No. 779,442. PATENTED JAN. 10, 1905.

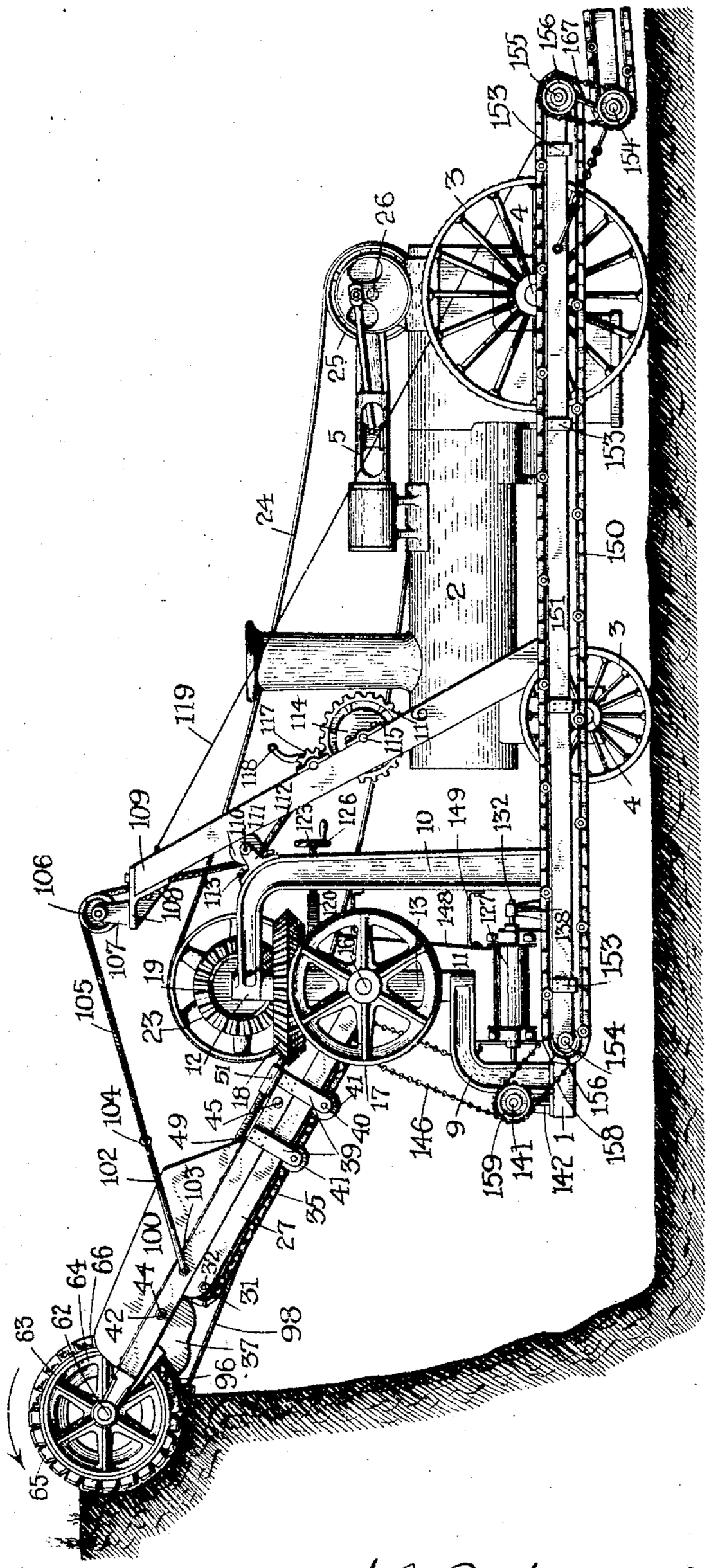
J. T. RICHMOND & N. H. BEEBE.

EXCAVATING APPARATUS.

APPLICATION FILED JAN. 30, 1904.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
L. M. Langston.
Geo. A. Neubauer.

Joseph T. Richmond. Inventors
Norman H. Beebe.
By C. J. Langston Attorney.

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6 SHEETS—SHEET 2.

Fig. 4.

