G. A. FOWLER.

MUCK SHOVELING, CATCHING, AND CONVEYING APPARATUS FOR TUNNELING MACHINES.

APPLICATION FILED MAY 22, 1909.

994,144. **Patented June 6, 1911.**

2 SHEETS—SHEET 1.

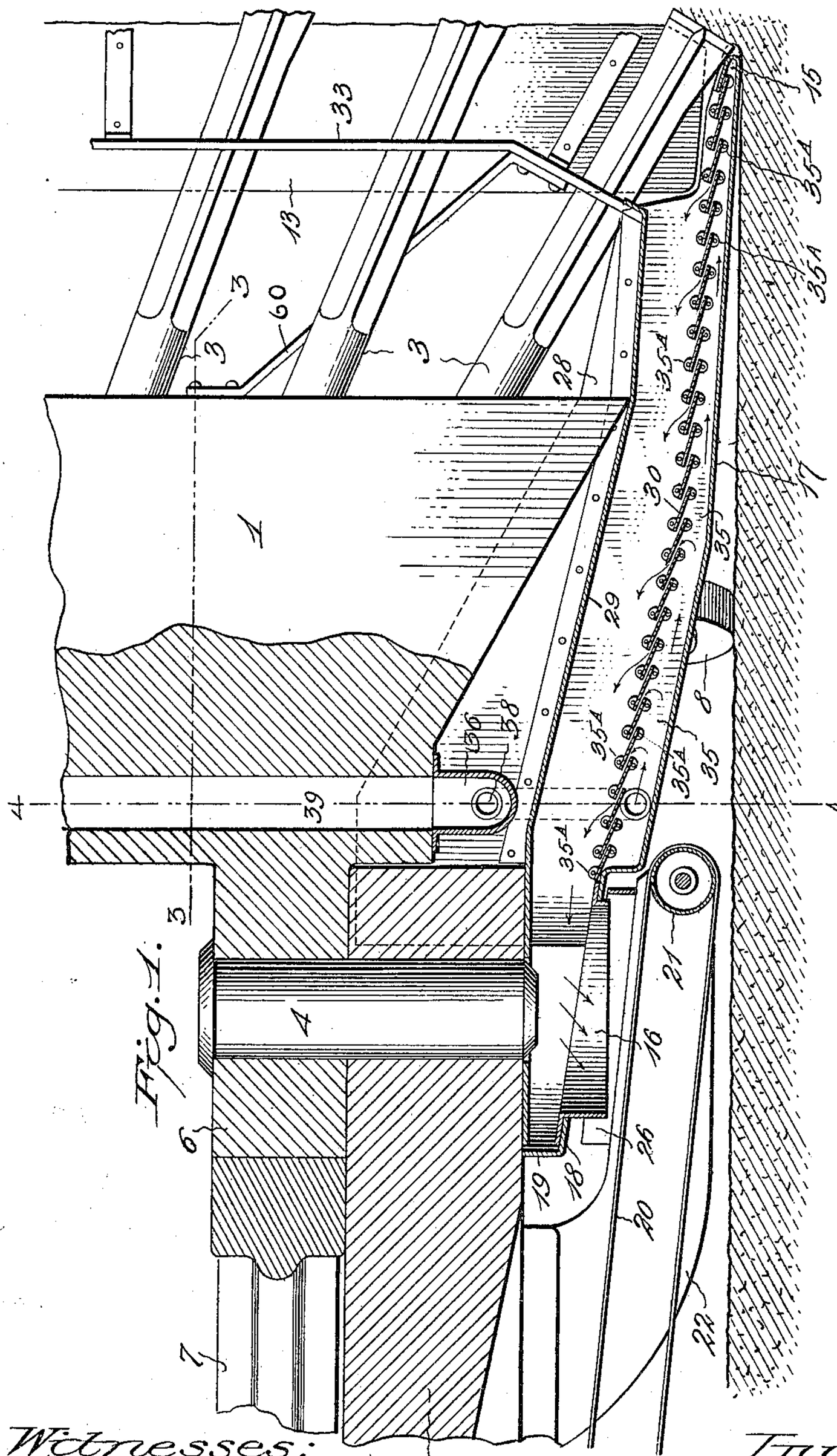

Fig. 1.

