No. 875,082. PATENTED DEC. 31, 1907.

S. A. KNOWLES & W. E. CARR.

TUNNELING MACHINE.

APPLICATION FILED JAN. 7, 1907.

4 SHEETS—SHEET 1.

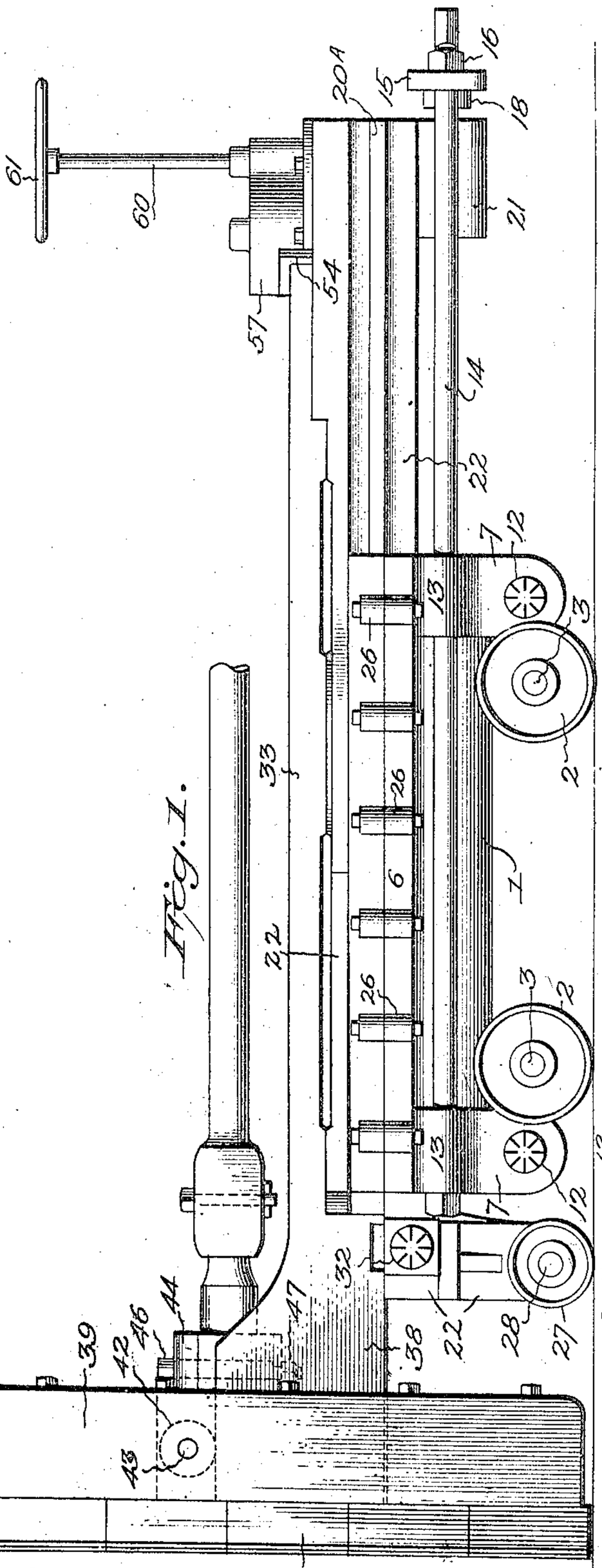

Fig. 1.

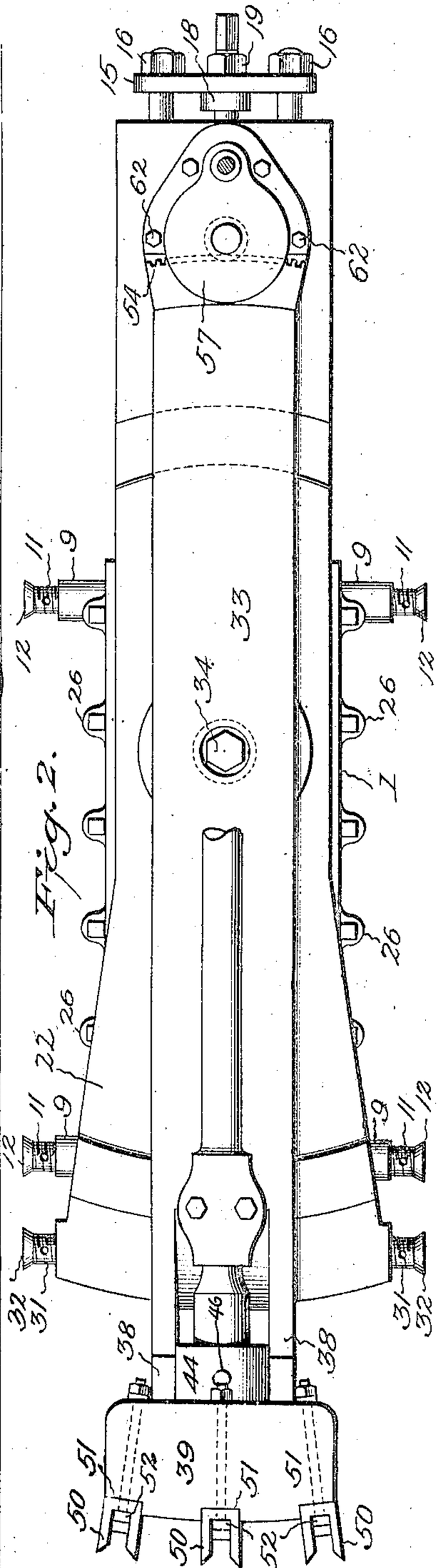

Fig. 2.

Witnesses:
J. Sargent Elliott
Adella M. Fowle

Inventors:
Silas A. Knowles.
Walter E. Carr.
By H. S. Bailey. Attorney.

