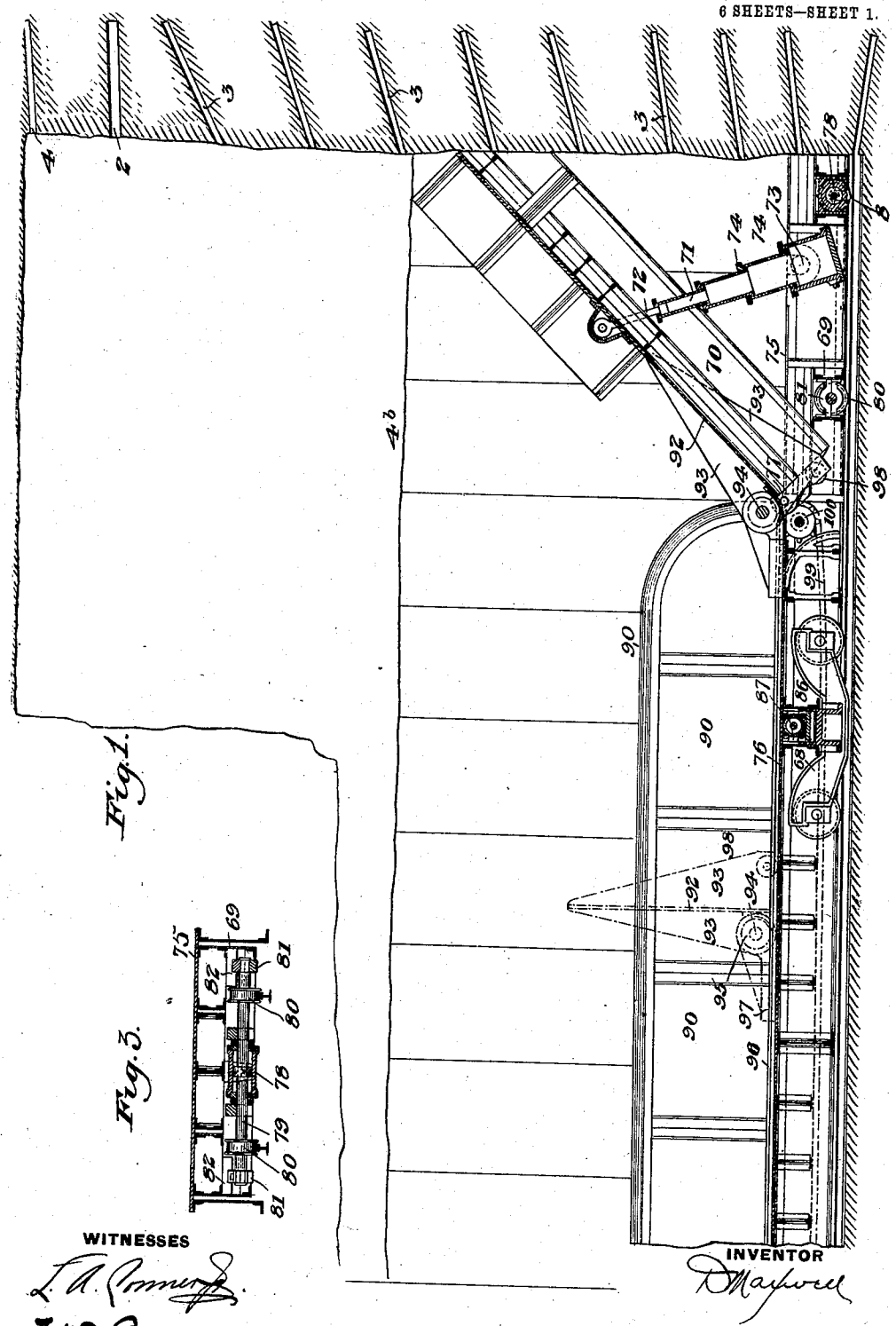


Fig. 1.

Fig. 3.

