C. Wilson,

2 Sheets-Sheet 1.

Stone Drill.

No. 14,483. Patented Mar. 18, 1856.

Fig. 5

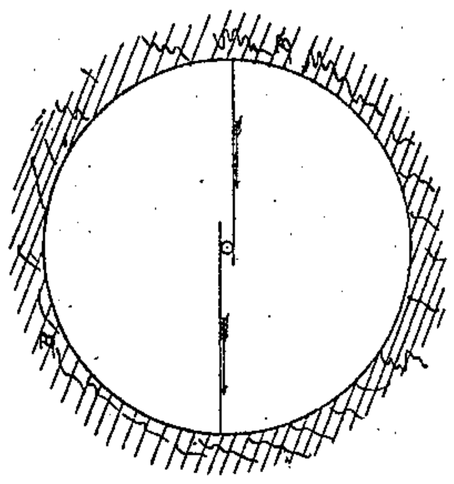


Fig. 4

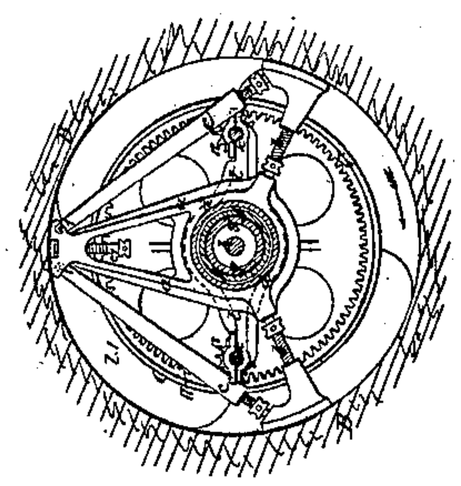


