No. 17,650. PATENTED JUNE 23, 1857.

C. WILSON.

EXCAVATING AND TUNNELING MACHINE.

5 SHEETS—SHEET 1.

Fig. 2.

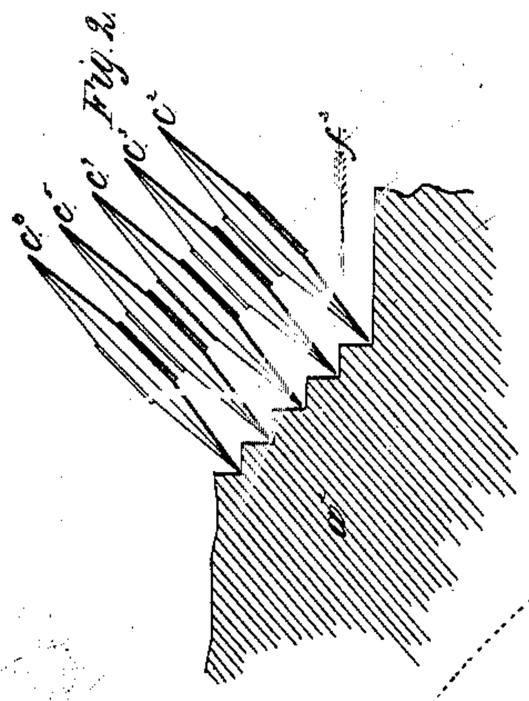


Fig. 4.

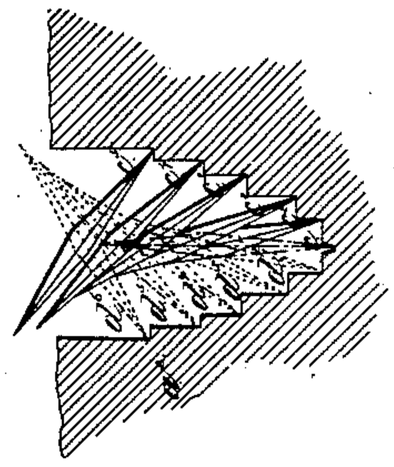


Fig. 5.

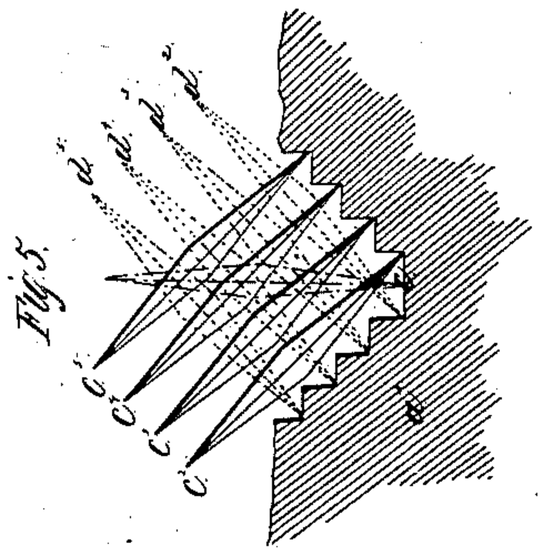
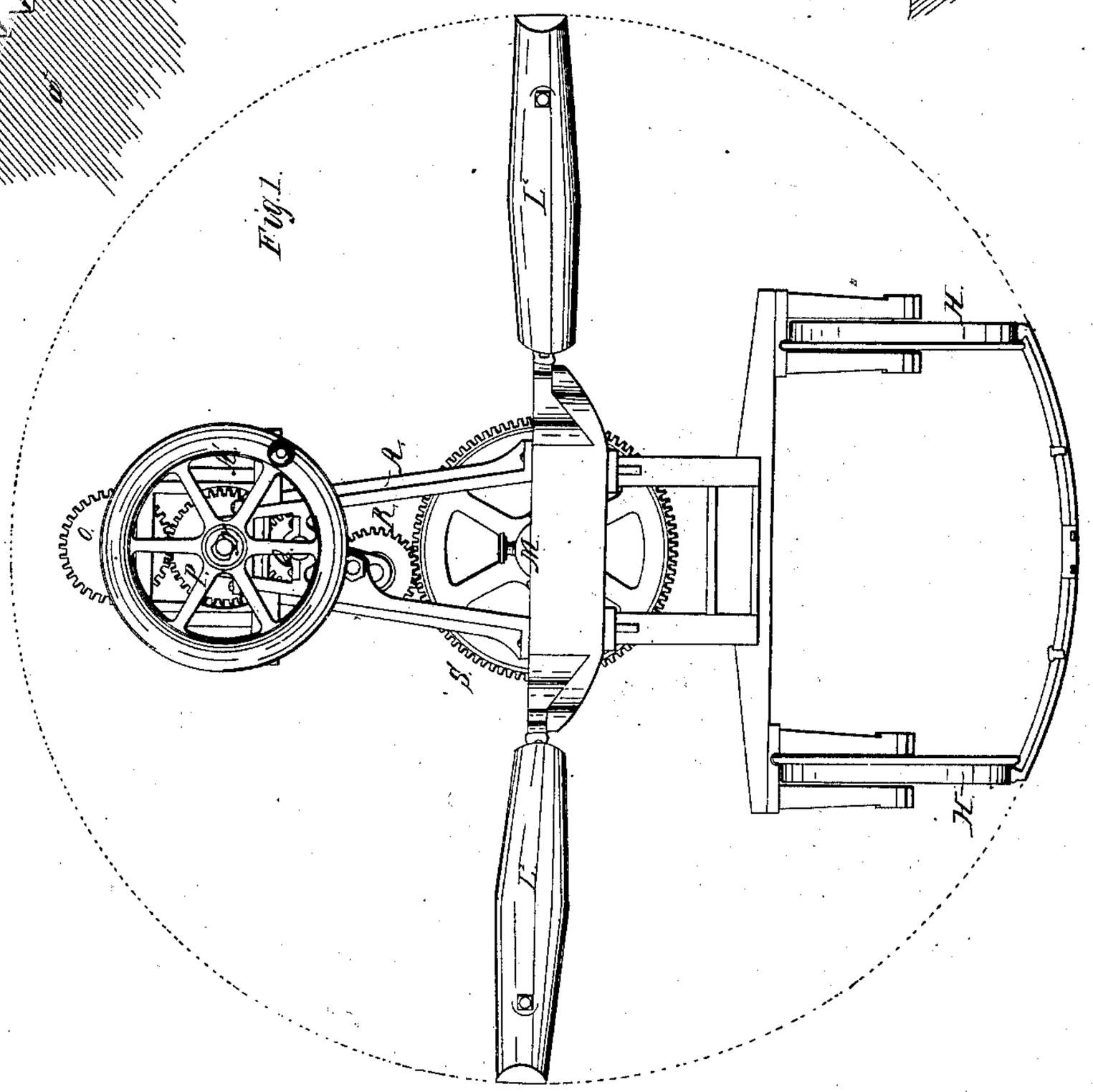


Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 2.

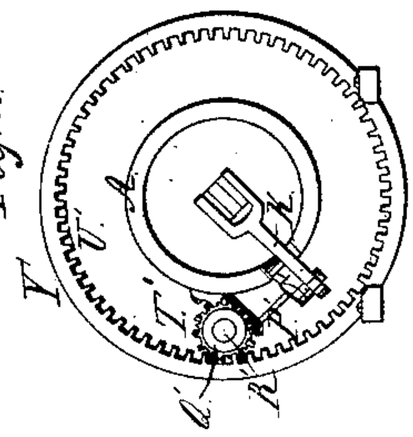
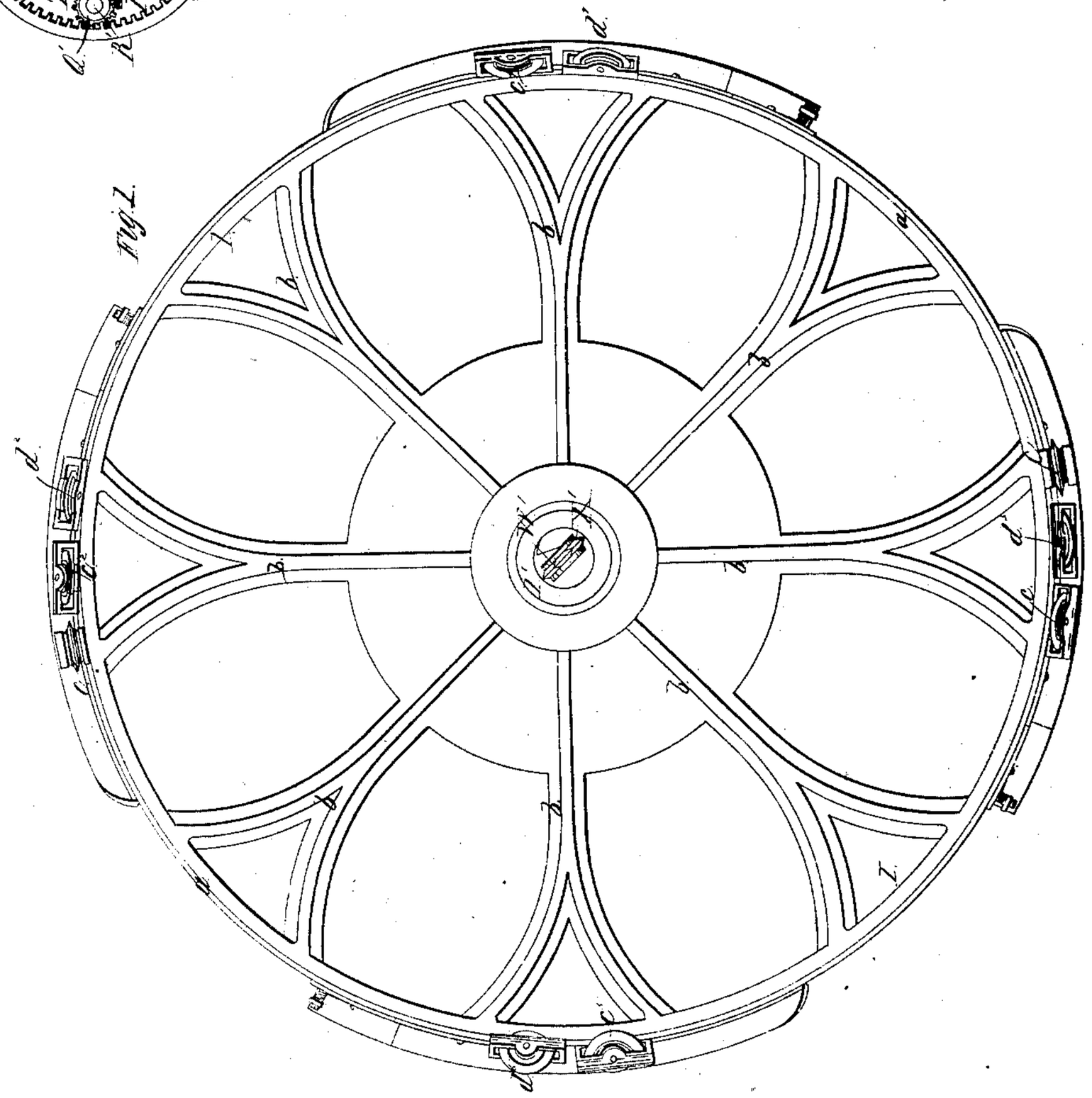


