April 7, 1925. 1,532,243

W. HEBSACKER

EXCAVATING MACHINE

Filed June 17, 1920 5 Sheets-Sheet 1

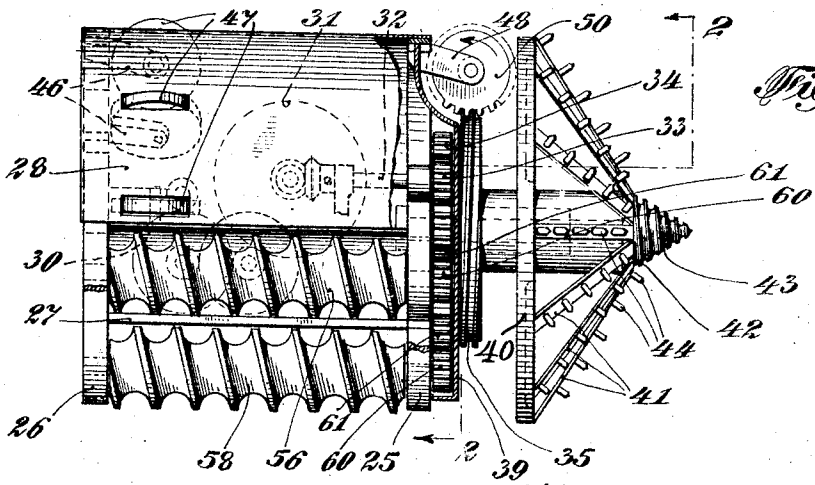


Fig. 1.

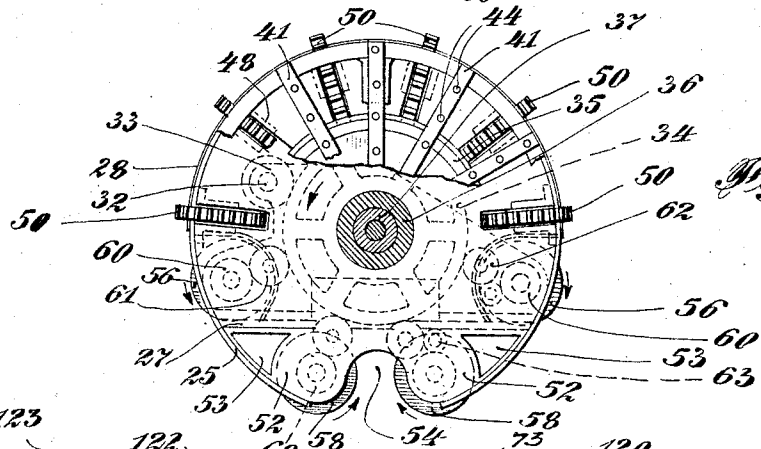


Fig. 2.

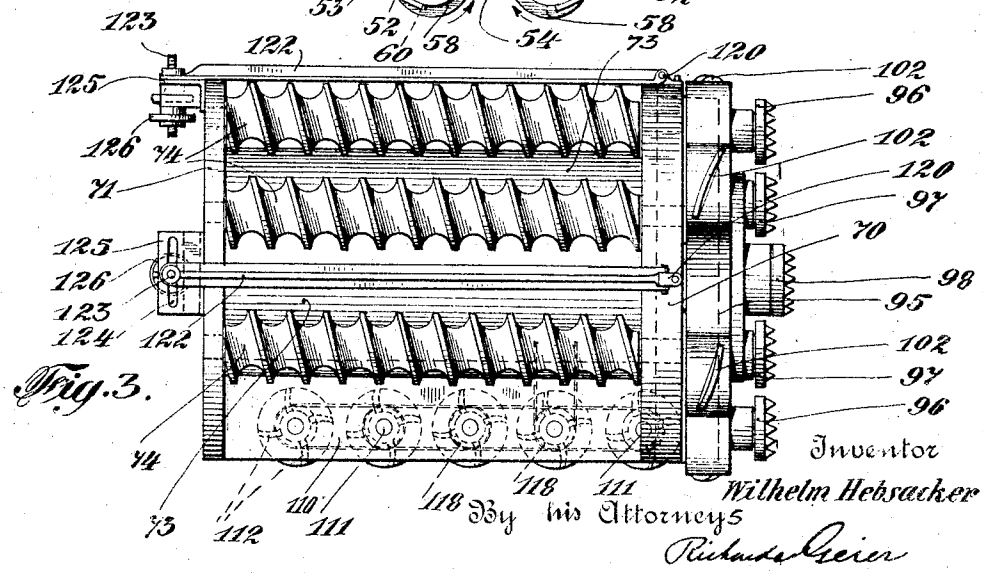


Fig. 3.