Fig. 7.

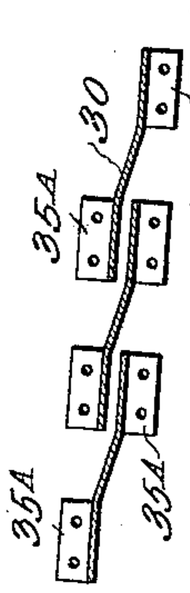

Fig. 6.

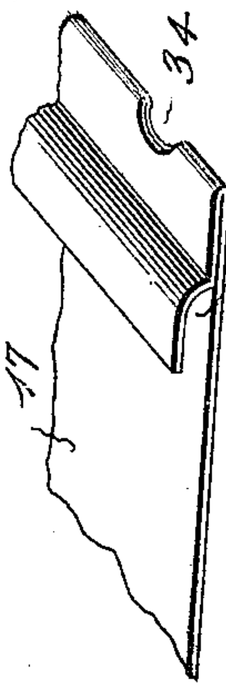

Fig. 5.

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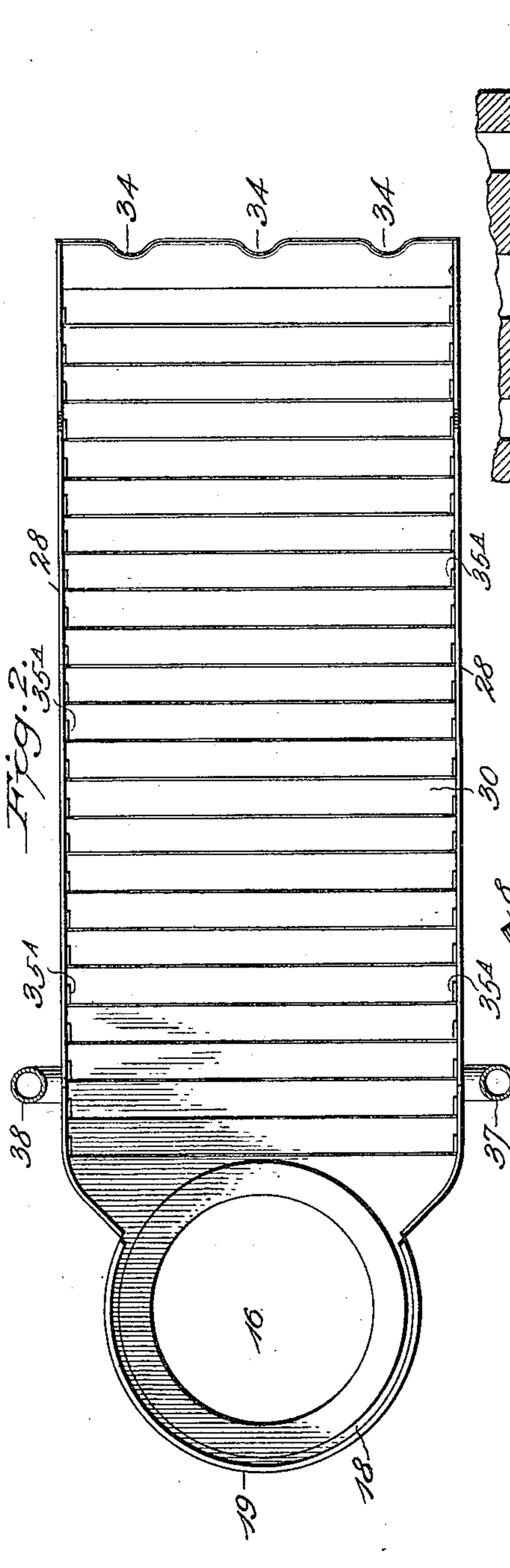

Fig. 2.