Fig. 1.



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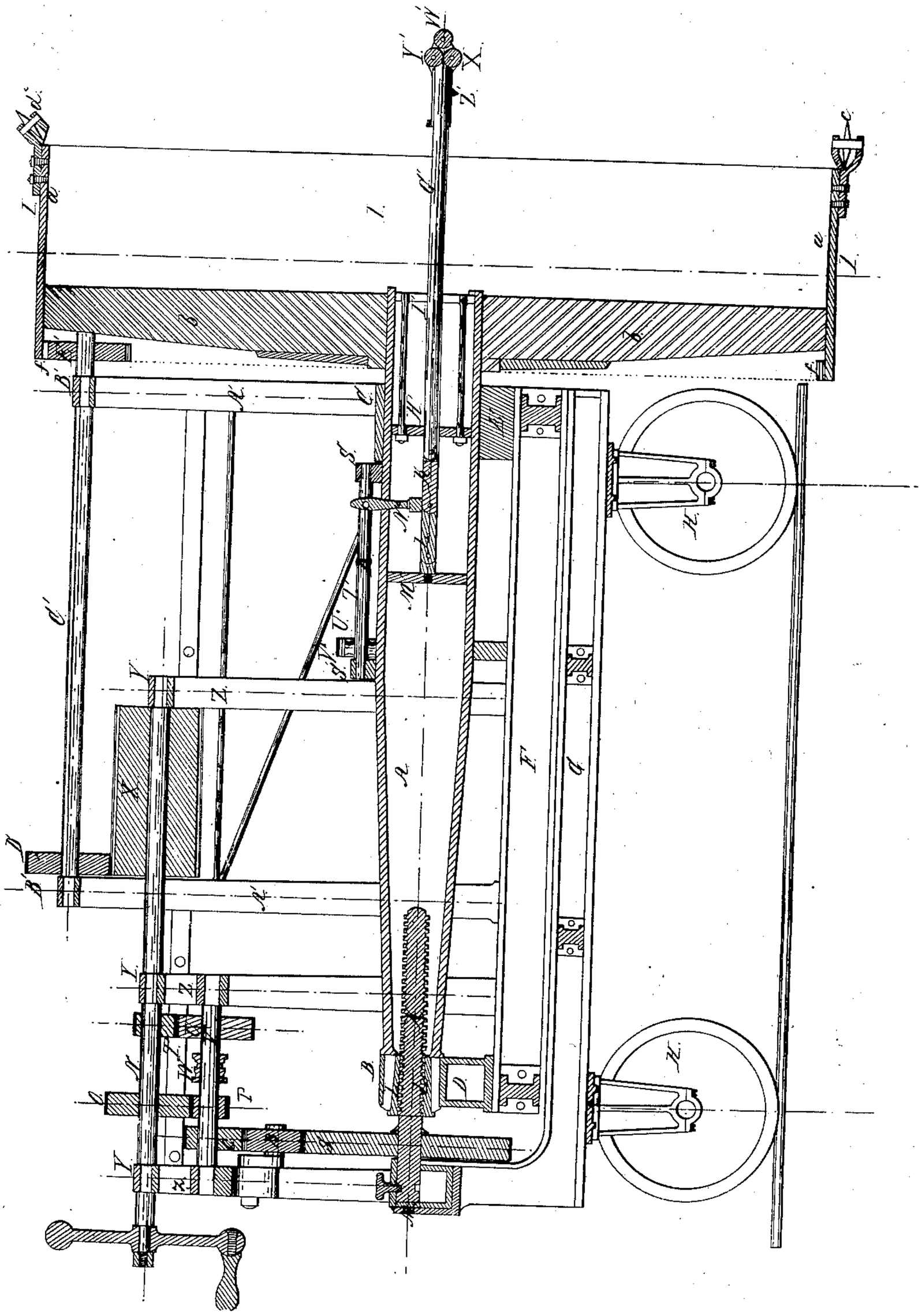
5 SHEETS—SHEET 3.