WITNESSES

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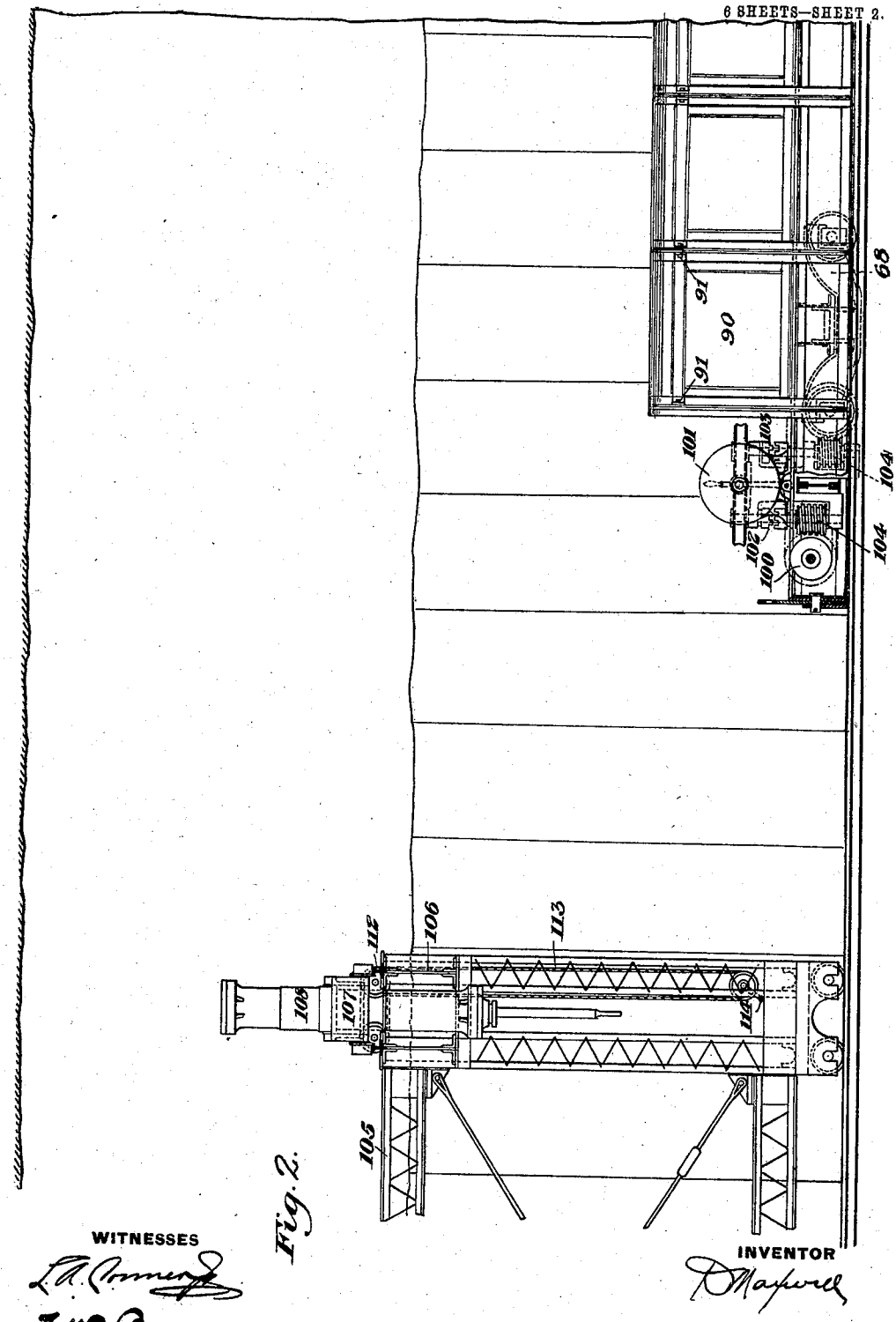


Fig. 2.