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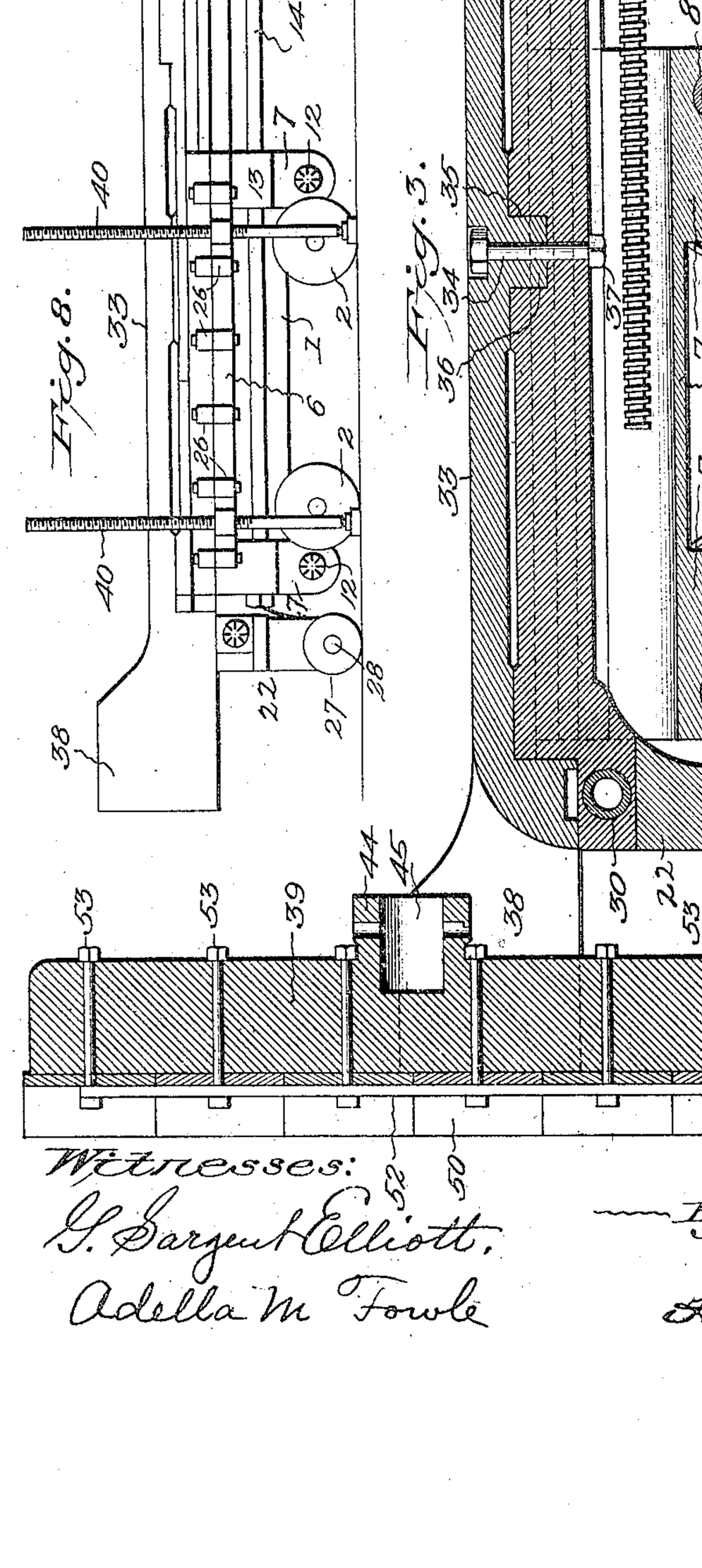

Fig. 8.

Fig. 3.

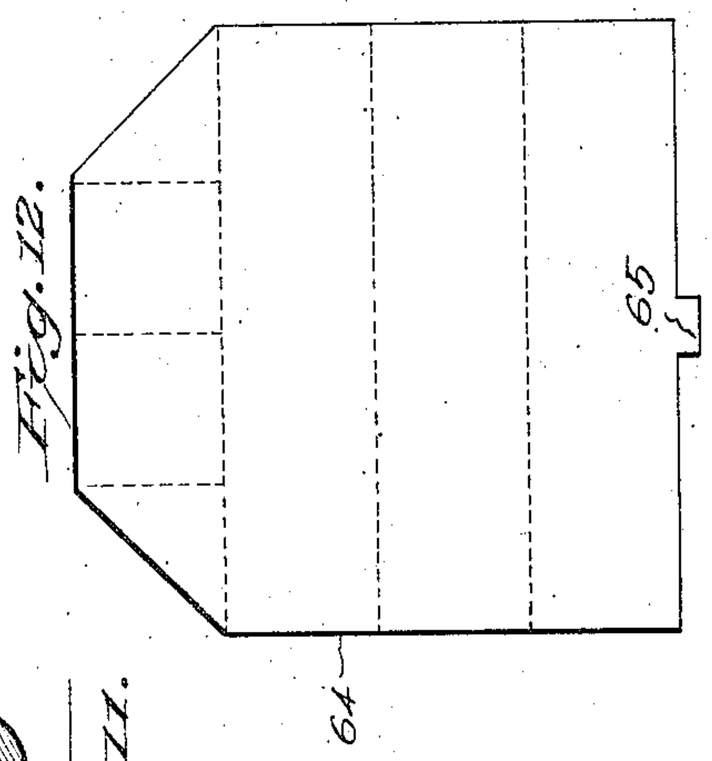

Fig. 12.