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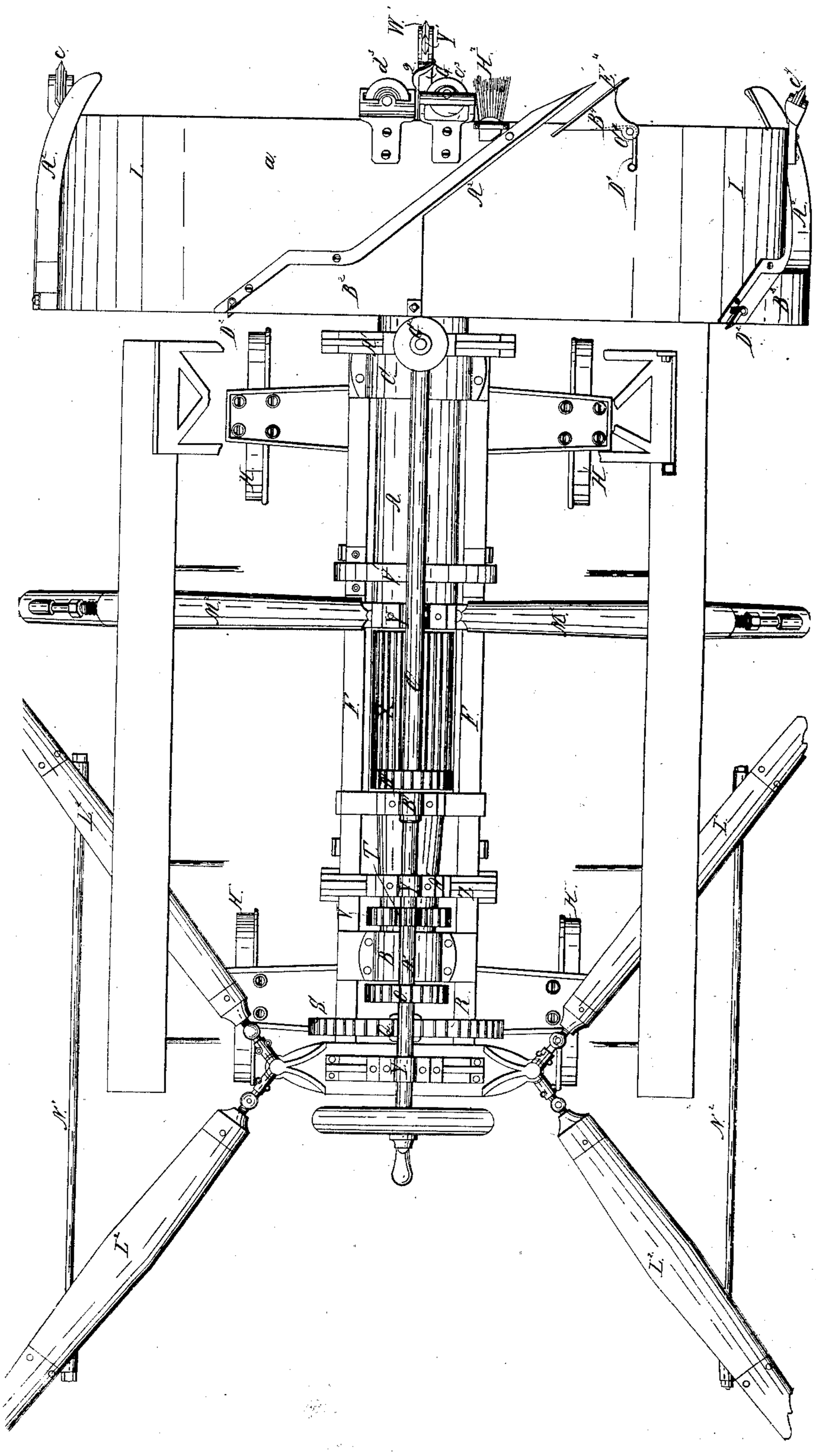
EXCAVATING AND TUNNELING MACHINE.