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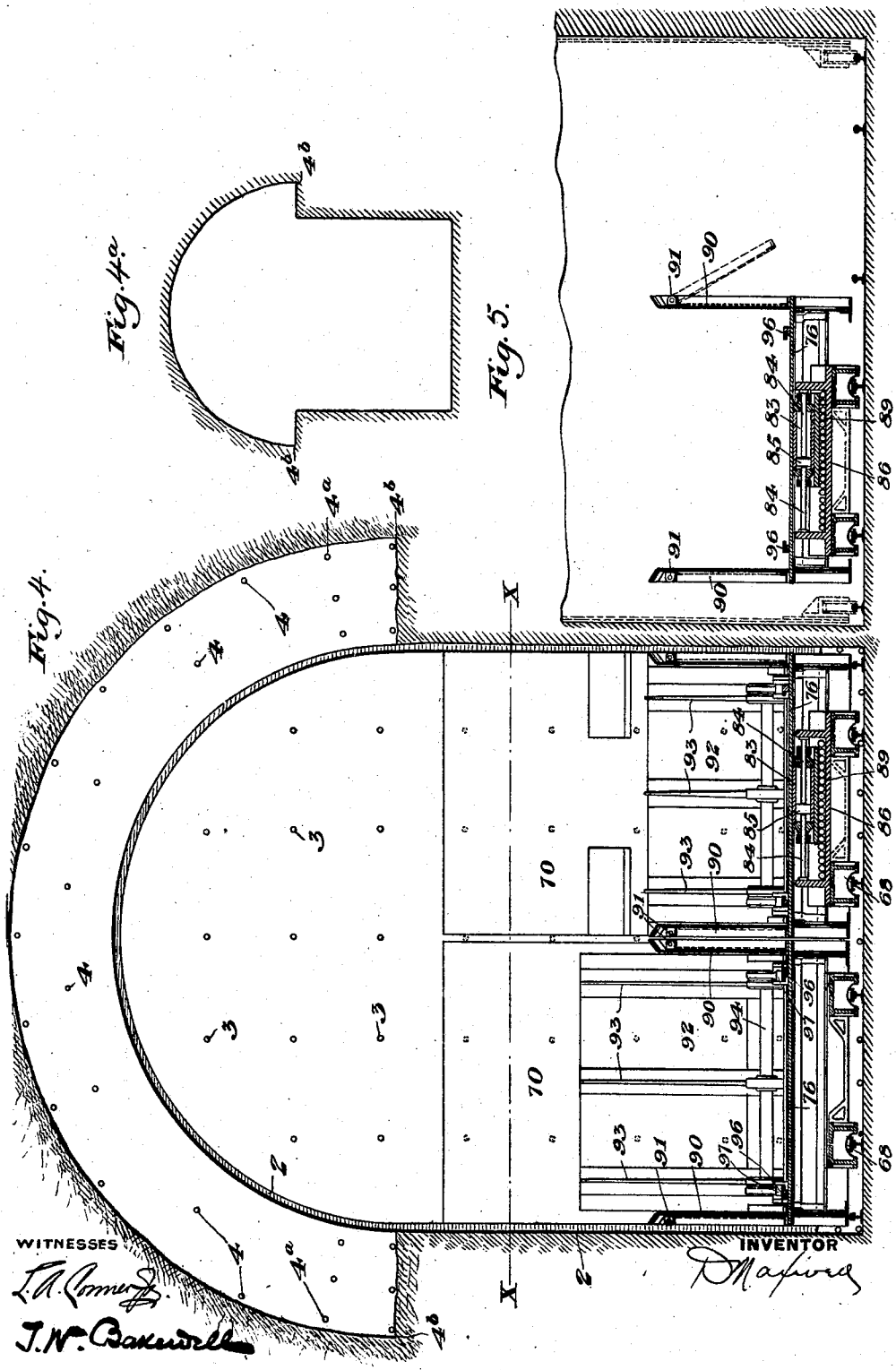
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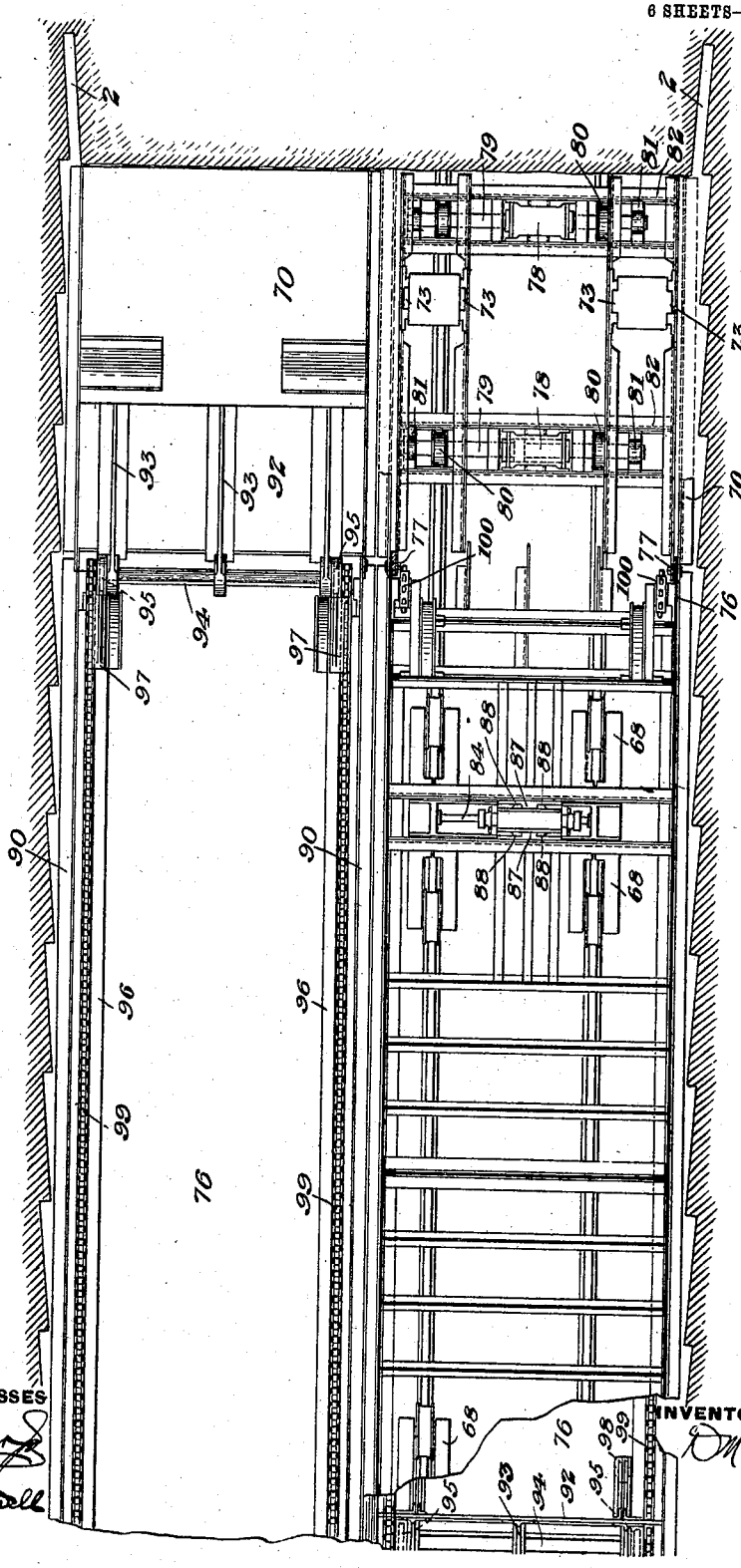
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6 SHEETS—SHEET 4.