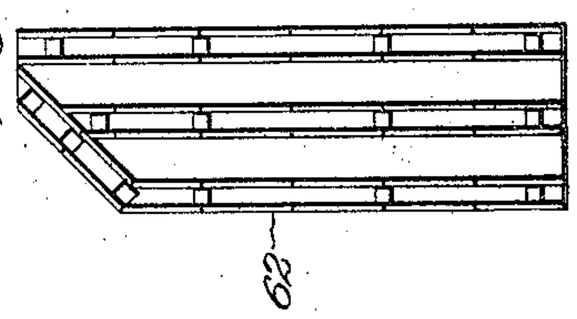

Fig. 11.

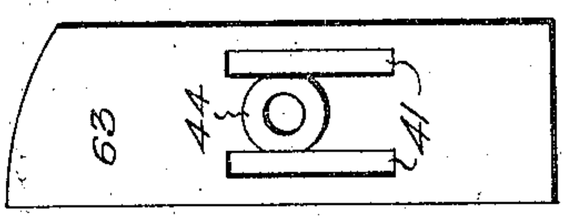

Fig. 10.

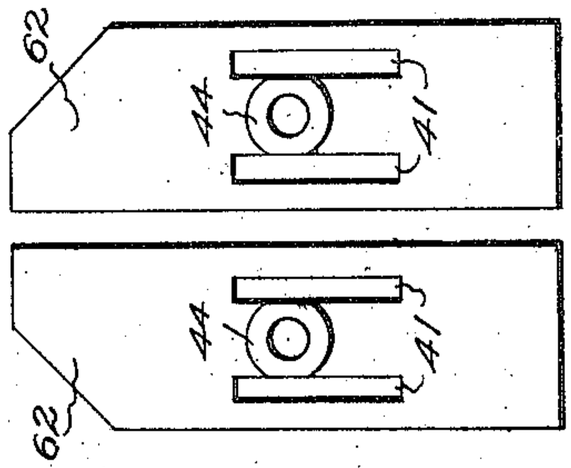

Fig. 9.

Witnesses:
G. Sargent Elliott.
Adella M. Fowle

Inventors:
Silas A. Knowles.
Walter E. Carr.
By H. S. Bailey. Attorney.

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4 SHEETS—SHEET 3.

Fig. 4.

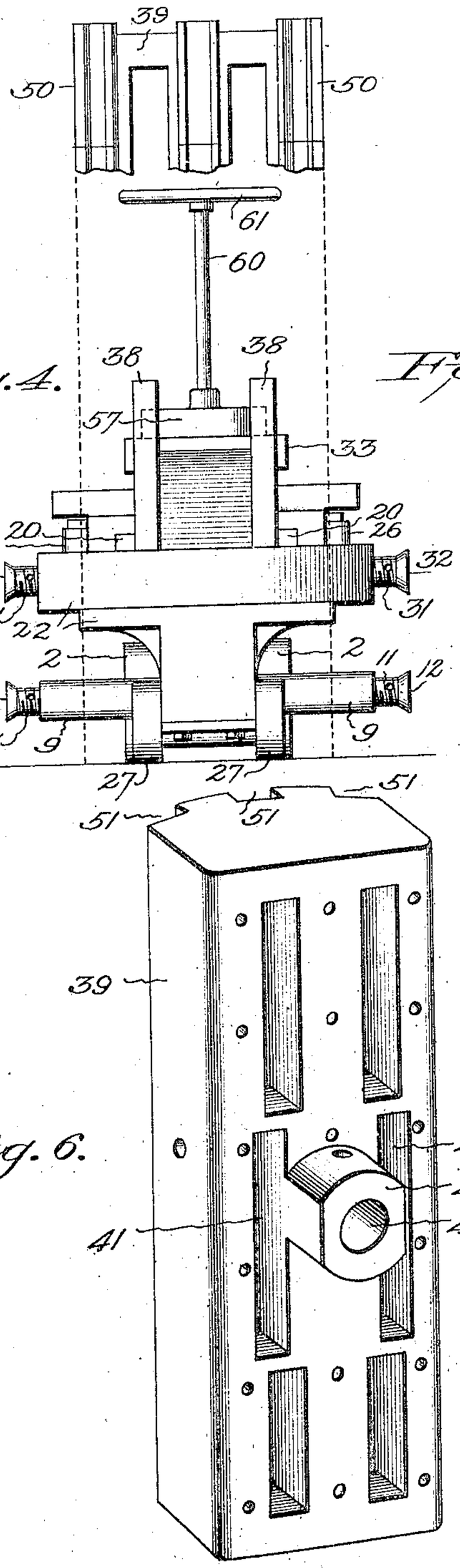

Fig. 5.