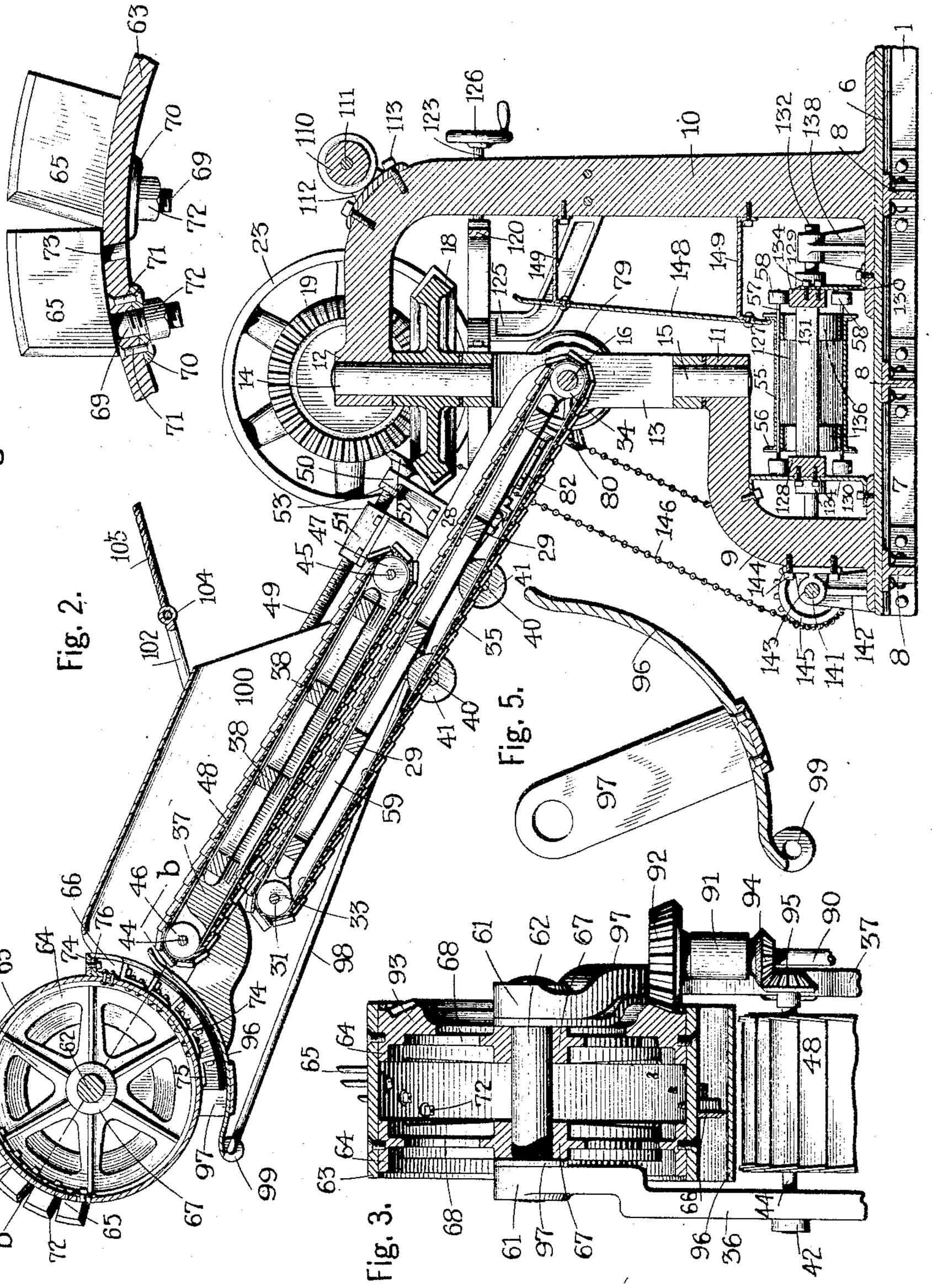

Fig. 2.

Fig. 5.

Fig. 3.

Witnesses.

L. M. Sangster.

Geo. A. Neubauer.

Joseph T. Richmond. Inventors.

Norman H. Beebe.

By G. H. Sangster Attorney.

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6 SHEETS—SHEET 3.