5 SHEETS—SHEET 4.



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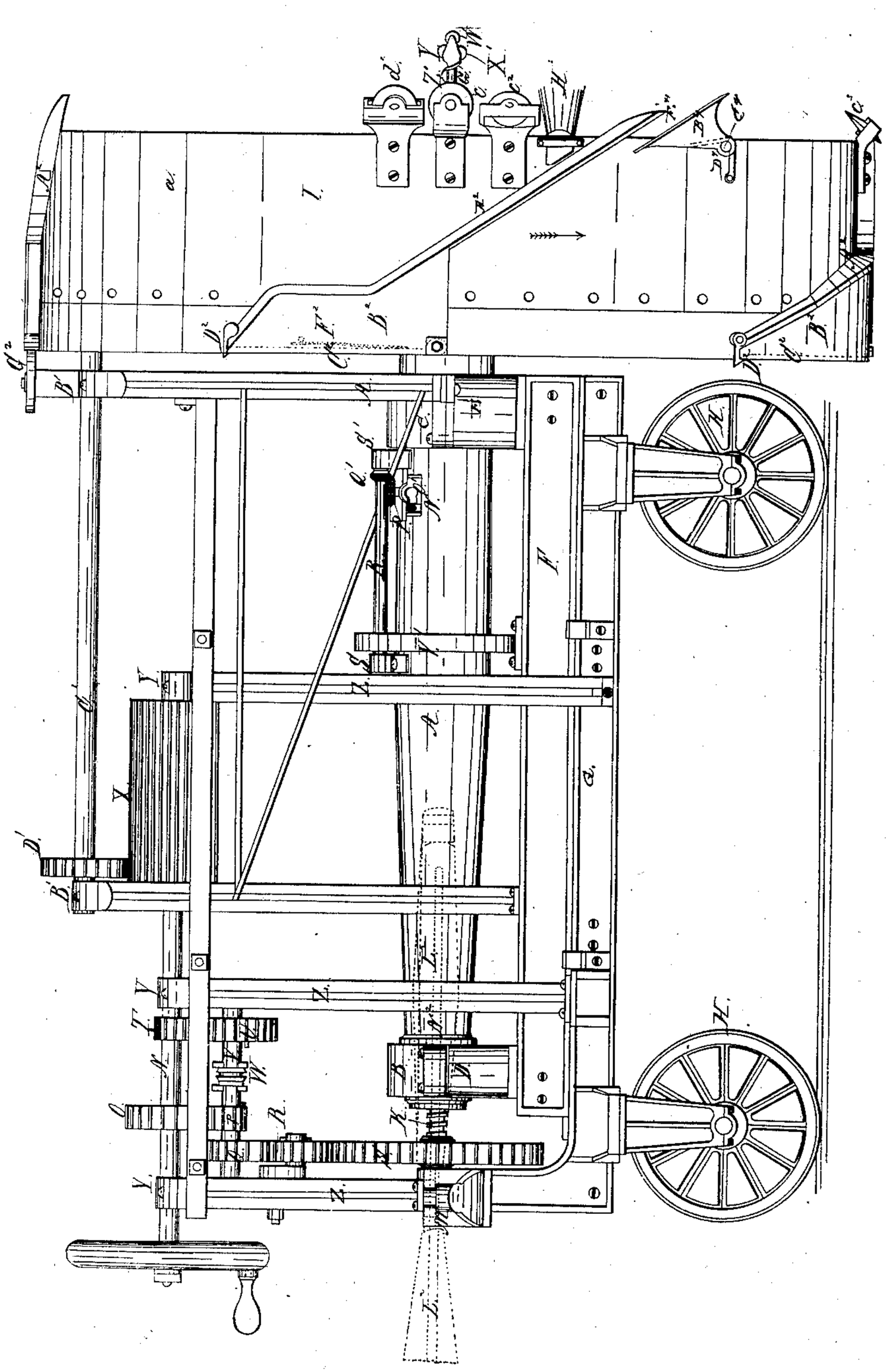
EXCAVATING AND TUNNELING MACHINE.

5 SHEETS—SHEET 5.



UNITED STATES PATENT OFFICE.

CHARLES WILSON, OF SPRINGFIELD, MASSACHUSETTS.

MACHINE FOR EXCAVATING TUNNELS.

Specification of Letters Patent No. 17,650, dated June 23, 1857.

To all whom it may concern:

Be it known that I, CHARLES WILSON, of Springfield, in the county of Hampden and State of Massachusetts, have invented a new and useful Machine for Excavating or Boring Tunnels, Holes, or Passages Through Rock or Earth; and I do hereby declare that the same is fully described and represented in the following specification and the accompanying drawings, letters, figures, and references thereof.