Fig. 1

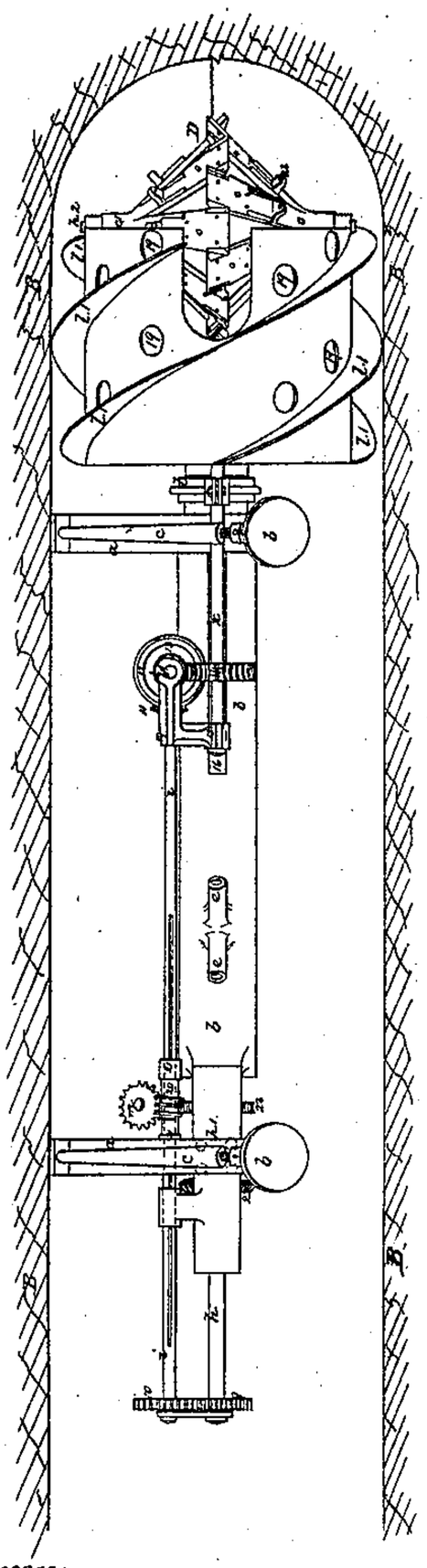


Fig. 2

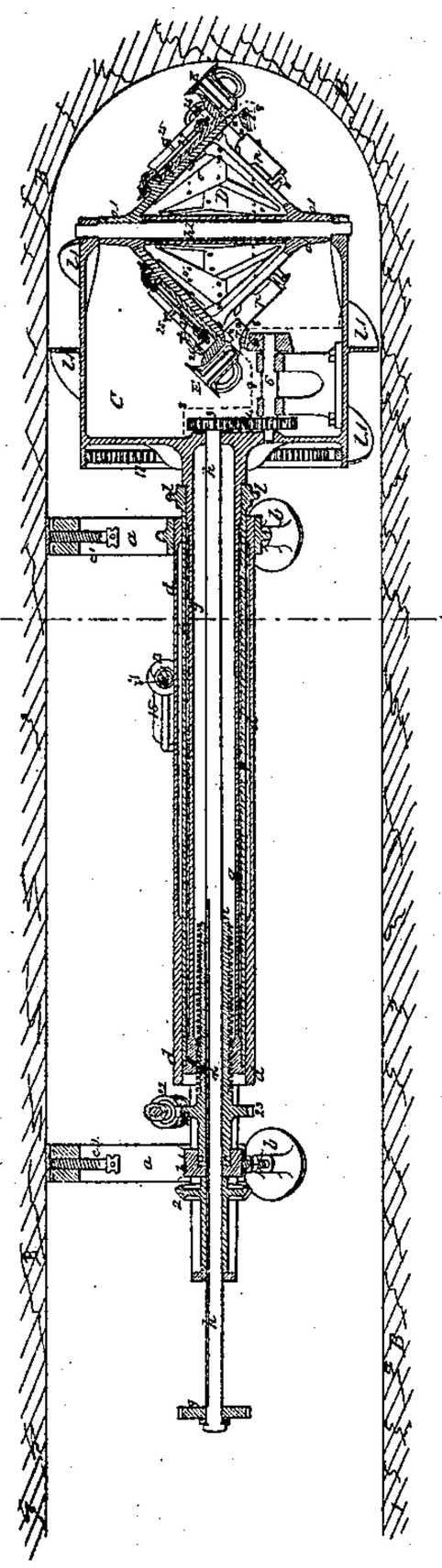
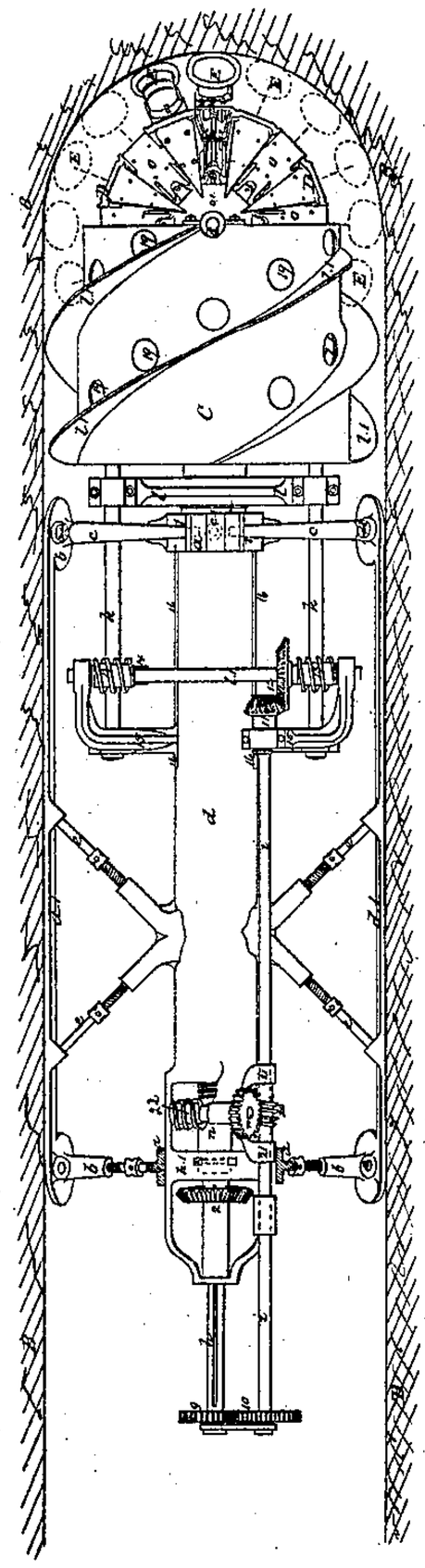