Inventor
Wilhelm Hebsacker
By his Attorneys
Richards & Geier

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Fig. 4.

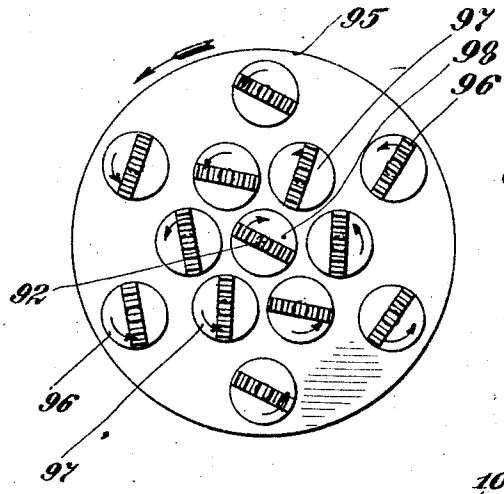


Fig. 5.

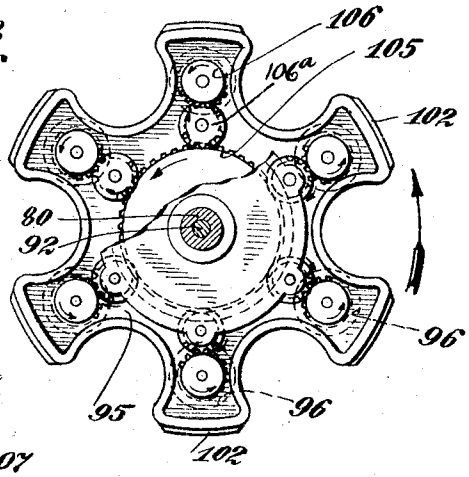


Fig. 6.

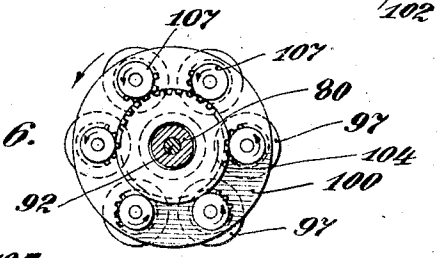


Fig. 8.

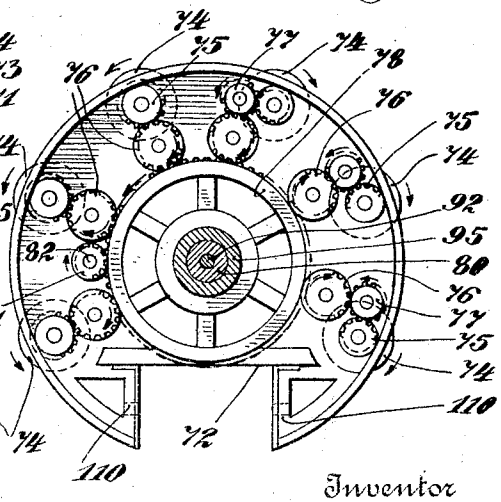
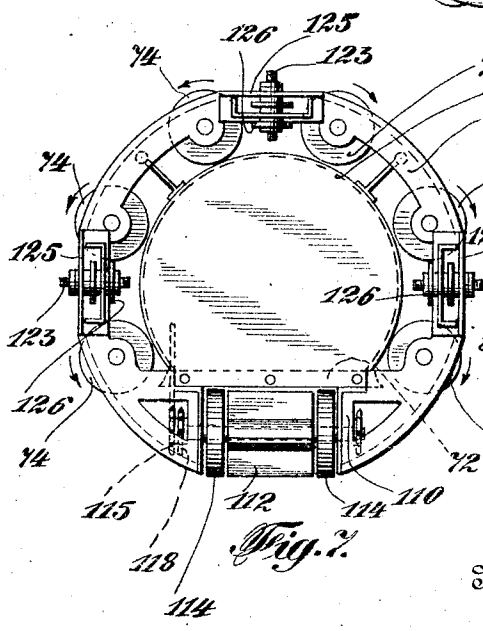


Fig. 7.