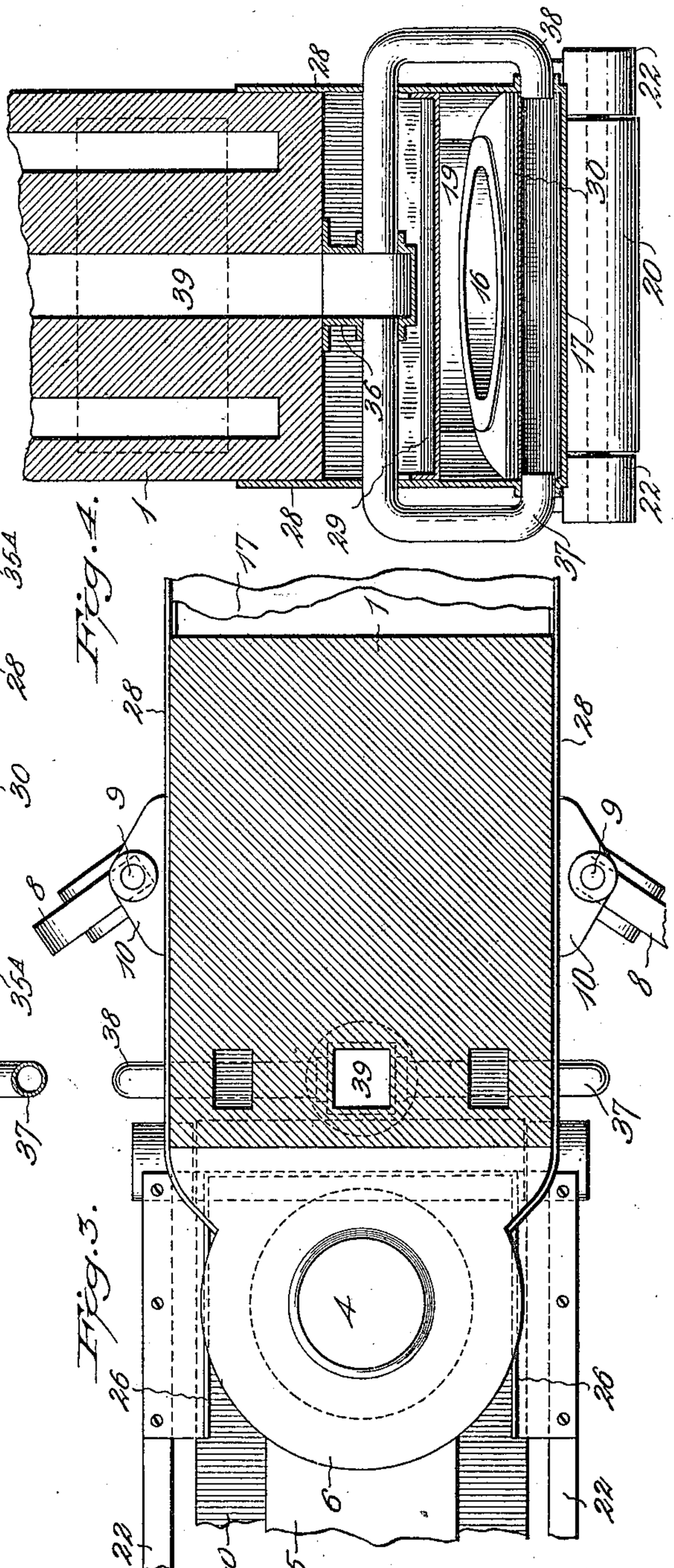

Fig. 4.

Fig. 3.

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UNITED STATES PATENT OFFICE.

GEORGE A. FOWLER, OF DENVER, COLORADO.

MUCK SHOVELING, CATCHING, AND CONVEYING APPARATUS FOR TUNNELING-MACHINES.

994,144. Specification of Letters Patent. Patented June 6, 1911.

Application filed May 22, 1909. Serial No. 497,774.

To all whom it may concern:

Be it known that I, GEORGE A. FOWLER, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Muck Shoveling, Catching, and Conveying Apparatus for Tunneling-Machines, of which the following is a specification.