Fig. 3



Witnesses:

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Inventor:

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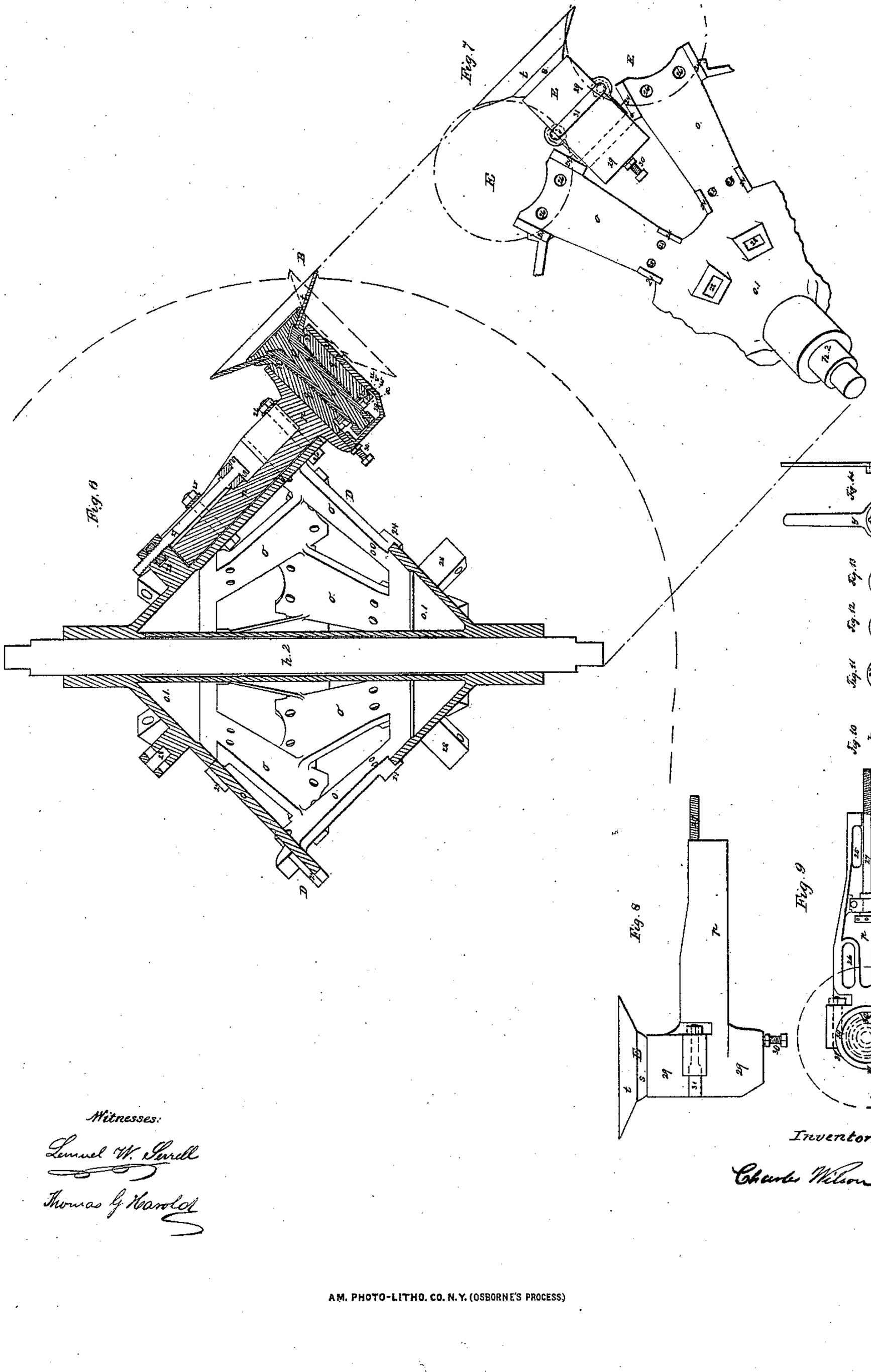
2 Sheets. Sheet 2.