Inventor
Wilhelm Hebsacker
By his Attorneys
Richards & Geier

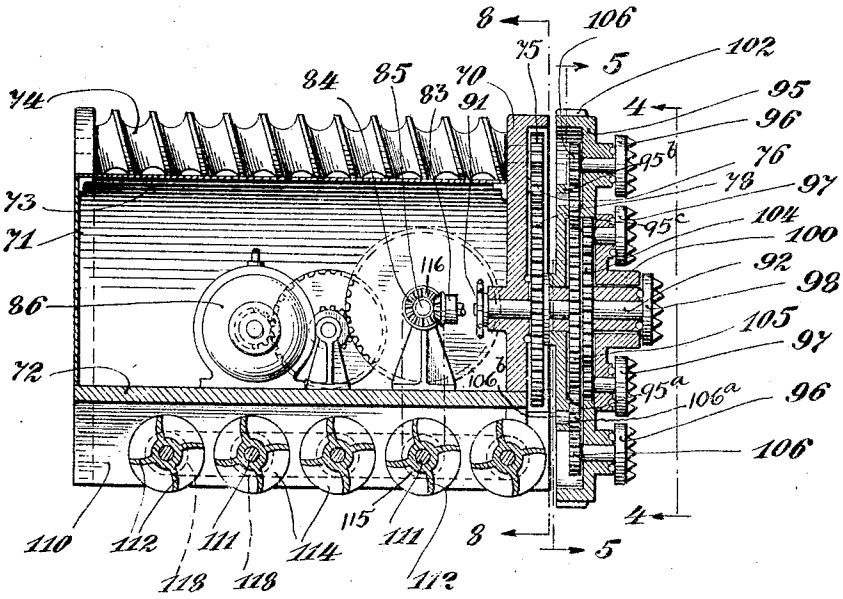
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Fig. 9.



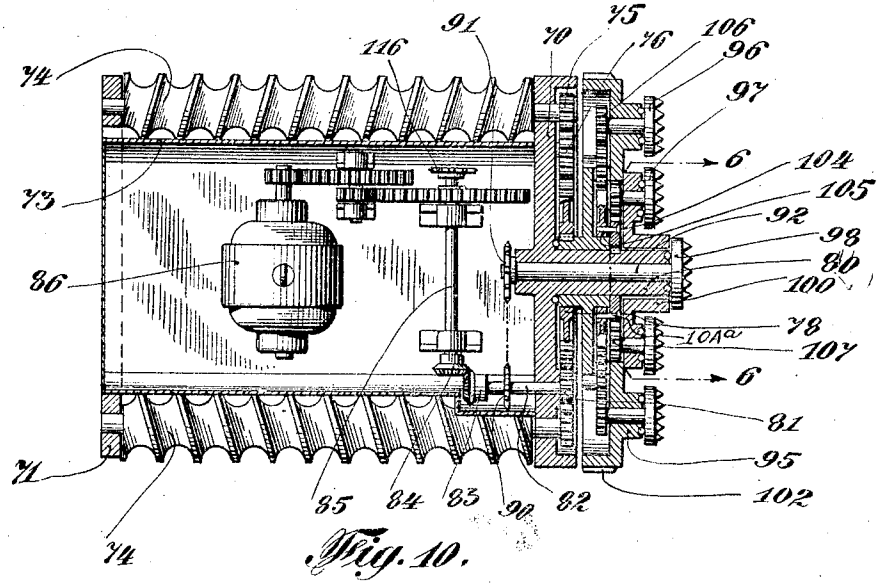


Fig. 10.

Inventor
Wilhelm Hebsacker
By his Attorneys
Richards & Geier

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Fig. 11.

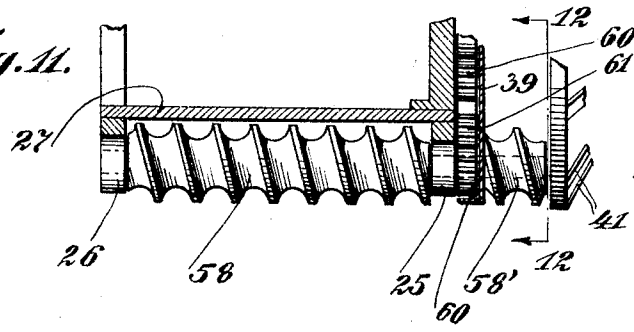
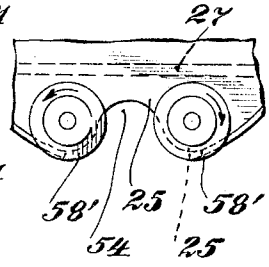


Fig. 12.