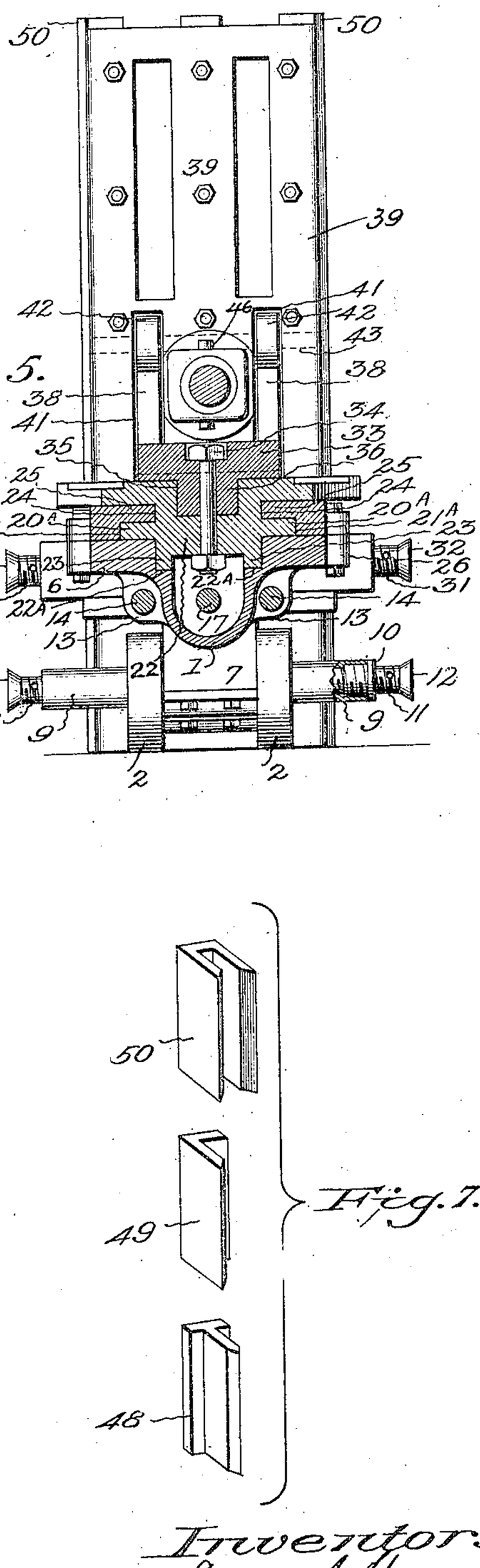

Fig. 6.

Fig. 7.

Witnesses:
G. Sargent Elliott
Adella M. Fowle

Inventors:
Silas A. Knowles
By Walter E. Carr
H. S. Bailey. Attorney.

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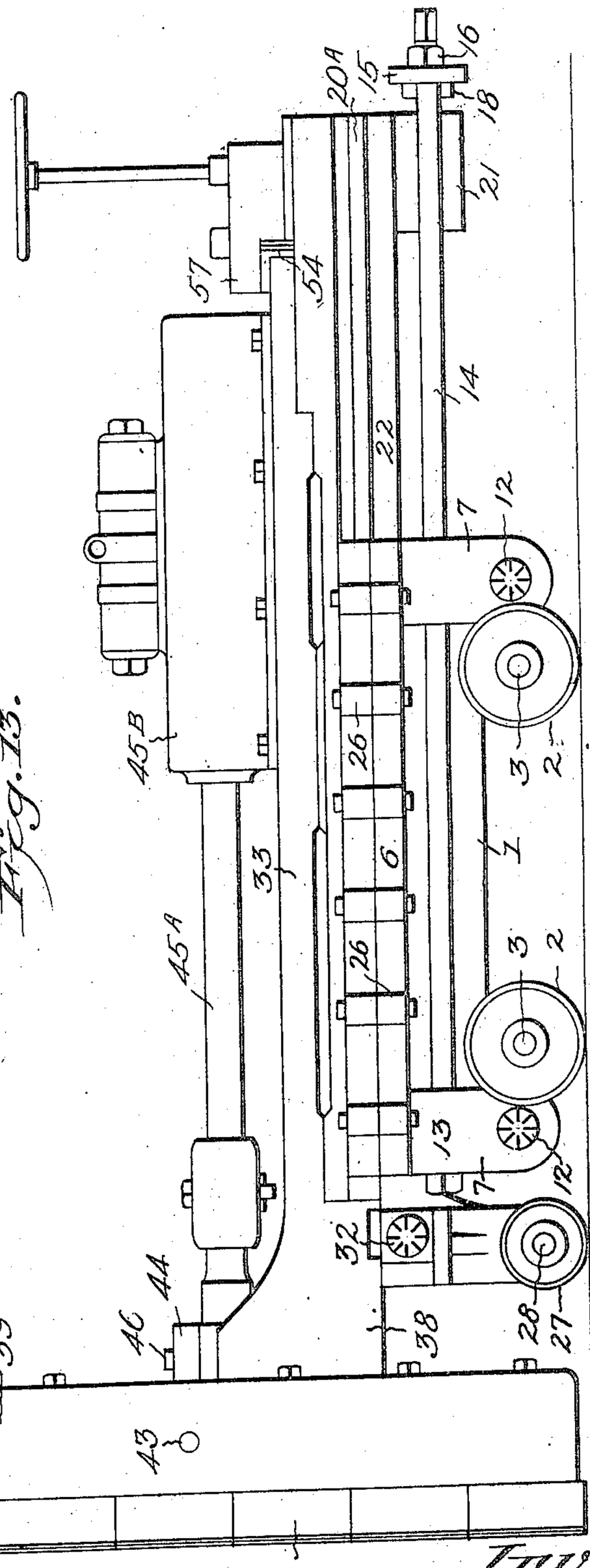

Fig. 13.

Witnesses:
G. Sargent Elliott.
Adella M. Towle.

Inventors
Silas A. Knowles.
By Walter E. Carr.
H. S. Bailey.
Attorney.

UNITED STATES PATENT OFFICE.

SILAS A. KNOWLES AND WALTER E. CARR, OF IDAHO SPRINGS, COLORADO.

TUNNELING-MACHINE.

No. 875,082. Specification of Letters Patent. Patented Dec. 31, 1907.

Application filed January 7, 1907. Serial No. 351,187.

To all whom it may concern:

Be it known that we, SILAS A. KNOWLES and WALTER E. CARR, citizens of the United States of America, residing at Idaho Springs, county of Clear Creek, and State of Colorado, have invented a new and useful Tunneling-Machine, of which the following is a specification.