Stone Drill.

No. 14,483. Patented Mar. 18, 1856.



Witnesses:

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UNITED STATES PATENT OFFICE.

CHS. WILSON, OF SPRINGFIELD, MASSACHUSETTS.

MACHINE FOR TUNNELING ROCKS, &c.

Specification of Letters Patent No. 14,483, dated March 18, 1856.

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, made, and applied to use certain new and useful Improvements in Machinery for Boring or Excavating Holes or Tunnels in Rocks or other Substances; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making part of this specification, wherein—

Figure 1, is a side elevation of the apparatus complete except the cutters which are removed to avoid complexity. Fig. 2, is a vertical longitudinal section. Fig. 3, is a plan of the apparatus complete, except that only two cutters are shown in place. Fig. 4, is a cross section at the line A, A, and Fig. 5, is a representation of the end of the tunnel or hole showing the manner in which the cutters leave the face of the stone. Fig. 6, is a section of the conical cutter wheel and one cutter in place in large size. Fig. 7, is a view at right angles to the conical surfaces receiving the cutter stock. Fig. 8, is a side view and Fig. 9, a plan of the cutter stocks.

The same marks of reference denote similar parts.

The nature of my said invention consists in so arranging constructing and fitting the parts of a revolving cutter wheel made use of in said machine that the cutters are gradually forced forward with a very slow motion while a wheel carrying rolling disks or cutters receives a compound motion, the one motion a revolution on its own shaft, which shaft is at right angles to the axis of the tunnel or hole being bored, and the other motion a gradual rotation of said cutter wheel and parts carrying the same on the line of the axis or general direction of said tunnel. These two motions in addition to the very slow forward feeding motion produced, by the rolling cutters, a gradual removal of the rock or other substance at the semispherical end of the tunnel or hole, similar to the operation of a double semicircular cutting edge of an auger. The speed and proportioning of the parts must be according to the size of the tunnel and the character of the material operated on and the number of cutters, but for the purpose of illustration we might suppose that for every revolution of the cutter wheel on its axis said axis was turned so as to produce about two inches motion at the circumference of said tunnel, or so that each successive cutter shall act on the stone at the circumference of the tunnel about $\frac{3}{16}$ of an inch in advance of the preceding cutter, and at the same time the cutter wheel is gradually fed forward producing a gradual spiral or helical cut.

In the drawing a section of the rock or other substance being bored to form the tunnel is shown at B, B, and within this tunnel the machine is sustained by means of screws setting against the sides; but on commencing to bore a tunnel the machine must be sustained by a suitable framework or within the approaches to the tunnel until the machine has penetrated sufficiently to be braced against the rock.

a, *a*, are triangular frames fitted with jack screws and bearing blocks *b*, *b*, which are to be screwed up until the axis of the machine is slightly elevated above the center line of the tunnel, and then the screws *c'*, *c'*, are to be forced against the top part of the tunnel until the machine is brought axially with the same; this tightens the screws *b*, *b*, and then on screwing up the screws *c*, *c*, which are attached at 1, 1, to the frames *a*, the said frames *a*, *a*, and parts attached are effectually prevented from turning within the tunnel, and to resist pressure endwise of the machine I make use of jack screws *e*, *e*, see Fig. 3, taking against plates or sills *d'*, running lengthwise of the tunnel and forcing them against the sides. The inner ends of these jack screws *e*, *e*, are connected to a cylinder *d*, and that is also connected permanently to the forward triangular frame *a*, and jack screws, and said cylinder *d*, carries within it the second cylinder *f*, that is fitted with one or more feathers, (see Fig. 4) so that it can only have an endwise sliding motion within the cylinder *d*, and within this second cylinder *f*, is a third cylinder *g*, so fitted that it can turn within the cylinder *f*, but this cylinder *f* is confined to the cylinder *g*, by a collar at each end, so that the two must slide back and forth together within the cylinder *d*. On the end of this cylinder or hollow shaft *g*, I cast or otherwise attach by means of arms the main drum or boring head C, moved and acting as hereafter described. The cylinder *d*, is extended back by straps or side pieces and connected to the rear triangular frame *a*,