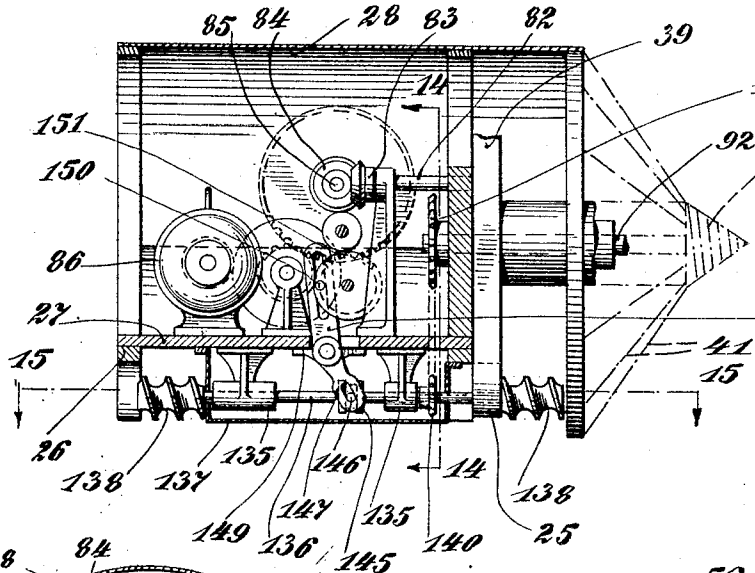


Fig. 13.

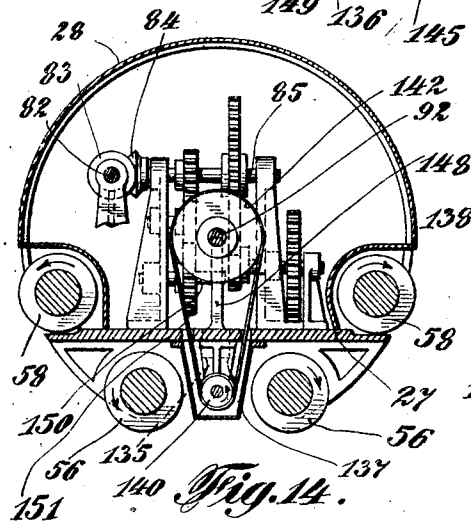


Fig. 14.

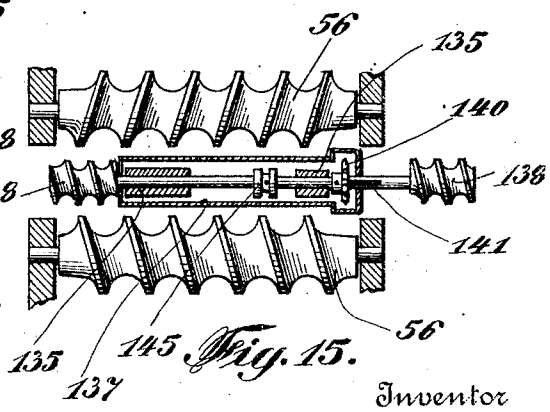


Fig. 15.

Inventor
Wilhelm Hebsacker
By his Attorneys
Richards & Geier

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Fig. 16.

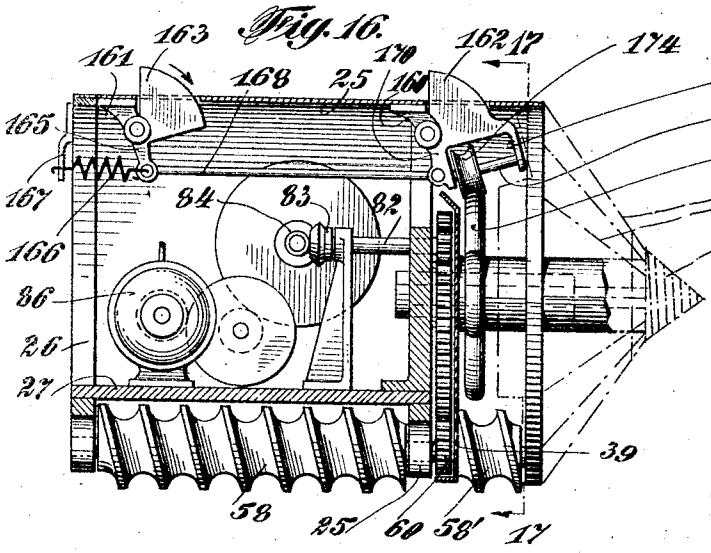


Fig. 20.

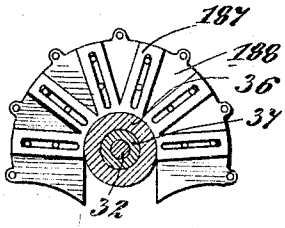
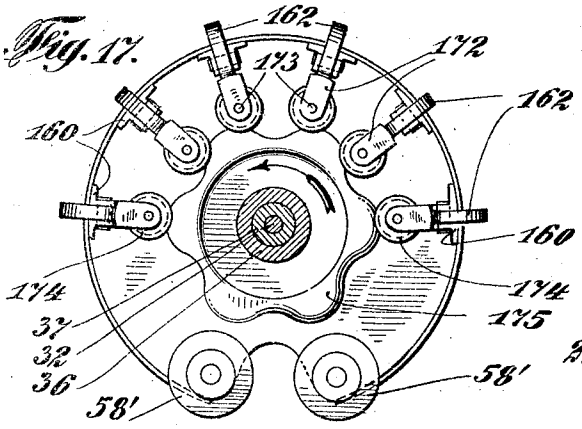


Fig. 17.