Fig. 6.



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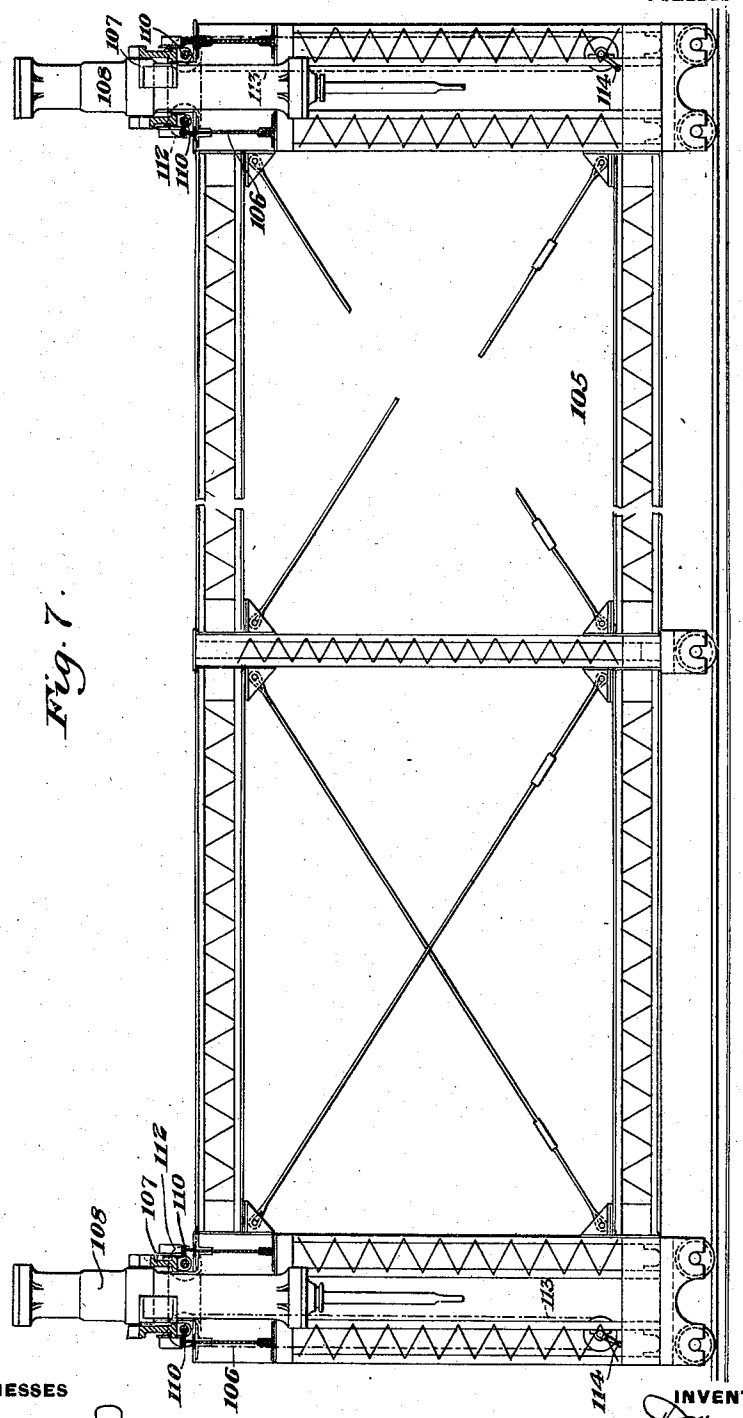