and set of jack screws by the block h', and through this block the main center shaft h, passes; the said shaft is to be driven by a wheel 2, or other suitable connection to competent motive power the same not being here shown, as this forms no part of the present invention. This shaft h, passes the length of the hollow shaft g and enters the drum C, where it is fitted with a gear wheel 3, and as this shaft h, slides through the wheel 2, as the machine progresses the motive power is communicated by a feather and slot or other suitable means to said shaft h. The wheel 3, gears to a second wheel 4, on a shaft 5, set in bearings within the drum C, and 6, is a miter pinion taking a miter wheel 7, formed as a ring and attached to the double conical cutter wheel D, set and rotating on the shaft h^2, mounted in journal boxes on the drum C. This cutter wheel D, is made as hereafter set forth and is revolved at the required speed proportioned to that of the other parts by the gearing aforesaid, and to prevent the dust or chips from the rock getting into the gearing I inclose the same by a casing of sheet metal as at 8, 8, which is attached to the inside of the drum C.

At or near the back end of the shaft h, a wheel 9 is fitted, gearing to a wheel 10, on the auxiliary shaft i, and a strap around these shafts keep the gears together, and the inner end of this shaft i, is secured by and turns in a journal box in the arm 15, projecting from the cylinder f, through a slot 16 in the cylinder d, and this arm 15, and a similar one on the other side carry the cross shaft i', geared to the auxiliary shaft i, by miter gears 11, and 12, and fitted with worm pinions 13, 13, driving wheels 14, 14, on the short longitudinal shafts k, k. These shafts k, k, are set in journal boxes in the arms 15, and the aforesaid end pass through boxes on the cross head l, that is formed with and on the end of the shaft f and these shafts k, k, are fitted with pinions 18, on their ends acting on gears 17 placed within the end of the main drum C.

n, is a strong hollow screw around the shaft h, and retained at one end within the block h', by a groove around near its end and keys entering the same and a nut formed around the inner side of the hollow shaft g takes the threads of this screw.

It being premised that the cutter wheel D, by its rotation removes the rock in a semi-spherical surface at the end of the tunnel by cutters hereafter described, the motions and operations thus far are as follows: The cylinder d, being immovably fixed by the jack screws before detailed, the second cylinder f, cannot turn therein on account of its feathers before mentioned but simply slide out therefrom endwise, carrying with it the cross head l arms 15, shafts k, i', i, and h, and also the drum C, shaft g and parts attached moving forward simultaneously. As the cutter wheel D, is now rotated on its axis the drum C, and shaft g through the worm pinions and gear 11, 12, 13, 13, 14, 14, 17, and 18, 18, are slowly rotated causing the cutter wheel to act in its semi-spherical end in a series of nearly radial lines relatively with the axis of the tunnel, and if the screw n, were stationary the whole of the parts would be pressed forward out of the cylinder d, the extent of the pitch of the screw thread each revolution of the drum C, feeding the cutting wheel forward to that extent; but as this is sometimes too slow cutting and sometimes too fast when the rock is very hard I take a motion by suitable gearing from the auxiliary shaft i, to turn said screw n, in either direction according as I want to feed forward fast or slow.