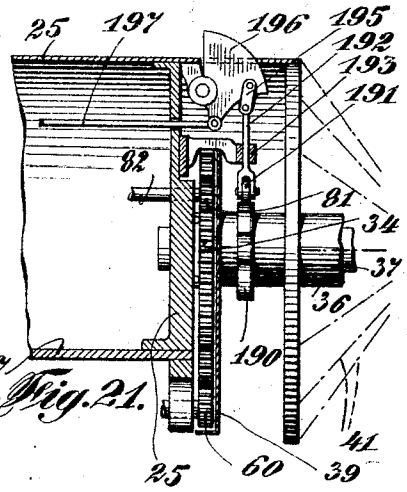


Fig. 21.

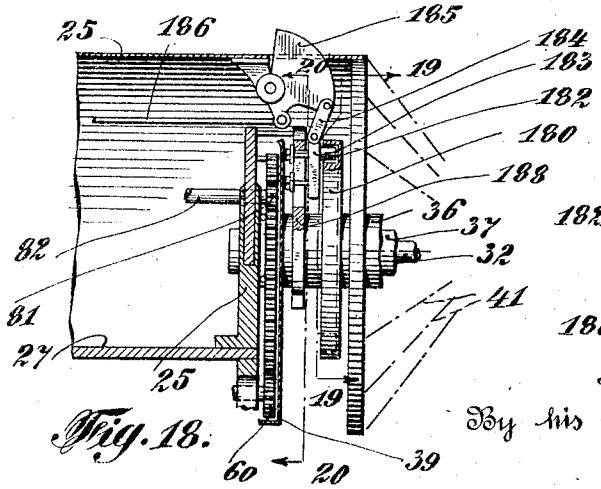


Fig. 18.

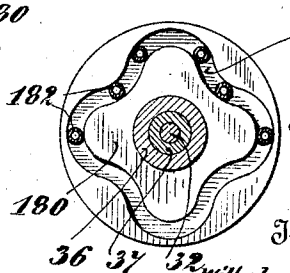


Fig. 19.

Inventor

Wilhelm Hebsacker

By his Attorneys

Richards & Geier

Patented Apr. 7, 1925. 1,532,243

UNITED STATES PATENT OFFICE.

WILHELM HEBSACKER, OF HEILBRONN, GERMANY.

EXCAVATING MACHINE.

Application filed June 17, 1920. Serial No. 389,780.

To all whom it may concern:

Be it known that I, WILHELM HEBSACKER, a citizen of the Republic of Germany, and a resident of Heilbronn, a. n. Wurttemberg, Germany, have invented certain new and useful Improvements in Excavating Machines, of which the following is a specification.

This invention has its main object to provide an excavating machine adapted for digging tunnels, canals, ditches, etc., in any kind of soil, the machine being self-propelled as the material is removed from its path.

Another object is to provide an encased driving mechanism by which the soil in the path of advance is disintegrated and moved to the rear in condition to be disposed of by ordinary means, the apparatus boring its passage either in a straight line or deflected as may be desired.

These and other important objects, which will become evident as the description progresses, are attained by the novel construction, combination and arrangement of parts hereinafter described and shown in the accompanying drawings, forming a material part of this disclosure, and in which:

Figure 1 is a partial side elevational and sectional view of an excavator made in accordance with the invention, the casing walls being removed.

Figure 2 is a partial front elevational and transverse sectional view, the section being taken on line 2—2 of Fig. 1.

Figure 3 is a side elevational view showing a modified form of construction of the same, the casing being omitted.

Figure 4 is a front diagrammatic view showing a modified form of cutter carrying head, looking on line 4—4 of Fig. 9.

Figure 5 is a transverse sectional view taken on line 5—5 of Fig. 9.

Figure 6 is a similar sectional view taken on line 6—6 of Fig. 10.

Figure 7 is a rear elevational view of the structure shown in Fig. 3.

Figure 8 is a transverse sectional view taken on line 8—8 of Fig. 9.

Figure 9 is a longitudinal sectional view taken approximately on the vertical center line of Fig. 10.

Figure 10 is a horizontal sectional view of the structure shown in Fig. 9.

Figure 11 is a fragmentary longitudinal sectional view, showing a modification in conveyor structure.