Our invention relates to improvements in railroad and mine tunneling machines, and the objects of our invention are: First, to provide a reciprocating cutter head tunneling machine that is adapted to cut tunnels in rock for mining and railroad use. Second, to provide a tunneling machine that will cut tunnels of angular shape and of any size. Third, to provide a machine that will cut tunnels or drifts or passage-ways for any purpose into rock, and that will form a tunnel with vertical side walls and with a straight curved or semi-curved form, and that will also cut out a water channel in the floor of the tunnel and grooves in which to lay and cement rails if desired. Fourth, to provide a tunneling machine having a narrow cutter-head provided with a plurality of removable rock cutting bits that are of the full height of the tunnel or of any desired part of the full height of the tunnel, and that are adapted to be moved over the face of the tunnel. Fifth, to provide a tunneling machine in which a reciprocating cutter-head is adapted to be moved across the breast of a tunnel from wall to wall. Sixth, to provide a tunneling machine having a reciprocating cutter-head movement, and a forwardly feeding movement of the cutter-head into rock, and that is adapted to be fed through an arc of a circle across the predetermined width of the tunnel as it operatively cuts said tunnel into rock, and that is adapted to be set in the tunnel at different parts of the tunnel's height and be fixed rigidly in operative tunnel cutting positions in said tunnel. And seventh, to provide a simple, practical tunnel cutting machine that is adapted to use the common form of chisel edge drill for cutting the rock, and any suitable kind of motor of the common form of reciprocating engine, also cam and spring motion, for driving the rock cutting bits. We attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1, is a horizontal side elevation of a tunneling machine embodying our invention. Fig. 2, is a plan view of Fig. 1. Fig. 3, is a vertical longitudinal central section view of the same. Fig. 4, is a front elevation of the machine, a portion only of the cutter-head being shown. Fig. 5, is a transverse vertical sectional view of the machine, taken centrally therethrough. Fig. 6, is a perspective view of the cutter-head. Fig. 7, illustrates in perspective the different forms of bits used. Fig. 8, is a side elevation of the machine, showing means for elevating it to stand at different levels. Figs. 9 and 10 show cutter-heads adapted for different forms of tunnel roofs. Fig. 11 shows the manner of placing the cutting bits on one of the cutter-heads; Fig. 12, is a diagram illustrating the shape of one form of tunnel, and the progressive order of removing or cutting away the rock, and Fig. 13 is a horizontal side elevation of our tunneling machine showing a motor thereon operatively arranged to reciprocate the cutter head.

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

Referring to the drawings, the numeral 1, designates a carriage which is mounted on wheels 2; these wheels are secured to axles 3, which may form a part of or be secured to the under side of the carriage by any suitable means. We preferably illustrate these axles secured to the axles in boxes 4, which are formed on the under side of the carriage and are provided with caps 5, by which the axles are removably secured in their bearings to the carriage. This carriage is preferably formed of a low flat body portion 6, from the front and rear terminal ends of which large lug portions 7 depend, to the bottom of which the axles are journaled adjacent to their inner ends, while through their outer end portions apertures 8 are formed. These apertures are formed substantially parallel with the axles of the carriage, and in these apertures we secure tubes 9, preferably by placing bolts through them and the lugs. These tubes preferably extend slightly beyond the opposite ends of these lug portions of the carriage, and in the opposite ends of these tubes we secure nuts 10, which are each provided with an axial threaded aperture in which a threaded rod 11 is threaded, which we term the wall braces, the inner end of which extends through the nut into the tube a short distance. The outer end of each of these wall braces is provided with an aperture adapted to receive a pin or rod, which is used to turn the screw. The outer ends of the

screws are also provided with heads 12, the faces of which are serrated to form a frictional gripping surface. These wall braces are adapted to be screwed against the side walls of the tunnel the machine is making and brace the carriage against movement. The opposite sides of the carriage at its opposite end portions are also provided with projecting lugs 13, to which rods 14 are secured, which we term extension rods. These extension rods extend through the lugs and along both sides of the carriage, and are provided with nuts at their forward ends, which are screwed against the ends of the lugs at the head end of the carriage, and with nuts which are threaded to the rods to screw against the outer ends of the lugs at the rear end of the carriage, thus rigidly clamping the rods to the lugs and to the carriage. The rear ends of these rods extend rearward a short distance, and support a cross yoke 15, which extends across from one rod to the other, and is secured to each end of the rods by nuts 16, which are threaded on the ends of the rods to clamp the yoke to them.

An aperture is formed through the center of the yoke, in which one end of a feed screw 17 is rotatably journaled, a suitable collar 18 and a nut 19 being arranged on the rod on opposite sides of said yoke member. The adjacent terminal end of the rod is squared or otherwise shaped to receive a crank or other suitable wrench, and the opposite end of this feed screw is threaded to a nut 20, that is secured in a depending lug 21, that forms a part of a reciprocating frame, which we term the feed frame 22.

While we have illustrated a feed screw for operating the feed frame, it will be understood that any suitable feeding device may be employed. This feed frame is provided on its opposite sides with projecting guideways 20^A, which fit into slideways 21^A, formed in the sides of a central recess formed through the longitudinal center of the carriage. A pair of shouldered steps 22^A are also formed just below these slideways, on opposite sides of this central recess, and depending guideways 23 are formed on the bottom of the feed frame that fit slidably into these shouldered steps. The central recess in the carriage is formed deep enough in the carriage and below the feed frame to form a clearance space or housing for the inner end of the feed screw, which extends into this central recess of the feed screw a portion of the length of the carriage sufficient to allow the feed frame to be fed reciprocally on the carriage a portion of its length. This feed frame is also provided with guideways 24, just above the slideway in the carriage, and the top of the carriage along the edge of its central recess is formed into slideways 25, and adapted to project into and fit slidably into these guideways 24, while the top portion of this feed frame is formed to extend over and rest slidably on top of the top portion of the carriage. Consequently there are a plurality of sliding surfaces formed partially between the carriage and the feed frame. The slideway of the carriage is preferably made separate from the body of the carriage, and is bolted to it by bolts which extend through lugs 26, that are formed partially on the slideways 25, and partially on the sides of the carriage.