20, is a worm pinion driven by a feather or key and slot in the shaft i, and confined in its place by the supports 21, of the shaft. m, is a wheel with a second worm 22, to a wheel 23, on the screw n; by this means the screw n, can be rotated in either direction according to the twist of the worm pinion 22, which for this purpose as well as speeding the parts by the pitch of the worm pinion may be made changeable; and when the shaft g and parts moving therewith have been projected out of the cylinder d, nearly the length of the screw n, the motion of the same is to be reversed by hand or otherwise so as to draw the parts again back within the cylinder d, the jack screws are to be loosened and the whole apparatus set forward the required amount and then again screwed tight into place to act as before, and for the purpose of facilitating this operation a suitable carriage or rollers may be used on which to move the apparatus forward.

Any dust or chips falling into the drum C, are passed out through openings 19, and all the dust chips, &c., are passed back of said drum C, by means of screw formed flanches l', from which point the same may be shoveled away or removed by any suitable apparatus.

Having thus described the construction and operation of the machine as a whole, I will now describe the construction and operation of the cutters and wheel carrying the same. The double conical cutter wheel D, which is rotated as before detailed is composed of a series of alternate tapering planes o, o, set at an angle of 45° or nearly so with the center of the shaft h^2 and these planes are cast or attached together at their point of crossing the opposite planes, and the narrower ends are formed with the conical hubs o', around the shaft h^2, so that the general form of this cutter wheel is that of two cones united at their bases, and the shaft

passing through the apexes. The number of these alternate tapering planes may be varied according to the size of the machine, the drawing representing sixteen, eight taper toward each end of the shaft h^2, and on each of these planes a stock p is mounted carrying a rolling cutter or disk E.

24, 24, are blocks or ribs forming slides on the planes o, within which the stocks p, p, are secured by bolts 25 and 26, passing through the planes o, o, through slots in the said stocks p, and through clamping straps above said stocks, so that upon slackening said bolts 25 and 26 each of the stocks p, can be slid out the required distance to compensate for the diameter of the cutter b, becoming less by wear, and this stock is adjusted and retained in its proper position by a bolt 27, furnished at one end with a head and holes by which it is turned and also collars setting on each side of a cap or box screwed into the stock p; the other end of said bolt 27 passes through a nut 28, in a block attached to or formed with the conical ends o', of the cutter wheel. Each cutter and stock is thus fitted so that the stocks are slid out as the cutters wear in order to bring them precisely into line and then on screwing up the bolts 25 and 26, the stocks are firmly secured in place.

Each of the cutters (t) is formed as a concave or short hollow truncated cone in the center of which is an opening setting around a groove in the sleeve or hollow shaft s, and a bolt r, having a large head inside the dishing part of the cutter and fitted with a nut 33, on its other end, clamps the cutter t, firmly to the flaring end of said hollow shaft s, and gives facility for removing the cutter t, when worn out. Around this shaft s, I place a hollow shell or cylinder q, lined with suitable antifriction composition and provided with packings as at 32, to exclude dust and dirt; and to secure the shaft s, into this cylinder q, and allow its free rotation I first slip over the inner end a plain metallic washer u (Fig. 13). I then slip over a second washer v, (Fig. 12) that is made with lugs or feathers entering grooves in the sides of the shaft s, the plain nut w, (Fig. 11,) is then screwed on and followed by the nut x (Fig. 10) and the two screwed up as tight as possible by a wrench y, (Fig. 14,) the nut w, being moved by a pin inserted through notches in the wrench and nut x, as at z. This brings the parts to their correct bearing the nuts are then slightly loosened to allow the shaft s to turn freely, the pin at z, is then withdrawn and the nut x, set up against the nut w, which effectually prevents any of the parts working loose. Two sets of cutters thus formed are provided for each machine, so that one set may be ground sharp by mounting each cutter and cylinder q, in a lathe and rotating the same against any suitable grinding surface. The other set of cutters are to be used in the machine, the meantime; and in order to attach the cutters in the machine the cylinder part q, has simply to be dropped into the socket 29 of the stock p, and the set screw 30, adjusted to prevent the cylinder q, dropping down too far into the socket 29, and by adjusting the screws 27 and 30, the cutting edge of the disk t, is brought to the exact position by any suitable gage, the screws 25 and 26, are then tightened up as before mentioned and a strap 31, passing into a mortise through the side of the socket 29, and fitted with nuts on the ends as shown in Figs. 7, 8, and 9 is tightened up, which binds the cylinder q, firmly into the socket.