Of the drawings above mentioned that of Sheet No. 1 represents a top view or plan of my improved excavating and tunneling machine. That of Sheet No. 2 is a side elevation of it. That of Sheet No. 3 is a vertical, central, and longitudinal section of it. The main drawing of Sheet No. 4 is a front end elevation of the great wheel that sustains and carries the series of rotary cutters to be hereinafter described. The drawing of Sheet No. 5 is a rear end elevation of the machine.

The particular object of my machine is to excavate and bore tunnels through earth or rock, and particularly through the latter, to which it is especially adapted. I have arranged two series of rotary disk cutters and applied them to a rotary shaft in the particular manner so that by their rotation against a surface of rock or material to be cut away they shall cut into such surface a circular ring or path. I have also arranged and applied to a shaft a series of such cutters which during their operation as will be hereinafter desrcibed are made to bore or cut into the center of such ring.

In the drawings above mentioned A denotes a hollow tubular shaft, which is supported by and made to revolve in bearings B, C, Sheets 2 and 3, applied to the tops of standards D, E, of a horizontal frame or carriage F. The said carriage F is supported and slides longitudinally upon another carriage G, which runs or is supported upon four or any suitable number of railway wheels H, H, &c. On the front end of the shaft A is a large wheel I which is made sufficiently strong and with a very broad rim *a*, *a*, as seen in the drawings. The arms of this wheel are shown at *b*, *b*, *b*, Sheet 4, Fig. 1. It is on the front external edge of this wheel that the two series of rotary disk cutters for cutting a circular belt of surface are applied; such two series of such cutters being shown at c^2, c^3, c^4, c^5, d^2, d^3, d^4, d^5, of Sheet No. 4. The peculiar arrangement of these cutters so as to cut a circular belt of surface constitutes a material part of my invention.

In Figs. 3 and 4 Sheet No. 5, I have made diagrams that will serve to illustrate the peculiar arrangement of my cutters for cutting a circular groove in a rock, a cross section of which groove may be supposed to be represented in such figures. In cutting a groove in a stone I make use of two series of such cutters, one series being represented by the letters c^2, c^3, c^4, c^5, and the other by the letters d^2, d^3, d^4, d^5. In dressing stone by means of such cutters it is customary to apply them to a revolving shaft and to arrange a series of them together somewhat as represented in Fig. 2 of Sheet No. 5, wherein c^2, c^3, c^4, c^5, c^6, may be supposed to represent five of these cutters each of which is arranged with its cutting edge a little in advance of and above the next cutter below it, the cutters being all inclined to the surface to be dressed. When cutters so arranged pass across the surface of a stone they cut or chip it away very much as represented in Fig. 2, Sheet No. 5, a^2, being the stone, the cutters being made to advance longitudinally in a direction denoted by the arrow f^2, and while at the same time they are carried across the stone in a direction about at right angles thereto. This mode of operating on stone by means of cutters of this description is well understood by persons skilled in the art of using them.

In forming a groove in a stone I make use of two series of cutters c^2, c^3, c^4, c^5, d^2, d^3, d^4, d^5, Sheet 5, Fig. 4, the one series being arranged in directions opposite to those of the other as denoted in Figs. 3 and 4 of Sheet No. 5, and I would remark that while one series is made to cut away half of the groove the other series cuts away the other half of it.

In Figs. 3 and 4, Sheet No. 5, I have represented the series c^2, c^3, c^4, c^5, by black lines, the other series d^2, d^3, d^4, d^5, by red lines, a^2 denoting the stone as cut by them. In Figs. 4 and 5, *c* represents a cutter which if necessary may be used in connection with the said two series of such cutters to cut along the middle of the groove and generally to stand perpendicularly to the face of the stone to be cut. In Fig. 1, Sheet No. 4, I have represented two such cutters at *c*, *c*, they being on opposite sides of the wheel.

It is not essential that the cutters of one series be all arranged at the same angle of inclination, as their angles of inclination may be varied, and in disposing them on the edge of the periphery of the wheel I arrange them so that their planes shall stand at different angles of inclination to the general plane of the wheel, and so that one may be in advance of the other, not meaning to limit myself to any particular order of arranging them. And I also arrange them so that the cutting edges of the cutters c^2, d^2, shall be farther from the edge of the rim of the wheel than the cutting edges of the cutters c^3, d^3. So with regard to the cutting edges of the cutters c^3, d^3, they are to be arranged farther from the edge of the rim of the wheel than are the cutting edges of the cutters c^4, d^4, and this in order that each series of cutters may be made to enter the stone in a manner similar to that in which the cutters c^2, c^3, c^4, c^5, &c., in Fig. 2, Sheet No. 5, perform their operation.