The feed frame is made considerably longer than the carriage, and is adapted to be fed reciprocally forward and backward longitudinally in the carriage by turning the feed screw in its nut by means of the crank, as is well understood, and at its forward end it is extended downward in front of the carriage to near the floor line of the wheels 2 of the carriage, where a pair of wheels 27 are journaled to it, and bear and run on the floor of a tunnel and thus support this front end of this feed frame. These wheels are preferably mounted on an axle 28, which is journaled in a box 29, that is formed in the bottom of the depending end of the frame. This box is preferably provided with a cap by which the axle is removably secured to the end of the frame. The wheels 27 of the depending front end portion of the frame are preferably positioned at the same distance apart as the wheels of the carriage. The forward end of this feed frame is also provided with a wall brace, which comprises a tube 30, secured in an aperture formed through the forward end of the feed frame above its supporting floor roller and the threaded brace rods 31, which are threaded into nuts that are secured in the opposite ends of the tube and the serrated heads 32, that are secured to or formed on the ends of the threaded brace rods. The top surface of this feed frame is finished to form a flat bearing and sliding surface for a rock arm 33, which we term the guide arm. This guide arm is pivotally secured to the feed frame intermediate of its ends by any suitable character of a pivotal connection, but it is preferably illustrated pivotally connected to the feed frame about the center of its length by a pivotal bolt 34, the center of the top of the feed frame being provided with a circular recess 35, in which a hub 36 that is formed on the under side of the guide arm is rotatably fitted and the pivot bolt is extended down through the arm and its hub and through the feed frame, a nut 37 being threaded to the end of the bolt to screw against the under side of the feed frame and thus clamp the guide arm and the feed frame rigidly but pivotally together. From its pivotal center the guide arm extends rearward to the end of the feed frame and carriage, and forward to and beyond the forward end of the feed frame, where its extreme end is bifurcated into two forwardly

extending parallelly arranged thin but wide arms 38, which form guideways for a drill bit cutter-head 39, which is reciprocally mounted on them, and these guide arms are preferably extended up above the top surface of the guide arm in order to support the cutter-head more centrally of its normal working center or of the height of the tunnel the cutter head is adapted to cut.

We preferably illustrate a cutter-head of the full height of the tunnel, altogether our invention contemplates cutter heads made in any length or width of the predetermined size of the tunnel to be bored. Thus for example, a cutter head of a third or a quarter or any other proportion of the height and width of any predetermined tunnel could be used, and can be adapted to work at the various third or quarter parts of the height of a tunnel by raising the carriage to different heights of the tunnel the cutter is adapted to cut at a time. Thus, assuming that the cutter head was made to extend from the floor of the tunnel to a height equal to a little more than one-half of the heights of the tunnel ,the lower half could be cut in to a predetermined depth of from a few inches to a foot or two, and then the tunneling machine could be raised up in the tunnel on jack screws 40 (see Fig. 8) high enough to cut out the upper half of the tunnel to the same depth and to a further predetermined depth before it was lowered, and after the machine is raised it can be braced sidewise against the walls of the tunnel as firmly as when resting on the floor of the tunnel. Consequently, if the carriage is adapted to be raised by jack screws as illustrated in Fig. 8, cutter heads of but a quarter or a third or any other portion of the height of the tunnel could be provided and but a quarter or third or any other proportion of the height of the tunnel can be cut out across the width of the tunnel at a time by making the carriage low enough to make the first cut while resting on the floor of the tunnel.

We preferably make the cutter heads of the full height of the tunnel it is desired to form, and of a width that will be a small part of the tunnel's width; consequently we have illustrated as the preferred construction a cutter head of the full height of the tunnel to be formed, and of a small part of the tunnel's width, which provides a long narrow cutter-head, and the tops of the guide arms are preferably arranged to extend up to about the center of the length or height of the cutter-head. The cutter-head comprises a long narrow bar of metal of thickness enough to give it sufficient strength to be rigid under the work required of it, and of sufficient weight to cause a heavy impact, and through it a pair of slideway recesses 41 are formed, which are positioned and arranged to permit the cutter-head to be fitted loosely and slidably over the guide arms 38 of the rock arm 33, and in the upper ends of these slideway recesses two rollers 42 are pivotally secured therein on a pin 43, which extends through the opposite sides of the cutter-head. These rollers are adapted to rest and roll on the top edges of the guide arms, and they carry the weight of the cutter-head on the top of the guide arms; consequently the cutter-head is rollingly mounted on the guide arms. The central portion of the rear side of the cutter-head between the recess 41, is provided with a hub 44 in which an axial aperture 45 is formed, which is adapted to receive the end of the plunger 45^A of a powerful reciprocating engine 45^B, such as a pneumatic or steam or gasolene or other fluid actuating reciprocating piston engine of the forwardly extending plunger or slugger type as shown in Fig. 13, or if desired an electrical motor may be operatively arranged to reciprocate the cutter head. We preferably illustrate however, a reciprocating engine of the plunger piston type, which is mounted on the guide arm in any suitable manner, and is operatively connected to a supply of actuating fluid, preferably compressed air, by hose, as is well understood. The end of the plunger is secured to the hub of the cutter head by a key 46, which extends down through both the hub and the plunger, and its end is threaded and provided with a nut 47, which is adapted to clamp the key to the hub against accidental displacement. The reciprocating engine is adapted to reciprocate the outer head rapidly on the guide arms of the feed frame.

The cutter head is provided with a plurality of rock cutting bits, which may be of any suitable character or form of rock-cutting lips. We preferably use, however, the chisel edge form of cutting bit, and in order to adapt it for use with our cutter head we form it on the ends of T-shaped or L-shaped or U-shaped bits, 48, 49, and 50 respectively, as shown in Fig. 7, but preferably illustrate the U-shaped form of bit connected to the cutter head. In order to secure either one of these forms of bits to the cutter head, we provide it with a plurality of recesses 51, which may be formed in its face in any direction, but which we preferably arrange parallel with its length. These recesses may also be arranged close together if desired, but we preferably place them at a short distance apart and make the cutter head wide enough to arrange three recesses in it, two of which we place along the side edges of the cutter head, and the third recess we form along the center of the cutter head. The center recess is preferably formed with a flat bottom and with square sides, but the corner recesses are cut in from the sides or edges of the cutter head, and consequently they have a side shoulder on their inner sides only. The

face of the cutter head is preferably curved with a curve of the radius of the distance from the pivotal center of the guide arm to the face of the cutter head, and the U-shaped cutters are made with a flat base and to fit them, and the curvature of the cutter head causes the two opposite corner cutters to face outward at a radial angle from the pivotal center of the guide arm, which causes the outside cutting lips of the two outside cutters to stand at an outward and forward angle from the sides of the cutter head.