Fig. 7.

WITNESSES

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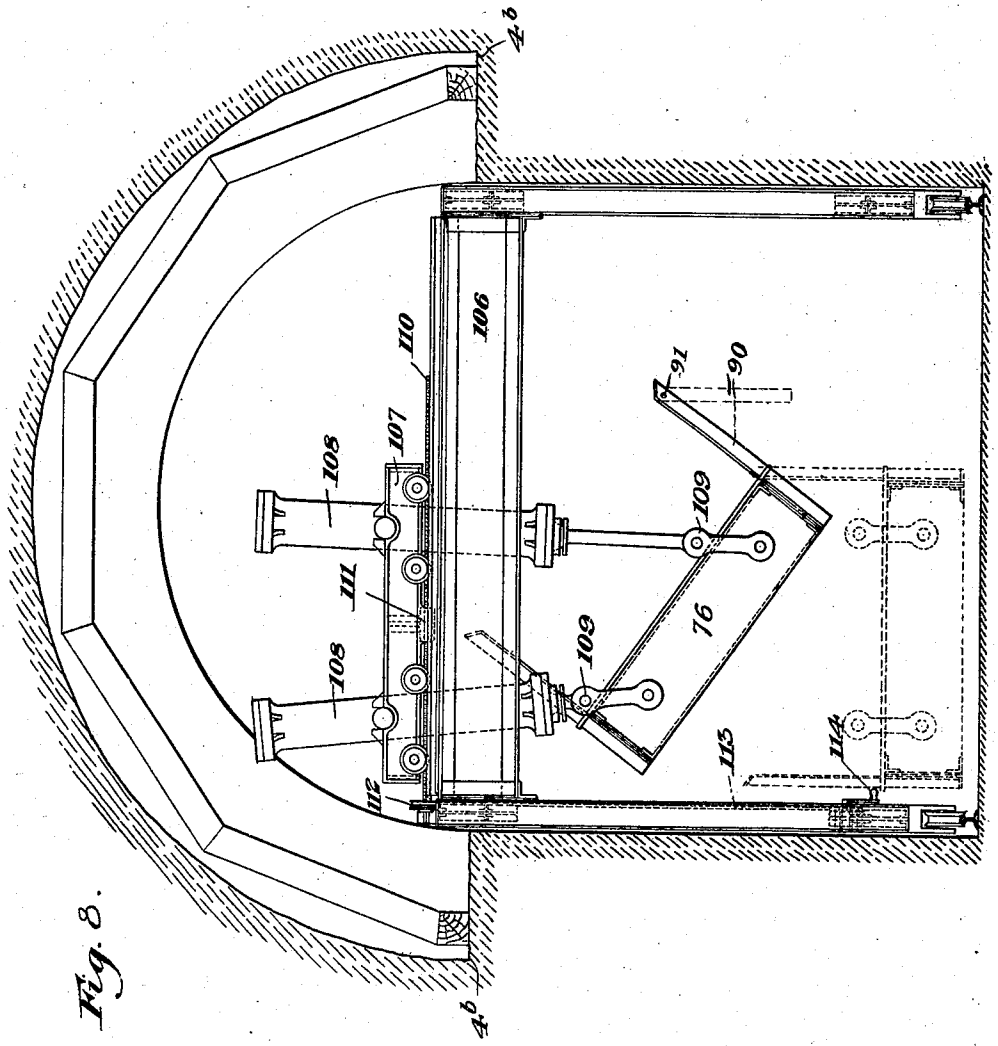


Fig. 8.