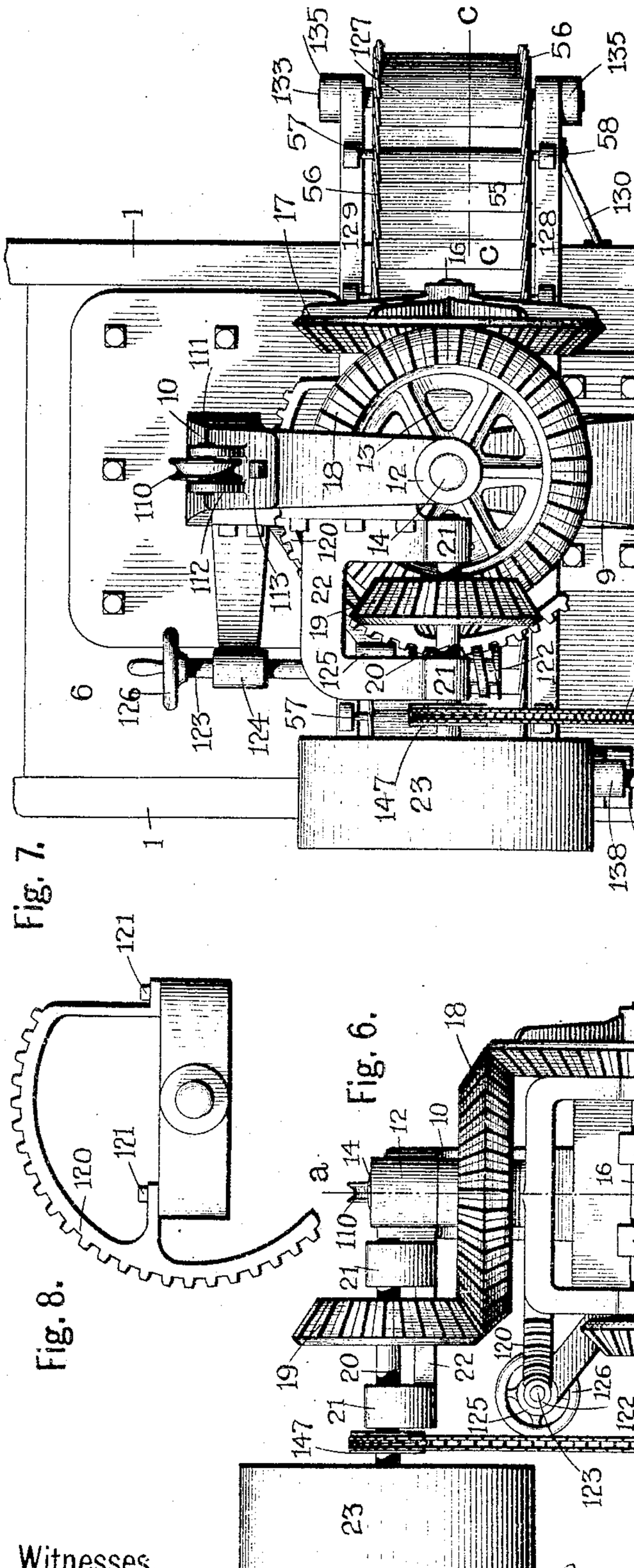

Fig. 7.

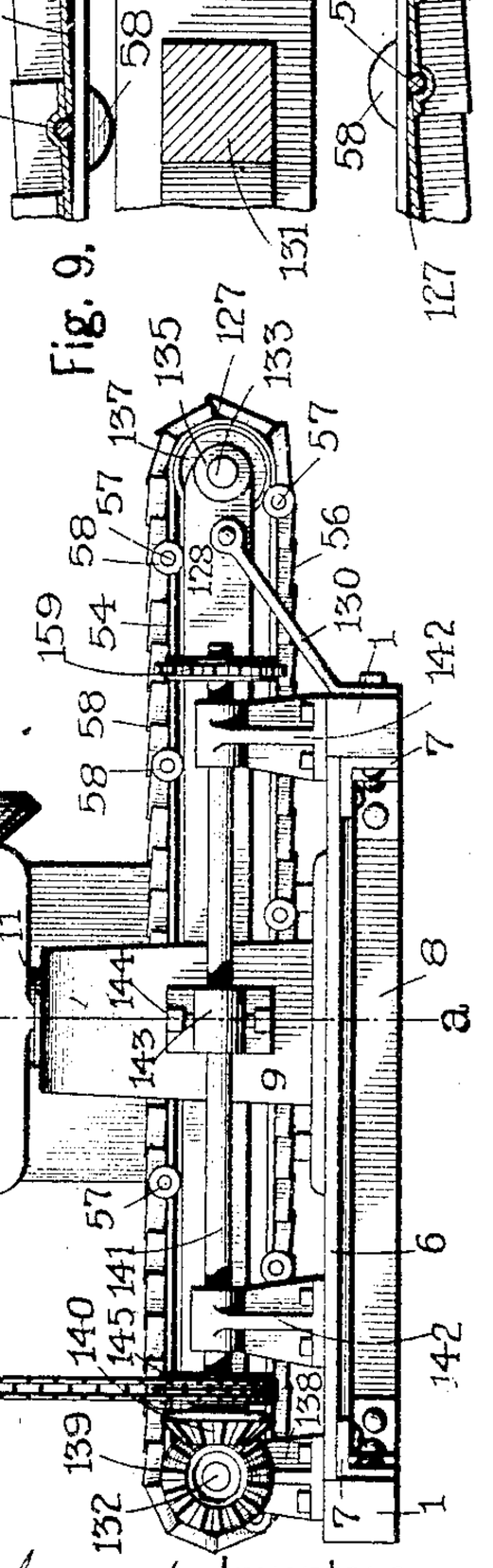

Fig. 9.

Fig. 8.

Fig. 6.

Witnesses.

L. M. Sangster.

Geo. A. Neubauer.

Inventors.

Joseph T. Richmond.

Norman H. Beebe.

By C. J. Sangster Attorney.

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6 SHEETS—SHEET 4.