Figure 12 is a fragmentary transverse sectional view taken on line 12—12 of Fig. 11.

Figure 13 is a longitudinal vertical sectional view showing a modified form of excavator.

Figure 14 is a transverse sectional view taken on line 14—14 of Fig. 13.

Figure 15 is a sectional view taken on line 15—15 of Fig. 13.

Figure 16 is a longitudinal vertical sectional view showing a further modification in construction of the excavator.

Figure 17 is a transverse sectional view taken on line 17—17 of Fig. 16.

Figure 18 is a fragmentary vertical sectional view showing a modification of the advancing means.

Figure 19 is a transverse sectional view taken on line 19—19 of Fig. 18.

Figure 20 is a similar sectional view taken on line 20—20 of Fig. 18.

Figure 21 is a fragmentary vertical sectional view showing a further modification of the advancing means.

The apparatus in general consists of a cylindrical non-rotatable body and revoluble cutter carrying head, the mechanism for propulsion and actuating the head being encased in the body.

Referring to Figures 1 and 2 in detail, a pair of metal bands 25 and 26, respectively at the front and rear have secured between them a platform 27, the same being disposed horizontally at a point below the centers, while extending over the bands is a semi-cylindrical casing 28.

Secured to the platform 27 is an electric motor 30 arranged transversely within the casing and energized by current from any convenient source.

The motor shaft drives a speed reduction gear train terminating in the spur gear 31 the same driving a shaft having upon it one of a pair of bevel gears transmitting rotary motion to a short shaft 32 upon which is fixed a pinion 33 meshing with a spur gear 34 having at its outer side a helical worm 35, both gear and worm being mounted on a sleeve 36 rotatable on a stub axle 37 fixed in the front end of the body, there being a casing 39 interposed between the gea-

and worm so that the former is tightly enclosed.

Mounted on the outer end of the sleeve 36 is a head composed of a rigid ring 40 connected by bars 41 obliquely inclined from the periphery of the ring 40 to a sharply pointed center 42 forming the apex of the conical head, axially of the body and shaped to present a helical spiral 43 adapted to worm itself into the soil when rotated under pressure.

Fixed on the outer sides of the bars 41 are a plurality of rigid abraders, 44, acting when the head is rotated to loosen the soil in the manner of picks, bars or chisels, the soil passing through the head as it is advanced.

Brackets 46 are attached to and extend forwardly from the rear band 26 and carry rollers 47 extending partially through appropriate openings in the casing 28, the peripheries of these rollers being adapted to make contact with the surface of the bored passage in the coil, acting to guide the implement as it moves forward.

In a similar manner other brackets 48 are attached to and extend in advance of the front band 25 and carry worm gears 50 actuated by the worm 35 and are adapted to engage the bore made by the head and due to the teeth the gears impinging in the bore, serve to propel the apparatus forward.

These rollers and gears are arranged radially in spaced relation throughout the upper half of the apparatus, the lowermost pair being nearly diametrically opposite.

Extending below the platform 27 at each end are pairs of brackets 52 to which are secured the ends of the bands 25 and 26, and presenting clear openings 53 at the sides and a clear central space 54 directly below the apparatus.

A pair of opposed helical conveyors 56 are journalled in the ends of the body structure, their peripheral convolutions extending outwardly to the same distance from the axis of the machine as the peripheries of the rollers 47 and gears 50, a second pair of like conveyors 58 being journalled in the brackets 52.

Secured to the front ends of all of the conveyor shafts are spur gears 60 and meshing with those upon the left side of the apparatus (Fig. 2) facing the front, are intermediate gears 61, driven by direct engagement with the drive gear 34, while on the other side other intermediate gears 62 are driven in the same manner, their motion being conducted to the gears 60 through reversing idle pinions 63.

Thus the conveyors on one side of the apparatus are driven in one direction and those on the other side in a reverse direction, these conveyors serving the double purpose of carrying to the rear the soil loosened by the rotary head, and also materially augmenting the advance of the apparatus, while, due to the difference of rotational effect the conveyors tend to steady the body and prevent it from turning upon its own axis.

Figures 3 to 10 inclusive show a similar tunnel boring or excavating apparatus, differing only in constructive detail.

A pair of heads 70 and 71 have connected between them a platform 72 and casing 73, exteriorly of which are helical conveyors 74 arranged in uniformly spaced pairs, three on each side of the vertical center of the apparatus, these conveyors being journalled at their ends in the heads 70 and 71 and provided with gears 75 those on one side meshing direct with drivers 76 while those on the other side are rotated in an opposite direction by the interposition of idle pinions 77 meshing with the drivers 76.