WITNESSES

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UNITED STATES PATENT OFFICE.

DAVID MAXWELL, OF OAKMONT, PENNSYLVANIA.

APPARATUS FOR TUNNELING.

No. 867,520. Specification of Letters Patent. Patented Oct. 1, 1907.

Application filed August 25, 1904, Serial No. 222,040. Renewed February 4, 1907. Serial No. 355,724.

To all whom it may concern:

Be it known that I, DAVID MAXWELL, of Oakmont, Allegheny county, Pennsylvania, have invented a new and useful Apparatus for Tunneling, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a longitudinal vertical section of part of the car and the apron; Fig. 2 is a like view, being a continuation of Fig. 1, showing also a portion of the unloading machine; Fig. 3 is a vertical cross-section of the apron truck, the apron being in lowered position; Fig. 4 is a vertical cross-section of the tunnel looking toward the face and showing the blasting tables and apron in position; Fig. 4ª is a diagram view illustrating the method of blasting; Fig. 5 shows one of the blasting cars in the position it occupies in passing through the tunneling machine and before its bed has been shifted laterally; Fig. 6 is a horizontal section on the line X—X of Fig. 4; Fig. 7 is a vertical longitudinal section of the unloading machine; and Fig. 8 is a rear elevation of the unloading machine, showing one of the cars forming a part of the blasting tables; the full line position showing the car in dumping position, and in dotted lines its normal, position, some of the parts being omitted for clearness.

In the method of tunneling in connection with which my apparatus is of particular importance, I first form in the rock of the tunnel, a channel-cut 2 (see Fig. 4) of arch form and of suitable depth. I also drill in the face of the rock a series of upwardly slanting blast holes 3 and 4. Blasting is then commenced, the first blast being made with the top row of the holes 3, and with the holes at the center of the series 4, so that the effect of the first blast is to make a clearance space between the apex of the channel-cut 2, and directly above the same, and to discharge the loosened rock in great part forwardly, causing it to fall upon aprons at the base of the tunnel as explained below. The next blasting operation is done in the row of holes 3 next below and also in the holes 4 at the side of the space above the channel-cut which has been formed by the preceding blast. This discharges an additional mass of rock from below the channel-cut upon the aprons at the base of the tunnel, together with loose rock remaining from the preceding blast, and also widens the blasted spaced above the channel. The work of blasting is thus continued, each successive blast being made in a row of holes 3 below the last preceding one, and in holes 4 successively outward from the middle. When the blasting is finally completed, it affords a blasted space of the shape indicated in the diagram in Fig. 4ª, the upper portion being of greater width, and having seats 4ᵇ for the masonry and timbering. At each successive blast, the dislodged material falls upon a carrier which extends from side to side of the tunnel as hereinafter described, and when the entire face of the rock has thus been blasted, the material is transferred from the carrier to cars in the tunnel, the carrier being withdrawn.

The apparatus by which the rock which is dislodged by the blasting is removed from the tunnel is as follows:—It comprises preferably two pairs of trucks 68 and 69, which constitute carriers for the blasted rock, the members of each pair of trucks being coupled together as shown in Fig. 1, the advance truck carrying a pivoted apron 70 and a lifting cylinder 71, which is preferably made of telescopically fitted sections having an end plunger 72 connected to the apron. The lowest section of the cylinder is mounted on trunnions 73, and the sections are strengthened so as to resist the pressure by attaching to them end-flanges 74. The cylinder is single-acting, the return-stroke being effected by the gravity of the apron 70. The apron is not journaled directly to the truck 69, but is hinged to a transversely sliding bed 75 of the truck 69 and to a similar transversely sliding bed 76 of the truck 68, the hinge-pins 77 serving the double function of hinging the apron and of pivotally connecting the sliding bed 75 and 76 of the trucks. The bed 75 of the truck 69 is moved transversely by cylinders 78 having pistons 79 projecting from both ends of the cylinders, and attached to the bed 75 and also passing through the wheels 80 of the truck to which they serve the purpose of axles. At the ends of this axle-piston are cross-heads 81 which move in guides 82 and thus afford end-bearings which support and distribute the weight when the rock is discharged upon the apron. These cylinders therefore enable the sliding beds 75 to be moved transversely on the truck carrying the apron from one side of the truck to the other. The sliding bed 76 is also moved laterally on the truck 68 by means of cylinders 83 secured to the sliding bed and adapted to move upon fixed piston-rods 84 which bear at the ends against the truck and have between them a loose or floating piston-head 85. These cylinders are set vertically into U-shaped supports 86 which are fixed to the under side of the sliding bed 76, projections 87 thereon being adapted to enter between lugs 88 on the cylinder and to hold it from endwise motion relatively to the sliding bed, that is to say to cause the sliding bed to move with the cylinder. The cylinder 83 rests on anti-friction rollers 89 on the truck, so that when the cylinder is actuated it will move the support with the sliding bed transversely of the truck. The pressure is preferably maintained on both ends of the cylinder, as above explained, the cylinder being actuated by exhausting the pressure from one end