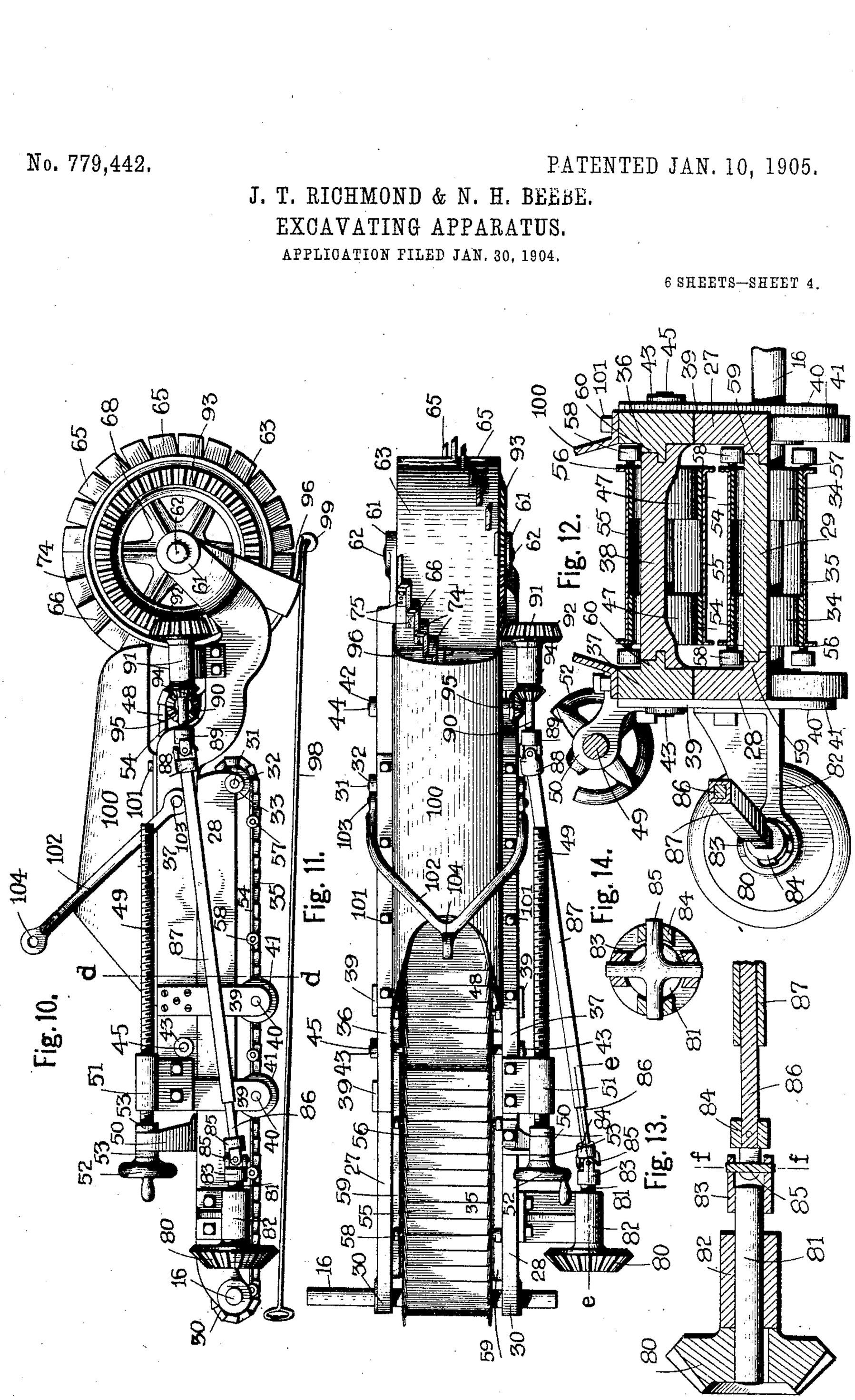

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 14.

Fig. 13.

Witnesses.
L. M. Bangster.
Geo. A. Neubauer.

Joseph T. Richmond Inventors.
Norman H. Beebe.
By C. J. Bangster Attorney.

No. 779,442. PATENTED JAN. 10, 1905.

J. T. RICHMOND & N. H. BEEBE.

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6 SHEETS—SHEET 5.