All of the several drivers 76 are rotated by a large spur gear 78 rotatable on a quill 80 extending outward from the front head 70 and rigid therewith, the gear 78 being driven by a pinion 81 (Fig. 10) fixed on a shaft 82, driven by bevel gears 83 and 84, the latter of which is secured on a short transverse shaft 85 driven in turn through a gear reduction train by an electric motor 86 all of these elements resting on the platform 72 enclosed within the casing 73.

Fixed on the shaft 82 is a sprocket wheel 90 driving a chain communicating rotary motion to another sprocket 91 fixed on the inner end of an axial shaft 92 rotatable in the quill 80 and the latter carrying loosely a tread 95 in which are operatively mounted a plurality of revolvable cutters 96 arranged in a concentric row circumjacent to an inner row of cutters 97, while an axial cutter 98 extends outwardly beyond their faces.

The cutter 98 is directly mounted on the outer end of the center shaft 92 and is driven directly thereby, antifriction elements being interposed between the base of the cutter and end of the sleeve 80 to take the thrust and reduce friction, similar anti-friction elements being also employed at the base of the other cutters.

The cutters 97 are revolubly mounted in an auxiliary or outer head 100 adjacent the main or rear head 95, said outer head being fast on the quill 80 and provided with extending hubs in which are journalled the stems of the cutters.

The rear head 95 is spider shaped, as best shown in Fig. 5 and has upon the exterior of its projections inclined, cam like teeth 102 arranged helically and adapted as the head is rotated, to advance the apparatus in addition to the effect of the helical conveyors 74.

The head 95 is rotated on the quill 80 by the gear 78 keyed to the hub of the head 95 (Fig. 10) and is provided with a forwardly facing cup shaped recess 95[a] in which is lo-

cated a gear 105 rotatable on the hub of the head 95 and which is secured to rotate with a gear 104 keyed to the quill 80 to rotate therewith. The head 95 is further provided with a rearwardly facing annular recess 95[b] in which are located the gears 106, which mesh with the idler gears 106[a] journalled upon studs 106[b] and the peripheries of which extend through suitable openings in the flange 95[c] to mesh with the teeth of the gear 105.

The inner gear 105 drives the pinions 106 fixed on the stems of the cutters 96, by means of the idler gears 106[a] while the outer gear 104 meshes with pinions 107 on the stems of the inner cutters 97, the idlers 106[a] and pinions 107, rolling after the fashion of planetary gears on the stationary gears 105, 104, respectively as the gear 78 and head 95 are rotated relatively to the stationary head 100 and to the quill 80.

Thus, due to the fixed gears, the several pinions 106 and 107 are rotated when the head 95 is rotated (the outer cutters 96, as they rotate about the individual axis in circular paths about the axis of the machine) and also the cutters 97, 98 boring their way into the material to be excavated.

Below the platform 72 extends a pair of brackets 110 in which are mounted a plurality of short transverse shafts 111 carrying rotary shovels or scrapers 112 the same being located between pairs of rollers or discs 114, adjacent the brackets 110.

One of the shafts 111 carries rigidly a sprocket wheel 115, Fig. 7, driven by a chain trained over a sprocket 116 fixed on the transverse shaft 85 so as to transmit rotary motion to the scraper. On all of the several shafts 111 are fixed other sprocket wheels 118 engaging an endless chain so that all of the several rotary scrapers are simultaneously operated, carrying the loosened material rearward of the apparatus.

In order to control the direction of advance of the apparatus, laterally and vertically, a pair of brackets 120 (Fig. 3) are pivotally secured to the front frame element 70 one on each side at its center, a third bracket 121 being at the top. Pivotally secured in these brackets are bars 122 of T section, the same extending longitudinally of the body past the rear frame 71, where they are engaged with bolts 123, passing through slots 124 formed in brackets 125 attached rigidly to the rear frame 71, said bolts being operated by hand wheel nuts 126, the arrangement being such that the side bars 122 may be set at a fixed definite inclination, together with the top bar, thereby guiding the excavator up or down, or to the right or left in an obvious manner, the exposed longitudinal elements of the bars making contact with the bore as it is moved forward.

The modification shown in Figures 11 and 12 embodies the details of structure shown in Figs. 1 and 2, with the additional feature of auxiliary conveyors 58′ arranged axially in advance of the main conveyors by which they are driven.

Figures 13, 14 and 15 show devices of the same general type as Figs. 1 and 2 and have in addition minor conveying elements mounted to rotate and also reciprocate.

Secured below the platform 27 are a pair of bearing brackets 135 in which is a revoluble shaft 136, the bearings and shaft being housed in a casing 137 except the ends of the shaft which have secured to them a pair of helical conveyors 138.