The cutters as illustrated are secured to the cutter head by fillets 52, which lie within the channels of the bits, and extend from the top to bottom of the cutter head, and through which pass bolts 53, which extend through the bottom of the U-shaped cutters and through the cutter head, but we may employ any preferred manner of securing the cutter to the head, and in order to facilitate the sharpening of the cutters they are preferably made of short conveniently-handled lengths, and are placed in the recesses and secured in any position along the whole length of the cutter head, the upper and lower cutters being arranged to project beyond the opposite ends of the cutter head far enough to cut the tunnel enough larger than the height of the cutter head to allow ample room for the operative movement and manipulation in the tunnel. By forming the rock cutters in short lengths they can be easily and quickly attached to and detached from the cutter head, and are easy to handle to resharpen. The opposite or rear end of the guide arm from its pivotal center is provided with a curved gear toothed rack 54, of a radius concentric with the pivotal center of the guide arm. This gear toothed segment is engaged by a pinion 55, which is rotatably mounted on a shaft 56, that is journaled at one end in the feed frame and in a casing 57 at its top end. A gear wheel 58 is secured to the shaft 56, above the pinion 55, or it may be integral with the said pinion, and a pinion 59 engages the gear wheel 58. This pinion 59 is secured to a shaft 60, that is journaled in the feed frame at one end, and also in the casing 57; but it extends above the casing, and a hand grasping wheel 61 is secured to its upper end. The casing 57 is secured to the feed frame by screws 62, and is arranged to support the shafts 56 and 60, and to cover the gears and pinions. The guide arm is turned on its pivotal center to swing across the feed frame and carriage, and from one side of the tunnel to the other, through the medium of the gears, by turning the hand wheel 61.

While we have illustrated this manner of operating the swinging arm 33, we may also employ any suitable mechanism by which the arm may be swung, and automatically reversed at the limit of its movement in each direction.

The operation of our tunnel cutting machine is as follows: The tunneling machine is positioned in a tunnel, and the carriage is braced rigidly between the side walls, and the engine is started up, which imparts a reciprocating movement to the plunger and the cutter-head, which reciprocates bodily on the top edges of the guide ways of the guide arm, and the cutter head and guide arm are fed forward by the feed screw as fast as the cutter head cuts into the rock, and as the cutters cut a recess into the rock larger than the cutter head it can be fed directly into and over the breast of the tunnel the whole distance the feed screw will feed the feed frame forward on the carriage, which would be several feet, or if preferred the cutter head can be fed forward to feed into the rock from three-quarters of an inch to an inch or two, and then the cutter head and feed frame can be fed back and the guide arm and cutter head can be swung around by the hand operating wheel and gears to the edge of the cut, and a new cut be started into the breast, and then the guide arm and cutter-head be moved until another cut has been made across the breast of the tunnel; and as the cutters cut out a tunnel of the full height of the tunnel, it is only necessary to tighten the wall braces of the feed frame against the walls of the tunnel, and loosen the wall braces of the carriage and move the carriage forward to the wheeled end of the feed frame, and then again brace the carriage and then releasethe feed frame.

If desired recesses may be made in the side walls for the heads of the jack screws to extend into, which would form an abutment to the jack screws and carriage, as well as a side brace to the carriage.

By employing cutter heads 62 and 63, as shown in Figs. 9, 10, and 11, the tunnel roof can be cut out in a flat arch form or with angular corners.

In Fig. 12, a diagram of the cross section of a tunnel 64 is shown, the dotted lines showing the order in which it is preferable to remove the rock, when the tunnel is of greater height than the length of the cutter head, as for example, a railroad tunnel, and a gutter 65, is formed in the bottom of the tunnel, as shown.

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

1. In a tunneling machine, a wheeled carriage, a feed frame slidably mounted in said carriage, means including a feed screw for feeding said feed frame reciprocally in said carriage, a depending front end portion on said feed frame extending down over the forward end of said carriage, and a supporting

wheel mounted in said end and adapted to support said forward end of said feed frame on the floor of the tunnel.

2. In a tunneling machine, a wheeled carriage adapted to run on the floor of a tunnel, a feed frame having its forward end extending over the forward end of said carriage towards the floor of a tunnel, wheels rotatably journaled in the forward end of said feed frame and adapted to support the forward end of said feed frame on the floor of the tunnel, and means for reciprocally feeding said feed frame on said carriage and tunnel floor independent of said carriage.

3. In a tunneling machine, a supporting carriage, a feed frame mounted on said carriage, provided with a forwardly and downwardly extending end, a floor engaging wheel journaled in the forward and downwardly extending end of said feed frame, and a feed screw connected to said carriage and feed frame and arranged to feed said feed frame reciprocally in said carriage.

4. In a tunneling machine, a rectangular-shaped reciprocating cutter-head having a slideway therein and having also a plurality of parallelly arranged drill-bit supporting recesses arranged a short distance apart, two of which extend into and along the opposite corners of said cutter-head and are positioned to point outward at an angle beyond the sides of said cutter-head, drill-bits adapted to fit said recesses and arranged to project beyond the sides and the ends of said cutter-head, means including bolts for securing said drill-bits end to end in a continuous row in each recess of said cutter-head, a supporting guideway for said cutter-head on which said cutter-head is reciprocally mounted and means including any suitable reciprocating movement motor for reciprocating said cutter head on said guideway.