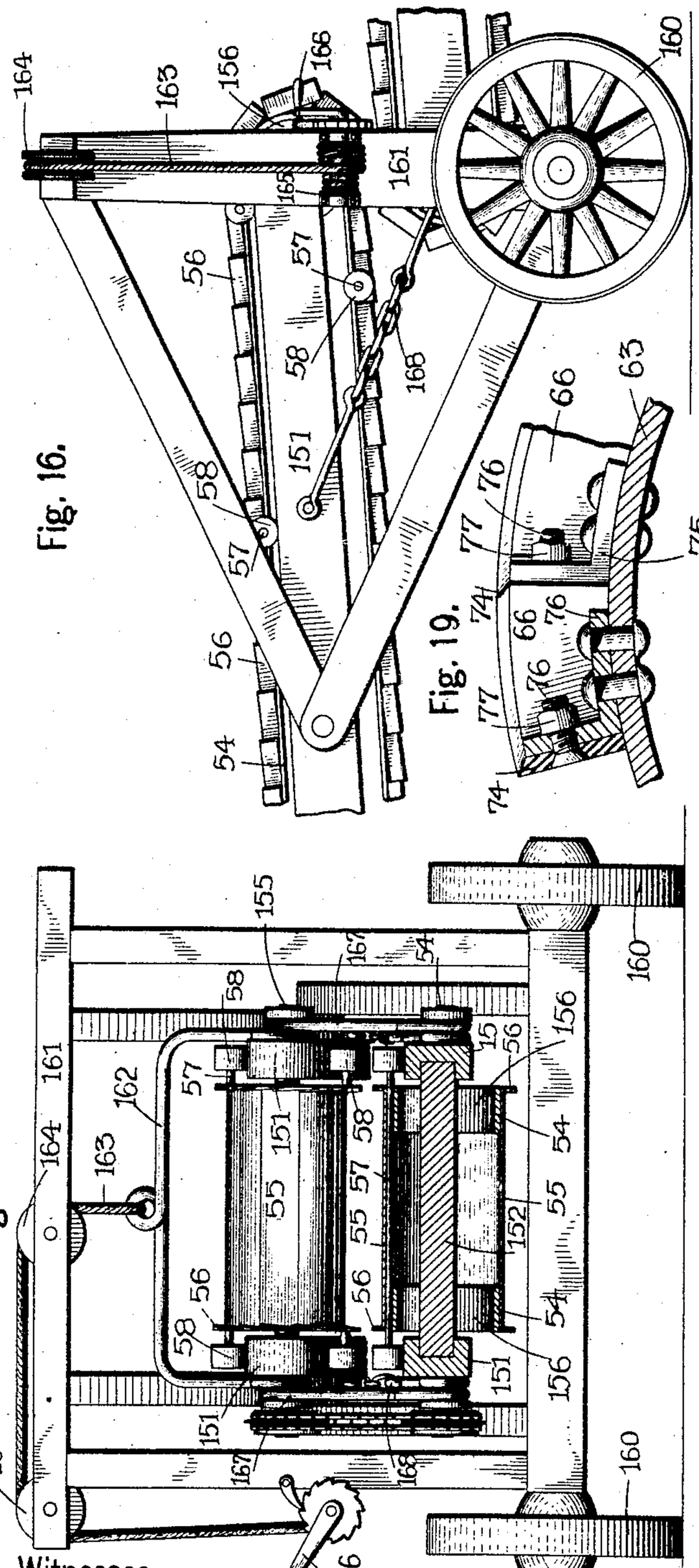

Fig. 16.

Fig. 19.

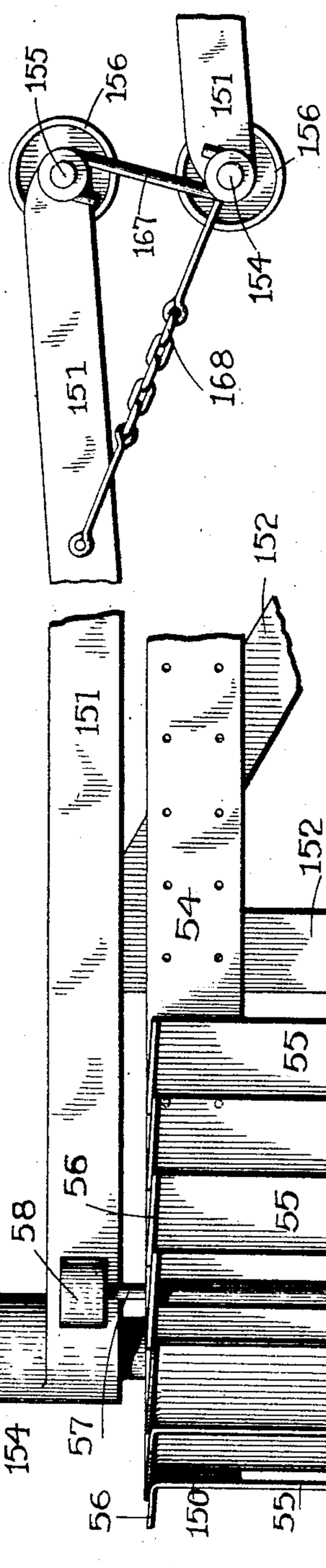

Fig. 18.

Fig. 15.

Fig. 17.

Witnesses.

L. M. Sangster.

Geo. A. Neubauer.

Inventors.

Joseph T. Richmond.

Norman H. Beebe.

By A. J. Sangster

Attorney.