In the above it will be seen that in cutting a groove it is necessary that I should have one series of cutters inclined in one direction and another series inclined in another direction and so that both series shall incline toward one another at acute angles. The shaft A having its wheel I mounted upon it is to be provided with a suitable mechanism for feeding or pressing it forward with the power and velocity necessary to enable the cutters to successively and properly perform their office when the boring operation is being carried on. For this purpose the rear end of the shaft A is provided with a female screw L (see Sheet 3), which is made to receive a feeding screw K whose outer end is supported and made to turn in a suitable bearing M applied to the carriage G, the adaptation of the screw to its bearing or to the carriage G being such as will admit of a rotary movement of the screw on its axis without any endwise movement of it. The main driving shaft of the machine is seen at N. A train of gears O, P, Q, R, S, (Sheets 1, 2, 3), connects the main shaft with the screw K so as to put such screw K in revolution when the main shaft is revolved. The gears T, U, seen in the figures are simply for the purpose of varying the speed or diminishing the rotary movement of the screw, either the gear T or the gear U being clutched with the shaft V by means of a clutch W as circumstances may require. On the inner end of the shaft N there is a drum gear or long gear X. The shaft N revolves in boxes on bearings (Y, Y, Y, Sheets 1 and 3) which are respectively supported by standards or frames Z, Z, Z, that are elevated on the carriage G and are entirely distinct from certain frames or standards A′, A′ which are raised on the carriage F and which carry at their tops boxes B′, B′ that support a horizontal shaft C′, Sheets 1 and 3. The shaft C′ carries two spur gears D′, E′, the former of which, viz, D′ is made to engage with the drum gear X while the latter E′ is made to engage with a gear or row of teeth *f*, *f*, extended around the inner surface of the ring *a*, *a*, of the wheel I. Now when the main shaft N is put in rotation it will revolve the drum gear X and thereby put in motion the gears D′, E′, and the shaft C′ and consequently put in rotary motion the wheel I. The rear standard A should be so made as to allow the drum gear X to pass through it, or so that there shall be no interruption to the forward movement of the standard A′ or its carriage F. The only movement the drum X has is a rotary one while the wheel D′ not only has a rotary one which is imparted to it by the drum X, but it has an endwise movement across the drum X, which endwise movement is in accordance with that of the wheel I or of the velocity of feed of the machine.

From the above it will be seen that while the wheel I is rotated on its axis it has a forward motion imparted to it.

The shaft A carries a drill rod G′, Sheet 3, whose axis is arranged in a line with the axis of the shaft A. This drill rod is supported in suitable bearings H′, I′, and so that it can slide endwise or longitudinally. Its rear end is jointed to toggle joints K′, L′, which are jointed to a cross piece M′ extending across and within the shaft A. These toggles are actuated or moved alternately from an angle into a straight line with each other by means of a connecting rod or pitman N′ which is jointed to the outer end of a crank O′ (see Fig. 2, Sheet 4) on whose shaft is a bevel gear P′ that engages with another bevel gear Q′ on a horizontal shaft R′ that revolves in bearings S′, S′, Sheet 3, that are fastened to the external surface of the shaft A. A pinion T′ is fixed upon the shaft R′ and engages with a row of cogs or teeth U′ formed on the inner periphery or surface of a circular ring V′ that is made concentric with the shaft A and is fixed firmly to the carriage F, the whole being as seen in the drawings, and particularly in Fig. 2, Sheet No. 4, which represents a cross section of the shaft A together with some of the above-mentioned parts.

From the above it will be seen that not only will the shaft G′ have a rotary motion on its axis in common with that of the shaft A but at the same time it will have a reciprocal rectilinear movement in the line of its axis. The front end of this shaft is provided with a rotary disk cutter W′ and one or more other rotary disk cutters X′, Y′, arranged in rear of the cutter W′ and made to project

laterally from the axis of the shaft G′ a distance greater than the radius of the cutter W′. In rear of this series of cutters W′, X′, Y′, and around the shaft G′ I arrange a helix or screw Z′ which is made to fit the bore of the hole made by the operation of the cutters W′, X′, Y′, and is so applied to the shaft that during the rotation of the shaft it will act upon and remove from the hole or bore the dust or particles of rock that are separated from the rock by the action of the cutters W′, X′, Y′. A rotary movement of the series of cutters W′, X′, Y′, together with their forward movement against the rock will cause them to act as a drill or borer and so as to bore a round hole in the rock.