My invention relates to improvements in muck shoveling, catching and conveying apparatus for tunneling machines, and the objects of my invention are: first, to provide a pneumatically operating muck receiving and shoveling conveyer; and second, to provide a compressed air actuating muck shoveling, catching and carrying conveyer adapted for the reciprocal swinging or oscillating of rock drilling or crushing heads of tunneling machines. I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1, is a vertical, longitudinal sectional view, showing the improved muck conveyer in connection with a portion of the cutting head of a tunneling machine. Fig. 2, is a plan view of the muck conveyer detached from the cutter head. Fig. 3, is a horizontal, sectional view on the line 3—3 of Fig. 1. Fig. 4, is a transverse, vertical sectional view on the line 4—4 of Fig. 1. Fig. 5, is a fragmentary perspective view illustrating a modification in the construction of the forward end of the conveyer; and Figs. 6 and 7 are sectional views illustrating modifications in the form of the plate through which air under pressure passes to convey the muck to the discharge end of the conveyer.

Similar letters of reference refer to similar parts thoughout the several views.

Referring to the drawings, the numeral 1, designates the head block of a rock tunneling machine. This block supports a plurality of rock drilling or crushing engines and drill bits 3, and the mechanism for operating them. These drilling engines and the mechanism for operating them I do not illustrate, as they do not form any part of my present invention, but I illustrate however the projecting drills of the three drilling engines, to show the coöperative application of my muck conveyer to a tunneling machine's drilling heads of this type.

My invention contemplates the application of my compressed air operated muck conveyer to any form or type of tunneling machine, to which it can be adapted and applied, but it is especially adapted for use with rock tunneling machine heads that swing on a central pivotal pin 4, reciprocally in an arc of a circle or in a full or substantially a full semi-circle at the breast of a tunnel. This pivotal pin 4, is secured in a bed plate casting 5, and projects above it, and forms a pivotal bearing for the lug portion 6 of the head block 1, which is swung around on its pivotal pin by suitable gearing 7, only a fragment of which is shown in this application, as it does not form any part of my present invention.

My compressed air muck conveyer is positioned below the drilling engine supporting head 1, and is secured to it in such a manner that it moves with and is carried by it, as it swings from one side to the other side of the tunnel. The air conveyer and the head are supported by rollers 8, which are mounted on pins 9 in brackets 10, at the opposite lower edge portions of the head. These rollers hold the front end of the conveyer close to but clear of the floor of the tunnel. The head is preferably provided with side housings 13, which may be made of rubber or metal or other suitable material. These housings act to guide the falling muck onto the front end of the conveyer. These housings extend to the front ends of the drill bits close to the breast of the tunnel, and they inclose the sides of the drill bits so that the rock cuttings that fly from the breast fall between them onto the conveyer.

My muck conveyer consists of two pan-like members that are arranged one within the other, the lower member being provided with a lip portion 15 at its forward end, which I term a muck shoveling lip, and with a discharge aperture 16 at its rear end. The conveyer comprises an air receiving passage, and a passage for the muck from the lip portion to the discharge aperture. The shoveling lip portion 15, is formed at the end of the bottom plate 17 of the conveyer, and this lip is formed by curving up and over and back up on itself the terminal end of the bottom plate, and the top edge of this lip extends backward from the end substantially parallel with the bottom plate 17 a short distance, and forms the end of an air passage space along the inside of the bottom of the pan, as will be more fully described hereinafter.

The rear end portion 18 of the conveyer preferably surrounds the pivotal pin portion of the head and bed plate, and consists of a circular flange or band portion 19 that stands vertically below the bed plate with its top edge close to the bottom of the bed plate, and in this part of the plate 17, is formed the opening 16, through which the muck is discharged onto the adjacent end of an endless conveyer belt 20, the end of which is mounted on a roller 21, which is journaled in the lower ends of arms 22, the opposite ends of which are secured to the bed plate or frame of the tunneling machine. I illustrate only a fragment of this endless belt conveyer, as this feature while coöperating with does not form a part of my present invention, and my invention can be applied to various constructions and arrangements of endless conveyers. This discharging end of the conveyer is surrounded by a housing flange 26, which is secured to the supporting arms 22 of the conveyer belt, and is arranged to guide the muck as it discharges from the air conveyer onto the belt and prevent its falling over the side edges of the belt and sides.