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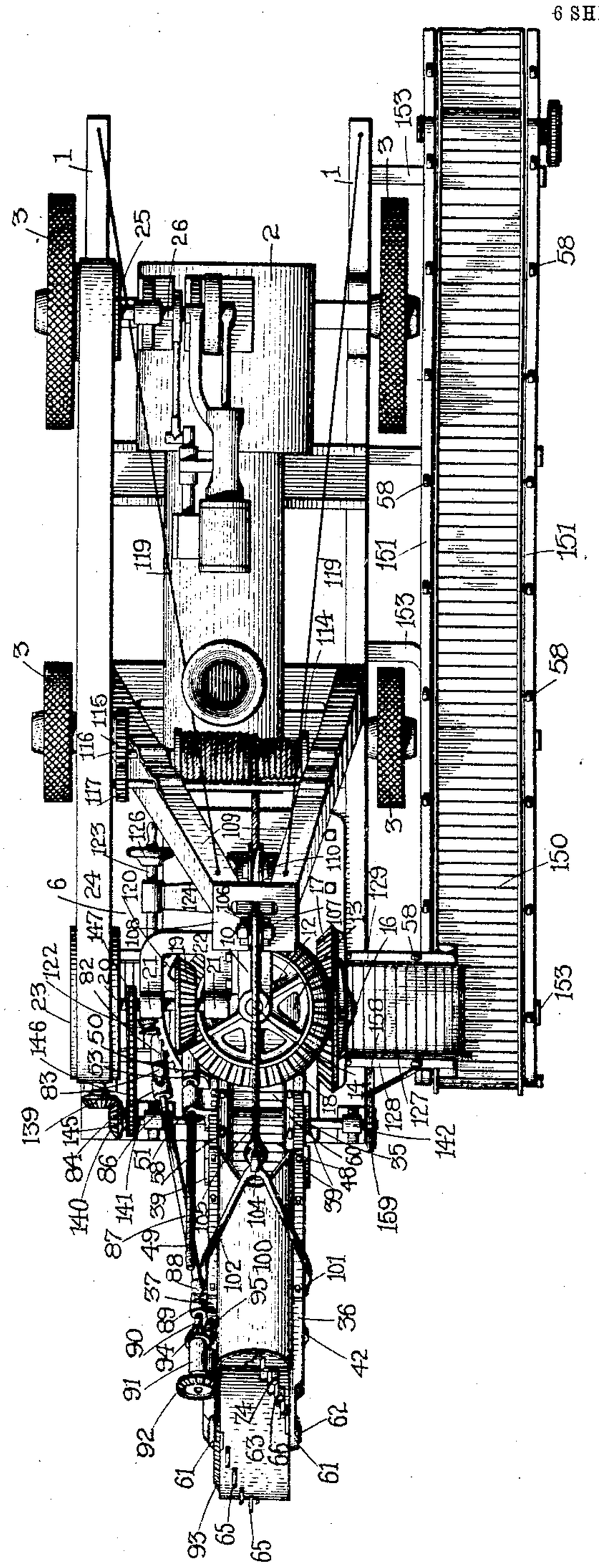
J. T. RICHMOND & N. H. BEEBE.

EXCAVATING APPARATUS.

APPLICATION FILED JAN. 30, 1904.

6 SHEETS—SHEET 6.

Fig. 20.



Witnesses.

L. M. Sangster.

Geo. A. Neubauer.

Joseph T. Richmond Inventors.

Norman H. Beebe.

By G. J. Sangster. Attorney.

No. 779,442. Patented January 10, 1905.

UNITED STATES PATENT OFFICE.

JOSEPH T. RICHMOND AND NORMAN H. BEEBE, OF ANTHONY, KANSAS.

EXCAVATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 779,442, dated January 10, 1905.

Application filed January 30, 1904. Serial No. 191,282.

To all whom it may concern:

Be it known that we, JOSEPH T. RICHMOND and NORMAN H. BEEBE, citizens of the United States, residing at Anthony, in the county of Harper and State of Kansas, have invented certain new and useful Improvements in Excavating Apparatus, of which the following is a specification.

This invention relates to an improved apparatus for excavating and similar purposes.

One of the features of the invention has reference to the universal supporting of an excavating mechanism and a carrying mechanism, whereby it can be turned vertically or horizontally into excavating position.

Another feature has reference to a novel form of excavating-cylinder having a diagonal series of peripheral cutting-blades and a diagonal series of peripheral carrying-blades.

Another feature has reference to an extensible frame supporting a plurality of overlapping carrier-belts.

The invention also has reference to various features of construction; and among its objects are to permit of moving the excavating mechanism independently of its supports either vertically, horizontally, or longitudinally and to arrange for picking up and carrying any loose dirt left by the cutting-blades.

The novel features of the invention will be fully and clearly hereinafter described and claimed, reference being had to the accompanying drawings, in which a preferred adaptation of the invention is illustrated.