thereof. By using the floating cylinder head 85, instead of fixing the piston-head to the piston-rod, as has been the practice heretofore, I effect a very considerable saving in the working area of the cylinder and increase its efficiency.

The sliding-bed 75 of the truck is provided with sides 90 to retain the load, portions thereof being pivoted at 91 so as to permit them to swing outwardly. It also carries a plow 92 consisting of a plate having strengthening flanges 93 and hinged to an axle 94 provided with wheels 95, mounted on track 96 which extends along the sliding bed. The plow has forwardly projecting shoes 97, portions of which take under the track 96. These shoes carry the axle 94 on which the plow is adapted to move radially, but the plow is normally held in vertical position by guide-rollers 98 which are mounted at its back end. The plow is moved by an endless chain 99, passing around sprocket-wheels 100 at the ends of the sliding bed, and driven by a motor 101 at the end of the truck. This motor is preferably connected by clutches 102 and 103 with the sprocket-wheel 100 and with one of the axles of the truck 68, respectively, intermediate worm-gearing 104 being employed to transmit the power. By imparting motion to the sprocket-chain 99, the plow can be moved from one end of the truck to the other. When it is at the back end of the truck, the guide-rollers 98 being freed from the support of the sliding-bed of the truck permit the plow to tip backwardly and to rest upon the apron 70, as shown in Fig. 5, at any inclination at which the apron may be, and it will then receive the rock discharged upon the apron by the blasting. When the plow is drawn forward by the sprocket-chain the guide-roller 98 engages the bed of the truck and will raise the apron into upright position, and the further motion of the plow along the truck will push before it the burden of rock which has been discharged from the apron.

The operation of this apparatus is as follows: Before firing a blast at the face of the tunnel one of the trucks 68 is then moved along its track and through the frame 5 as shown in Fig. 5, and when it reaches the end of the tunnel its bed is moved laterally by the cylinders so as to bring it into contact with the side-wall of the tunnel, the apron then being adjusted to rest against the face of the rock at the required inclination as shown in Fig. 1. The second pair of trucks 68 and 69 is then moved into the tunnel to the end thereof, the beds are moved sidewise in the opposite direction from the first pair, so that when both are in position the two pairs of trucks stand side by side, filling the end of the tunnel, as shown in Fig. 4. Both trucks having been adjusted, the blast is fired, and the rock falling upon the apron slides down the same over the plow 92 which then occupies the position shown by full lines in Fig. 1, or if the inclination is too small to be sufficient to cause the rock to slide down upon the plow, the apron may be tilted toward a vertical position after the blast has been fired. The plow is then moved along the truck 68 so as to push the rock toward the front of the truck, and it is then moved back to its original position upon the apron, where it may receive the rock dislodged by another blast, and so the operation is continued until all of the rock discharged from a vertical series of blast-holes has been distributed upon the truck. Hand-labor is necessary only at the last blasting in the holes at the base of the tunnel for the purpose of clearing out such of the broken rock as may fall beyond the end of the apron.