Around on the periphery of the wheel I, I arrange a series of inclined planes or scrapers or excavators A^2, Sheets 1 and 2, each of which is connected to or extends from a box or bucket B^2 whose end is provided with a flap or closing door C^2 which turns on a hinge at one end and is held at the other end against the box by a small spring catch D^2. Each flap C^2 is provided with a spring that rests against a pin F^2 (Sheet 2), that extends through the box, the object of the spring being to throw the flap open (so as to open that side of the box against which the flap acts) when the catch D^2 is unlatched. It is intended that a spout shall be arranged in some suitable place in rear of the periphery of the wheel I and so that when the latch B^2 is carried around in contact with the underside of the spout it shall be so moved as to be unlatched from the flap C^2 so as to permit said flap C^2 to be opened by its spring and thereby discharge the contents of the box of the flap into the said spout, such spout being arranged so as to convey such contents into a railway car or any other receptacle placed underneath the carriage G. The outer edges of the inclined planes or scrapers A^2 are arranged so as to scrape up the dirt or particles of rock removed by the cutters and this during the rotation of the wheel I. By means of these inclined planes or scrapers such particles are conveyed into their respective buckets.

G^2, Sheets Nos. 1 and 2, is a roller or wheel placed on the top of the machine and in such a position that when each flap C^2 is brought up against it it will roll against the flap and latch it down to its bucket.

If desirable one or more brushes H^2, Sheet Nos. 1 and 2, may be used in connection with one or more of the cutters and so placed in front of them as to brush from the rock such particles as may have been loosened by the action of preceding cutters.

In order to keep the cutters to their work it becomes necessary to secure the frame F permanently in place, so that the screw K, shall have an abutment to act against in projecting the cylinder I and cutters forward. It has heretofore been sought to feed excavating or tunneling machines forward by power applied to rollers, and also the machines has been weighted to its place, but the power required is so great that either of said modes are inefficient. I therefore secure said frame F permanently in the successive positions required by means of jack screws L^2, Sheets 1, 2, and 5, connected near the circumference of the inclosing tunnel by bolts N^2 and attached at the other end to the part *y*, of the frame F, these become a horizontal resistance and the screws M^2, Sheet 1, both centralize the machine and also resist the rotating power of the cylinder I and cutters.

In regard to the scrapers or excavators A^2 hereinbefore mentioned they may be made like chisels or gouges where they extend beyond the edge at the rim *a*, and so that when the machine is used in tunneling earth and loose rock or partly through earth and partly through rock they shall serve the purpose of excavators to cut away the earth while the rotary cutters under such circumstances not only perform the operation of cutting away the rock but will cut into the earth, and thus it will be seen that my machine is not only adapted to tunneling through solid rock, but it may likewise be used to cut into hills composed of rock and earth.

In order that the scraper A^2 may not meet with any particular obstruction from the rock in the grooves as it is being cut there may be applied to operate in front of it a small spring guard or scraper B^4. This scraper may be made to turn on a pin C^4 and to be pressed into the groove by a spring D^4 so arranged as to allow the scraper to slip over any obstruction. If the scraper is provided with an inclined plate E^4 loose matters in the groove will be taken up by the inclined plate and discharged upon the part A^2. Besides two series or sets of rotary disk cutters applied to one shaft or circular rim thereof there may be one or more other rims or their equivalents attached to the arms of the shaft or to the shaft to carry additional cutters arranged and made to operate in a similar manner to the sets, c^2, c^3, c^4, d^2, d^3, d^4, whereby one or more parallel or concentric rings may be made at the time of formation of the ring made by the said sets c^2, c^3, c^4, and d^2, d^3, d^4. The rings thus formed may be so many and so close together as to adapt the machine particularly when the center boring tool is employed to the boring of a cylindrical or nearly a cylindrical hole.

The plan I have adopted in tunneling is to bore a single ring and a central hole. By means of a charge of gunpowder afterward placed in the central hole and exploded I expect to be able to detach all or a large portion of the rock intervening between the central hole and the ring or circular groove.

I would remark that I do not herein claim a single set of one or more rotary disk cutters

applied to a common revolving shaft and made to pass across a stone and to take a succession of chips or cuts from it essentially as represented in Fig. 2 of sheet No. 5, and as hereinbefore described.

I do not herein claim the drill (W′ Y′ Y′) as the same might be used by hand or in any other machine and becomes a separate invention that may hereafter be secured by Letters Patent.

What I claim and desire to secure by Letters Patent is—

1. Forming grooves in stone, or other mineral substances by means of rolling disk cutters on axes set in alternate opposite directions and acting substantially as and for the purposes specified.

2. I claim arranging a series of rolling disk cutters revolving in such a manner as to cut a deep annular groove into the rock substantially as specified.

3. I claim the arrangement of the scoops A^2 and buckets B^2 in combination with the cylindrical wheel I and rotary cutters; to free the annular groove of the chips and dirt abraded by said cutters, substantially as and for the purposes specified.

4. I claim a bed plate secured in place by the jack screws (L^2 M^2) or their equivalents in combination with a sliding frame or its equivalent, projected forward as the cutting progresses by means of a screw, acting between the fixed and moving parts substantially as and for the purposes specified.

In testimony whereof, I have hereto set my signature, this twenty-seventh day of July, A. D. 1852.

CHARLES WILSON.

Witnesses:
R. H. EDDY,
GEORGE W. CUTTER.