Figure 1 is a side elevation of the improved excavating apparatus arranged in operative position. Fig. 2 is a vertical section through the operative mechanism on line *a a*, Fig. 6, also showing a longitudinal section through the swinging carrier-frame, carrier-belts, and the excavating-cylinder. Fig. 3 is an enlarged transverse section through the excavating-cylinder on line *b b*, Fig. 2, also showing a plan view of the outer end of the swinging carrier. Fig. 4 is an enlarged fragmentary longitudinal section through the excavating-cylinder, showing the manner of attaching the cutting-knives thereto. Fig. 5 is an enlarged longitudinal section through the shield attached to the excavating-cylinder. Fig. 6 is an enlarged detached front elevation of the mechanism for operating the swinging carrier-frame and its excavating-cylinder and also the stationary carriers. Fig. 7 is a top plan view of the mechanism shown in Fig. 6. Fig. 8 is a detached top plan view of the rectangular pivotal frame and the segmental gear for operating it. Fig. 9 is an enlarged fragmentary longitudinal section through the transverse carrier on line *c c*, Fig. 7. Fig. 10 is an enlarged detached side elevation of the swinging carrier-frame and carrier and the excavating-cylinder with its operating mechanism. Fig. 11 is a top plan view of the mechanism shown in Fig. 10. Fig. 12 is an enlarged vertical section on line *d d*, Fig. 10, looking rearwardly. Fig. 13 is an enlarged section through the extensible shaft and its operating gear-wheel on line *e e*, Fig. 11. Fig. 14 is an enlarged transverse section through the universal joint on line *f f*, Fig. 13. Fig. 15 is an enlarged rear elevation of the truck for supporting the ends of the carriers which extend rearwardly of the machine, also showing fragments of two carriers and the method of supporting same. Fig. 16 is a side elevation of the truck and apparatus shown in Fig. 15. Fig. 17 is an enlarged fragmentary plan view of the forward end of the longitudinal carrier which is attached to the frame of the traction-engine. Fig. 18 is an enlarged fragmentary side elevation of the ends of two carrier-frames, showing the method of supporting the forward end of one frame from the rear end of the preceding frame. Fig. 19 is an enlarged fragmentary longitudinal section through the excavating-cylinder, showing the method of attaching the scraper thereto. Fig. 20 is a top plan view of the improved excavating apparatus.

In referring to the drawings for the details of construction like numerals designate like parts.

The apparatus is preferably mounted upon the frame of a traction-engine, as shown in Fig. 1, so as to be transportable, although it may be operated in other well-known ways. The form of traction-engine shown is of the

well-known construction having longitudinally-extending side frame members 1, upon which is mounted the boiler 2. The usual wheels 3 are provided, being mounted upon transverse axles 4, which are supported from the frame members 1. A horizontal engine 5 is mounted upon the boiler and supplies the necessary power to operate the various portions of the apparatus.

The excavating mechanism proper is supported in front of the traction-engine, being secured to the engine-frame in the manner hereinafter described or in any other well-known way.

The side frame members 1 of the traction-engine are extended forwardly and are connected by a plate 6, which is supported from the frame members 1 by longitudinally-extending angle-irons 7 and transverse T-irons 8. The angle and T irons 7 and 8 are fastened to the frame members 1 and plate 6 in the usual manner by rivets. (See Figs. 2 and 6.)

Two angular standards 9 and 10 are secured to the plate 6 by bolts, each standard having a vertical portion and a horizontal portion. The horizontal portion of the standard 9 extends rearwardly from the vertical portion and terminates in a bearing part 11, and the horizontal portion of the standard 10 extends forward from the vertical portion and terminates at a point vertically above the bearing part 11 of the standard 9 in a similar bearing part 12. The standard 10 is of greater height than the standard 9, so that the bearing part 12 is at some distance above the bearing part 11. (See Figs. 1, 2, and 6.)

A pivotal frame 13 is supported between the standards 9 and 10 and in turn supports the rear end of the pivotal carrier mechanism. (See Fig. 2.) The pivotal frame 13 is rectangular in shape and has two vertical side portions and horizontal top and bottom portions.

A short vertically-extending shaft 14 extends upward from the middle of the horizontal top portion of the frame 13, and a shorter shaft or pin 15 extends vertically downward from the middle of the horizontal bottom portion of the rectangular frame 13. The shaft 14 and pin 15 are journaled in the bearing parts 11 and 12 of the standards 9 and 10, as shown in Fig. 2.

A horizontal shaft 16 is mounted in the rectangular pivotal frame 13 and has a bevel gear-wheel 17 mounted upon one end thereof. The bevel gear-wheel 17 meshes with a double-faced bevel-wheel 18, which is loosely mounted upon the short vertical shaft 14 between the horizontal top portion of the rectangular pivotal frame 13 and the bearing part 12 of the standard 10. (See Fig. 2.) The double-faced gear-wheel 18 is driven by a bevel-gear 19, which is mounted upon a short horizontal shaft 20, and the said shaft is supported in bearings 21, extending from a plate 22, which is bolted to the horizontal portion of the standard 10. (See Fig. 7.) A pulley 23 is mounted upon the outer end of the shaft 20 and is connected by a belt 24 with a pulley 25, which is mounted upon the shaft 26 of the engine 5. (See Fig. 1.)

The swinging carrier-frame and its carrier-belts and the excavating-cylinder with the various operating mechanisms are supported from the horizontal shaft 16, which is journaled in the pivotal frame 13. This portion of the apparatus is illustrated in Figs. 1, 2, 3, 10, 11, 12, 13, and 14.

The swinging carrier-frame is made in two parts and is provided with two carrier-belts which are substantially duplicates of each other. The two parts of the carrier-frame are substantially parallel with each other and one part is supported and is adapted to slide upon the other. One of the carrier-belts is arranged within each part of the carrier-frame, so that they are substantially parallel with each other and so that the rear portion of the upper carrier-belt overlaps the forward portion of the lower carrier-belt. (See particularly Fig. 2.)