The conveyer consists of the bottom plate 17, the side plates 28 and the top plate 29, and an air passage plate 30. These plates are connected together to form an imperforate air-tight pan except at its shoveling lip and discharging ends, and they are arranged so that a supply of compressed air can be discharged into it in such a manner that the muck will be blown from its lip end through the conveyer and discharged through its discharge aperture onto the belt conveyer. The bottom plate 17 extends from the discharge end portion of the conveyer at a downward angle along the floor of the tunnel to beyond the head 1, and to close to the rock cutting ends of the drill bits, and the sides 28 of the conveyer preferably extend from the opposite sides of the head 1 to which they are secured, and on the outside of the muck housings to the end of the lip of the conveyer.

The curved shoveling lip portion of the conveyer extends across the bottom plate of the conveyer from side to side and across the space between the side muck housing strips, and above this curved lip portion the shoveling end of the conveyer is open between its side flanges for a distance from the end of the lip sufficient to permit the muck to drop from the breast of the tunnel as it is freed by the drill bits into the lip portion of the conveyer. In the drawing I have illustrated this open space extending back from the edge of the lip to a drill bit supporting plate 33, which extends across the front of the head 1 and is supported by braces 60 extending from the head at a sufficient distance in front of it to act as a support for the middle portion of the drill bits, this supporting plate being provided with apertures through which the drill bits slidably project. I illustrate a fragment of its lower portion only. Its lower end is bent inward to stand at substantially right angles to the lower drill bits. The lip portion of the conveyer is provided with recesses 34, which are formed in its edge in such a manner as not to interfere or destroy the imperforate air space formed by the curved lip, as shown in Fig. 2. These recesses are preferably made by curving the edges inward in such a manner that the end of the bottom plate is bent inward and the air space behind its curved end is not interfered with, but extends around these curved recesses. If desired, the extension end lip portion can be folded upon itself, and welded into a flat edge and then curved up far enough to form an air space close to the edge of the lip, as shown in Fig. 5.

The upwardly and rearwardly curved lip portion of the conveyer is adapted to form the terminus of an air passage 35, which I form along the bottom of the conveyer between the bottom plate and the air inlet plate 30. The plate 29 forms the roof portion of my conveyer, and it extends from the top of the rear discharging portion of the conveyer under the head and across from its sides of the conveyer to which it is secured to within a short distance from its lip end, which is left open to receive the falling muck. I have illustrated its forward end secured to the lower end of the drill bit guide plate 33, as when the conveyer is used with a head provided with this plate, it affords an additional support for its forward end, in addition to its rigid connection to the side plates of the conveyer.

The plate 30 of the conveyer consists of a succession of lattice strips arranged across the conveyer from one side flange to the other, and each lattice is preferably provided with turned-up end portions 35^{A}, that are riveted or are otherwise secured to the side flanges of the conveyer. These lattice strips are arranged to overlap each other, and they are positioned at a sufficient distance apart to allow a volume of compressed air to flow readily between them, and they are arranged to form collectively a plate that extends from under the curved terminal lip edge of the conveyer to the discharge aperture at the rear end of the conveyer. The front end lattice strip is also positioned to leave an air space between the under side of the curved lip and the top of the lattice strip. The lattice strips that compose this plate may be straight flat strips, as shown in Fig. 1, or curved as shown in Fig. 6. This lattice work air passage plate is positioned a short distance above the bottom plate of the conveyer.

While I preferably use a plate made of strips of metal arranged in the form of a lattice plate, my invention contemplates any suitable form of a plate provided with rearwardly inclined apertures or with apertures inclined from the bottom side of the plate toward the discharging aperture of the conveyer. Thus in Fig. 7 I illustrate an integral corrugated form of plate provided with apertures arranged and adapted to direct air flowing through them under pressure toward the discharge aperture of the conveyer. This plate 30 forms a floor plate for the muck and the space between it and the top plate 29 of the pan shaped casing forms the muck passage compartment of the conveyer, and the open space at and adjacent to the terminal end of the lip forms the shoveling end portion of the conveyer, and this shoveling end portion while containing the air passage within it below the top of the upper surface of the lip and of the adjacent end of the air aperture plates, is made only about three quarters of an inch thick and can consequently be moved easily underneath the muck at the junction of the floors and breasts of tunnels, and the space between these two plates forms a passage for a blast of compressed air. This blast of compressed air is admitted to this space 35 in the bottom of the conveyer through two pipes 37 and 38, which are connected at one of their ends to the opposite sides of the conveyer to connect to this space, and their opposite ends extend and are connected to the sides of a housing 36 at the lower end of an air passage 39, which connects either directly with a supply of compressed air or is arranged to receive the exhaust air from the drilling engines of the head block. I preferably, however, use the exhaust air from the rock drilling machines, when air operated drills are used, and the pipes as illustrated connect directly to the exhaust passage of the head, but when electrically operated drills are used, this passage is connected directly to the source of air supply and the air conveyer receives the air under full direct pressure from the air receiver.