5. In a tunneling machine, a reciprocating cutter-head having a slideway therein, a plurality of chisel-edge rock-cutting bits adapted to be secured to the face of said cutter-head in rows, the outside rows of which and the outside bits of which are arranged to project beyond said cutter-heads, a supporting carriage, a feed frame slidably mounted on said carriage, a supporting guide arm pivotally mounted on said feed frame, means including a manually operated screw for feeding said guide frame and cutter-head on said carriage operatively in rock-cutting relation to the rock breast of a tunnel.

6. In a tunneling machine, a reciprocating rectangular-shaped cutter-head, of the full height of the tunnel, to be cut, and of a predetermined part of the width of said tunnel in width, a plurality of drill-bits receiving recesses in said cutter-head, angular drill-bits adapted to fit said recesses, some of which are removably secured at the edges of said cutter-head to project from it at an outward angle from the cutter-head as to cut an aperture of larger dimensions than said cutter-head, clamping bolts extending through said drill-bits and said cutter-head for removably clamping said drill-bits to said cutter-head, a guideway support for said cutter-head, a carriage adapted to be removably set and positioned in a tunnel, a feeding frame slidably mounted on said carriage, said guiding support being pivotally attached to said feeding frame, means for reciprocating said feeding frame, and means for moving said guideway support and said cutter head across the width of the breast of a tunnel.

7. In a tunneling machine, a narrow rectangular reciprocating cutter head, of the full height of the tunnel to be driven, provided with vertical and parallelly arranged rows of chisel-edged drill-bits having angular bases, means for securing said drill-bits to said cutter head, said cutter head having slideway slots therethrough, a supporting guide arm having forward terminal ends which project into said slideway slots and on which said cutter head is reciprocally mounted, means for reciprocating said cutter-head a feeding support for said guide arm and said cutter head, a fixed abutment carriage arranged to support said guide arm and its feeding support, and means for guiding said cutter head over the surface of the breast of a tunnel, and for feeding it forward to drill and cut away the breast of tunnels.

8. In a tunneling machine, a wheeled carriage, a frame reciprocally mounted thereon, a supporting wheel at the forward end of said frame, a feed screw operatively mounted in said frame and carriage to reciprocally feed said frame longitudinally thereon, an oscillating arm pivotally connected to said frame intermediate of its ends, means including gearing at the rear end of said arm and frame for oscillating the forward end of said arm transversely across said carriage and feed frame throughout a predetermined radius, a rock-cutting drill bit supporting head reciprocally mounted on said oscillating arm and comprising a head provided with a plurality of angular-shaped rock-cutting drill-bits removably secured to said head, some of which are arranged to stand outwardly beyond the side edges of said head, and are adapted to cut an aperture in the rock breast of a tunnel of larger area than said head and means connected to said drill-bit head and comprising a reciprocating power transmitting motor for reciprocating said drill bits and head to operatively drill rock.

9. In a tunneling machine, a wheeled carriage, a feed frame reciprocally mounted on said carriage, a supporting wheel at the forward end of said feed frame, a rearward extension to said wheeled frame provided with a cross plate, a feed screw rotatably mounted

in said cross plate at one end and extending lengthwise of said carriage, a nut threaded to said feed screw and secured to said feed frame, a guide arm pivotally secured to said feed frame, having a gear segment at its rear end, gears mounted in mesh with said gear segment, a drill bit supporting head reciprocally mounted on said guide arm, a plurality of rock cutting drill-bits removably secured to said head, and means including an operative motor for reciprocating said head and drill bits on said guide arm.

10. In a reciprocating tunneling machine, the combination of the wheeled carriage, lateral adjustable wall bracing jack screws arranged to rigidly brace and secure said carriage between the walls of a tunnel, a feed frame reciprocally mounted on said carriage, supporting wheels on said frame, adjustable wall bracing jack screws extending from the opposite sides of the wheel supported end of said feed frame, a rock-cutting head and its supporting arm mounted on said feed frame, and means including a reciprocating movement motor attached to said head for operatively reciprocating and directing said drilling head to drill and cut away the breast of tunnels.

11. In a tunneling machine, the combination of the carriage, provided with wall braces, the feed frame reciprocally mounted thereon, means for reciprocating the feed frame, a supporting wheel and wall engaging braces at the forward end of the feed frame, a guide arm pivotally mounted on said feed frame to swing over the face of the breast of a tunnel, and provided with a gear rack portion, a train of gearing in operative mesh with said gear rack portion of said guide arm, and means for operating said gears to move said guide arm independent of said feed frame, a cutter head reciprocally mounted on said feed frame, provided with a plurality of rock cutting drill-bits, a reciprocating rod pivotally secured to said cutter head, and a suitable motor connected to said rod and adapted to reciprocate said cutter head.

12. In a tunneling machine, the combination of a wheeled carriage, a feed frame slidably mounted on said carriage, the feed screw arranged to feed said feed frame reciprocally in said carriage, a guide arm pivotally connected to said feed frame, a gear toothed section at the rear end of said guide arm, a train of gears in mesh with said gear toothed segment, an operating hand wheel mounted on said feed frame, two separated terminal end slideways on the opposite or forward end of said guide frame, a cutter head provided with recesses adapted to fit slidably over the ends of said guide arms, a roller pivotally mounted in said cutter head and arranged to support said cutter head reciprocally on the ends of said guide arm, a piston plunger connected to said cutter head, a suitable motor connected to said piston plunger and adapted to impart to it and to said cutter head a reciprocating movement, and a plurality of rock cutting drill bits removably secured to said cutter head.

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

SILAS A. KNOWLES,
WALTER E. CARR.

Witnesses:
G. SARGENT ELLIOTT,
BESSIE THOMPSON.