Rotary motion is transmitted to the shaft 136 by a chain driven sprocket 140 slidable on a key 141 as the shaft is moved lengthwise, the chain being actuated by a sprocket 142 fixed on the axial shaft of the apparatus and driven by the motor as before described.

A collar 145 held to move lengthwise with the shaft 136 but mounted thereon loosely so that the shaft may rotate in the collar, carries pins 146 extending into slots of a fork 147 at the lower end of a lever 148 pivoted in a bracket 149 extending down from the platform 27, the upper end of the lever being slotted to receive a pin 150 set in the side of a gear 151 and driven by the motor 86, the arrangement being such that the shaft 136 and attached conveyors are constantly rotated and at the same time given a reciprocating movement, carrying the loosened soil to the rear of the excavator, in addition to the main conveyors 56 and 58.

In Figs. 16 and 17 a modification is shown in which a novel form of propelling means is used.

Secured at suitable intervals around the interior of the upper half of the casing are front and rear brackets 160 and 161 in which are pivotally mounted sector shaped plate levers 162 and 163 passing through slots in the casing.

The rear lever 163 has an arm 165 to which is connected a tension spring 166 secured at its outer end to a bracket 167 fixed on the rear frame element 27.

Pivotally engaged with the arm 165 is a rod 168, its front end engaging in a similar manner with an arm 170 formed with the front lever 162 thus coupling the front and rear levers.

Another arm 172 extends from the front edge of the lever 162, parallel to the arm 170 and mounted in these arms is a spindle 173 on which is freely mounted a concave faced roller 174.

These several rollers 174 are drawn by the springs 166 against the undulating profile of a cam 175 fixed upon the sleeve 36 which carries the cutter carrying head.

In this modification the auxiliary conveyors 38′ are also used.

Thus as the cutter head is rotated and by it the cam 175, the several levers 162 and 163 are oscillated upon their pivots making contact with the bore produced by the head and advancing or propelling the excavator.

It is to be noted that while all of the several levers are constantly operating, the shape of the cam is such as to cause an irregular action, some of the levers being retracted while others are advanced.

Figures 18, 19 and 20 indicate a modified form of cam in which the springs are dispensed with entirely, the cam 180 having a sinuous endless lateral groove 181 suited to receive rollers 182 fixed on slides 183 and connected by links 184 with levers 185 of the same description as the levers 162, the front and rear levers being coupled by the connecting rod 186 and the slides 183 guided in radial slots 187 formed in a backing plate 188.

In the modification shown in Fig. 21 a lobed peripheral cam 190 is driven like the previously described cams and actuates rollers 191 pivoted in the inner forked ends of slides 192 guided and supported by brackets 193 affixed to the front frame 25.

Links 195 connect the outer ends of the slides 192 to the sector shaped levers 196 which are coupled in front and rear pair of rods 197 and operate in the manner before described.

From the foregoing it will be seen that an efficient and practical device for excavating purposes has been described capable of coping with various kinds of soil and operating under circumstances and conditions such as may arise.

Having thus described my invention and set forth the manner of its construction, application and use, what I claim as new and desire to secure by Letters Patent, is:

1. An excavating machine comprising a cylindrical body, a horizontal platform therein, a substantially conical head revoluble at the front end of said body, means on said platform for rotating said head, helical conveyors arranged at the periphery of said body extending parallel to its axis, means for driving said conveyors, a plurality of propelling means for said body, and adjustable means for guiding said body.

2. An excavating machine comprising a hollow body, a head revolubly engaged therewith, cutters arranged in concentric rows in said head, means carried by said body for rotating said head and the cutters therein, and helical projections in the periphery of said head adapted to exert a tractive effect on said body.

3. An excavating machine comprising a non-rotative cylindrical body, a rotatable head engaged therewith, cutters mounted in said head adapted to disintegrate soil, a motor in said body adapted to rotate said head, helical conveyors at spaced intervals in said body, means actuated by said motor for driving said conveyors, a plurality of rotary shovels arranged in alignment in the lower part of said body, and means for driving all of said shovels simultaneously.

4. An excavating machine comprising a non-rotative cylindrical body, a rotatable head engaged therewith, cutters mounted in said head adapted to disintegrate soil, means for rotating said head and for advancing said body, bars pivoted at the front of said body at the top and sides, said bars being adapted to engage the passage formed by said head, and means for individually adjusting said bars angularly with relation to the axis of said body.

Signed at Frankfurt am Main, Germany, this twelfth day of December, A. D. 1921.

WILHELM HEBSACKER.

Witnesses:

AUGUST BUCHENAUER,

IVAN LAVRETSKY.