The operation of my compressed air operating muck conveyer is as follows: A supply of compressed air is admitted to the air space passage 35 in the bottom of the pan, and this air being under high pressure rushes to the lip portion of the bottom of the pan and then flows through the air passages between the lattice strips of the plate 30, as shown by the arrows, at a backward angle that will move and force the muck that falls on the lip portion of the conveyer backward through the pan portion of the conveyer between its top cover portion and the lattice strip plate 30, and out of the discharge aperture at the rear end of the conveyer onto the belt conveyer, by which it is conveyed to the rear end of the tunneling machine. As the drilling head is moved from one side of the tunnel to the other, the shoveling lip would move under any muck that accumulates, in which case the shoveling lip, which is only about three quarters of an inch thick, would move under and through the muck, as it swings from one side to the other of the conveyer, and the muck would fall onto the open latticed lip portion of the conveyer, and the air would pick it up and force it quickly through the conveyer.

My invention is simple in construction and occupies but a small space in a tunnel, and does not contain any moving and wearing parts, and as the exhaust air of the drilling engines can be used to operate it, the expense of its construction, maintenance, and operation would be very small.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A pneumatically operating muck conveyer for tunneling machines, comprising a closed casing having an opening in its top near the forward end, a shoveling lip having a closed top portion extending beyond said opening, a discharge aperture at the opposite end of the casing, a perforated plate extending beneath said opening into said top portion and means for supplying compressed air beneath said plate, the perforations of said perforated plate being arranged to direct said air to move said muck from said shoveling lip through said casing and discharge it from said discharge aperture.

2. In a pneumatically operating muck conveyer for tunneling machines, a pan-shaped conveyer consisting of an imperforate top and bottom plate and side plates, a muck receiving plate within said pan-shaped conveyer between its top and bottom plates, a muck shoveling lip portion provided with air receiving and holding space within it arranged below its top muck receiving surface, said air receiving space being formed below said muck floor plate, a muck passage between said muck floor plate and the top plate of said pan, the top of said conveyer having an open space adjacent to said lip portion leading into said muck passage, said open spaced lip portion being made tapered to a thin shoveling lip or blade portion adapted to move into and under muck at the junction of a floor and breast of a tunnel, said muck floor plate having apertures therethrough arranged to extend at an angle from the under side of said plate away from the lip portion of said plate toward its discharge aperture, and means for introducing air under sufficient pressure to the air space below said lip and muck floor plate to move muck from said lip through said muck passage and out of the discharge aperture of said conveyer.

3. In a pneumatically operating muck conveyer for tunneling machines, an imperforate pan-shaped casing, provided with an open muck shoveling lip portion at its forward end, and with a discharge aperture at its rear end, a plate extending across the interior of said pan-shaped casing extending through it from beneath said shoveling lip to said discharge aperture, said plate having apertures in its bottom inclined away from its lip portion toward its discharge portion, an air space below said plate, and means including pipes leading into said air space for introducing air under pressure to the under side of said plate.

4. A pneumatically operating muck conveyer for tunneling machines, comprising a closed casing having an opening in its top near the forward end and a discharge aperture at its rear end, a shoveling lip having an upwardly and rearwardly curved wall extending beyond said opening, a perforated plate extending across said casing and beneath said opening and means for furnishing a supply of compressed air to the space between the bottom of the casing and the perforated plate.

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

GEORGE A. FOWLER.

Witnesses:
G. SARGENT ELLIOTT,
ADELLA M. FOWLE.