On reference to Figs. 5, and 6, it will be seen by the red lines that in the rotation of the cutter wheel the sets of cutters act slightly on opposite sides of the axis of the tunnel, and in cutting one set of cutters commence to act from the circumference of the tunnel toward the center, and the other set standing the opposite way commence at the center on the opposite side of a small projection left in the rock, and cut out toward the circumference see arrows Fig. 5, and in consequence of the forward motion of the machine and the rotation of the drum C, carrying also the cutter wheel, the stone presents the appearance in the concave end of two offsets where the cutters act, joined by a compound curved incline from the top of one offset to the bottom of the next, and the action of the machine is similar to a double lipped round-ended auger or boring tool. It will be understood that the small projection in the center of the tunnel is broken off successively by the back of the cutters, in Fig. 6, and that it is necessary for the cuts from the cutters set in opposite directions to slightly lap over each other in order that space may be left sufficient for the back of the cutters set in one direction to pass clear of the off set on which the other cutters are acting.

When one set of cutters becomes dull by use as before mentioned they are to be taken out of their respective sockets 29, together with the cylinders q, and cutters with sharp disks l, substituted; and by the construction of the sockets 29, oil or grease can be placed in the inner end which will gradually work through between the shafts s, and cylinder q, or holes may be provided in this cylinder q for passing in oil or grease, and at the same time dirt is entirely excluded from the moving parts.

I do not herein claim a revolving or rolling cutter in itself as this has before been used for a variety of purposes, but I am not aware that a concave or short hollow truncated conical cutter for cutting stone or

similar material has ever before been made use of, thereby I am enabled to use so much thinner steel than if the cutter were a flat disk because the slight conical or dishing form stiffens and strengthens the cutter so very much, and therefore said cutters are of less cost and require less material ground away to keep them sharp and also allowing of the head holding the same being within the cutter so that the head will not touch the rock even when the cutters are worn away almost as small as said head, and the cutting edge also will remove the stone on either side of the cutter thereby providing for cutting off the center core of the tunnel. I am also aware that cutters have been set on arms or wheels to cut by an alternating or semi rotary or reciprocating motion therefore I do not claim the same, neither do I claim a continuously revolving cutter wheel in itself but I am not aware of any machine having heretofore been constructed with a continuously revolving cutter wheel having cutters attached thereto at an angle of 45° or nearly so with the shaft of the cutter wheel, and alternately in opposite directions and acting in the semispherical end of the tunnel with a continuous cut on two offsets as set forth, thereby I have a continuous motion and avoid the loss of power by any alternate motion consequent in overcoming the inertia of the ponderous apparatus. I am also aware that rolling cutters have been adjusted by screws therefore I do not claim the same. Neither do I claim the compound feeding motion in itself as this is well known, my invention simply relating the peculiar cutter wheel and its action when receiving this compound motion.

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

1. The circular cutter formed as a short hollow truncated cone for acting on stone or other material substantially as and for the purposes specified.

2. I claim a continuously revolving wheel provided with circular rolling disks or cutters, the axis of which cutters stand alternately in opposite directions or nearly at an angle of 45° with the shaft of said cutter wheel, thereby acting to excavate the rock or other material substantially as specified.

3. I claim the arrangement of the alternating inclined tapering planes *o*, *o*, and stocks *p*, for the purpose of sustaining and adjusting the alternate rolling cutters as specified.

4. I claim the construction of the shaft *s*, cylinder *q*, and parts attached when used in connection with the socket 29, set screw 30, and binding strap 31, for the purposes and as specified.

5. I claim the general arrangement of the cylinder and shafts *d*, *f*, *g*, *h*, *i*, *i'*, and *k*, *k*, and gearing attached for rotating the drum C, and pressing the same forward in the manner and substantially as specified.

In witness whereof I have hereunto set my signature this thirty-first day of January 1856.

CHARLES WILSON.

Witnesses:
LEMUEL W. SERRELL,
THOMAS G. HAROLD.