The next operation is to discharge the rock upon the cars some distance back in the tunnel by which it is removed to the place where it is to be dumped. For this purpose I first draw the trucks and apron back from the face of the rock and through the hollow frame of the drilling and channeling machine to a point beyond the same, and I may then move the drilling and channeling machine to the end of the tunnel preparatory to further drilling and channeling. Then I uncouple the apron from the truck on which the rock is carried, and by means of lifting apparatus which I will presently describe I raise the bed of the truck with its burden upwardly from the truck and tip the bed laterally so as to discharge the burden into the dump-cars. The bed may then be placed upon the truck which is then drawn forward out of the way, and a second truck carrying a load of the rock, having been uncoupled from its apron is drawn beneath the unloading machine and is unloaded in the same manner. This unloading apparatus which is illustrated in Figs. 7 and 8, and partly in Fig. 2, comprises a frame 105, which is mounted upon the track in the tunnel, the same track upon which the drilling machine moves, and has an elevated bridge 106 on which is a buggy 107, carrying pivoted lifting-cylinders 108, the pistons of which are adapted to engage links 109 on the bed of the truck 68. These links are connected to the piston, the cylinders are actuated so as to raise the bed of the truck, and then by raising the outer piston to a greater extent than the other, the bed of the truck will be tilted and its load discharged, as shown by full lines in Fig. 8. When it is desired to unload the companion truck, the buggy 107 is moved to the other end of the bridge 106 by suitable mechanism, preferably by screw-shafts 110 which pass through nuts 111 on the buggies and are actuated by sprocket-wheels 112, the driving sprocket-chain 113 being driven by a suitable clamp 114 or otherwise.

The method of tunneling, and the rock cutting machinery, herein described in connection with this invention form the subject-matter of other applications to be filed.

Those skilled in the art, after becoming familiar with the construction above particularly described, will be able to modify it in many ways without departing from the principles of my invention, as stated in the claims, since

What I claim is:

1. Tunneling apparatus comprising carrier mechanism to receive the rock to be blasted, said mechanism being arranged to fill the tunnel from side to side at the face of the rock, and means for operating said carrier to discharge its contents upon a car; substantially as described.

2. Tunneling apparatus comprising a carrier and a pivoted apron adapted to rest at an inclination against the face of the rock to receive the blasted rock, and means for operating the carrier to discharge its contents upon a car; substantially as described.

3. Tunneling apparatus comprising carrier mechanism adapted to fill the tunnel from side to side at the base of the rock to be blasted to receive said rock, and plow mechanism for distributing the blasted rock upon said carrier; substantially as described.

4. Tunneling apparatus comprising a carrier, a pivoted

apron adapted to rest at an inclination against the face of the rock to receive the blasted rock, and a plow at the base of the apron; substantially as described.

5. Tunneling apparatus comprising a carrier, a pivoted apron adapted to rest at an inclination against the face of the rock to receive the blasted rock, and mechanism for varying the inclination of the apron; substantially as described.

6. Tunneling apparatus comprising a carrier, a pivoted apron adapted to rest at an inclination against the face of the rock to receive the blasted rock, and mechanism for varying the inclination of the apron, said mechanism comprising a pivoted power-cylinder; substantially as described.

7. Tunneling apparatus comprising a carrier, a pivoted apron adapted to rest at an inclination against the face of the rock to receive the blasted rock, and mechanism for varying the inclination of the apron, said mechanism comprising a pivoted power-cylinder, said power-cylinder being made in telescopic sections; substantially as described.

8. Apparatus for blasting comprising trucks movable within the tunnel and having laterally shifting beds; substantially as described.

9. Tunneling apparatus comprising trucks adapted to be drawn within the tunnel and to extend from side to side thereof in front of the rock to be blasted, and means for shifting the beds of the trucks laterally; substantially as described.

10. Tunneling apparatus comprising trucks adapted to receive the blasted rock, said trucks having removable bed portions, and means whereby they can be tipped to discharge their contents; substantially as described.

11. A shifting cylinder having stationary pistons on which it is movable and having an intermediate floating piston-head; substantially as described.

12. Apparatus for tunneling comprising a truck, a pivoted apron, and a pivotally mounted plow adapted to rest on the apron and to be elevated therefrom into plowing position; substantially as described.

13. Tunneling apparatus comprising a carrier for receiving the rock as it is blasted, and transfer mechanism in the tunnel adapted to elevate the bed of the carrier and to discharge its contents upon a car; substantially as described.

14. Tunneling apparatus comprising a truck and an apron adapted to be set at varying inclinations against the face of the rock; substantially as described.

15. Tunneling apparatus comprising a hollow frame, mounted on wheels, and adapted to be traversed along the tunnel, and trucks movable through the frame to receive the blasted rock; substantially as described.

In testimony whereof, I have hereunto set my hand, August 11, 1904.

DAVID MAXWELL.

Witnesses:
GEO. B. BLEMING,
T. W. BAKEWELL.