The lower part or member of the swinging carrier-frame is formed of two longitudinally-extending side pieces 27 and 28, which are connected to each other by transversely-extending frame-pieces 29. The rear ends of the side pieces 27 and 28 are provided with bearing portions 30, through which the horizontal shaft 16 passes, thereby providing a pivotal support for the carrier-frame and permitting it to swing in a vertical direction, with the shaft 16 as its center.

A transversely-extending shaft 31 is mounted in bearings 32 at the forward ends of the longitudinally-extending side pieces 27 and 28 and has two pulleys 33 mounted thereon. Two pulleys 34, which are similar to the pulleys 33, are mounted upon the horizontal shaft 16, which is journaled in the pivotal frame 13. An endless carrier-belt 35 runs over the pulleys 33 and 34 and forms one part of the means for conveying the dirt and similar material away from the excavating-cylinder. The construction of this carrier-belt 35 will be described farther on.

The upper part or member of the swinging carrier-frame is also formed of two longitudinally-extending side pieces 36 and 37, which are connected to each other by transversely-extending frame-pieces 38. The side pieces 36 and 37 of the upper member of the swinging carrier-frame are supported upon the top surface of the side pieces 27 and 28 of the lower member of the swinging frame, so as to slide longitudinally thereon. The upper member of the swinging carrier-frame is prevented from moving transversely with respect to the lower member by vertically-extending plates 39, two of which are secured by screws to each of the side pieces 36 and 37 of the up-

per member and near the rear ends thereof. These vertically-extending plates 39 extend downwardly past the outer surface of the side pieces 27 and 28 and prevent any transverse movement of the upper member. In order to prevent any independent vertical movement of the upper member of the swinging carrier-frame, the vertical plates 39 are extended below the bottom surface of the side pieces 27 and 28 and are provided with transverse inwardly-extending pins 40. A roller 41, the periphery of which bears against the bottom surface of the side pieces 27 and 28, is mounted upon each of the pins 40, thereby preventing any independent vertical movement of the upper member of the swinging frame with respect to the lower member thereof.

The longitudinally-extending side pieces 36 and 37 are provided with bearings 42 and 43, the bearings 42 being located near the front extremities of the side pieces 36 and 37 and the bearings 43 being located near the rear extremities thereof. Transversely-extending front and rear shafts 44 and 45 are mounted in the bearings 42 and 43, respectively, and are each provided with pulleys 46 and 47. The pulleys 46, preferably two in number, are mounted upon the front shaft 44, and the pulleys 47, also two in number, are mounted upon the rear shaft 45. (See Fig. 2.) An endless carrier-belt 48, which is similar to the carrier-belt 35, is mounted and runs upon the pulleys 46 and 47 and serves to convey the dirt and similar material from the excavating-cylinder to the carrier-belt 35.

The longitudinal adjustment of the upper member of the swinging carrier-frame with respect to the lower member thereof is accomplished by means of a screw-bar 49, which is immovably secured to the lower member and engages with a screw-nut secured to the upper member. (See Figs. 10 and 11.) The rear end of this screw-bar 49 is supported in a bearing 50, which is secured to the top surface of the side frame-pieces 28 of the lower member and extends diagonally upward and outward therefrom. The portion of the screw-bar extending forward of the bearing 50 engages with an interiorly-screw-threaded nut 51, which is secured to the rear end of the side piece 37. The rear end of the screw-bar 49 is provided with a hand-wheel 52, by means of which the screw-bar 49 is easily rotated. Collars 53 are secured to the screw-bar 49 on each side of the bearing 50 and prevent any longitudinal movement of the screw-bar in the bearing.

As all of the carrier-belts employed in this apparatus are similar to each other in construction, a detailed description of one carrier-belt will suffice for all. In the following description attention is called particularly to Figs. 2, 9, 12, and 17.

The carrier-belts are each composed of two endless belts 54, of leather or similar material, which in the case of the carrier-belt 35 are mounted upon the two sets of pulleys 33 and 34, and a series of overlapping metal plates which are secured at one edge only to the belts 54. Each of these metal plates is formed of a comparatively narrow strip of metal having a horizontal bottom portion 55, the ends 56 of which are bent upward at right angles thereto. The horizontal portions 55 of the metal plate are secured to the belts 54 at one edge only, as shown in Figs. 9 and 17. They may be fastened by rivets or any other well-known means. The metal plates are fastened to the belts 54, so that the rear edge of the plate which is not fastened to the belt overlaps and rests upon the forward edge of the succeeding plate which is fastened to the belts 54. The vertical portions 56 of each metal plate are also bent at a slight angle with respect to the front and rear edges of the bottom portion 55 of the plate, so that the rear part of the vertical portion 56 of one plate will fit snugly inside the front part of the vertical portion 56 of the succeeding plate. (See Fig. 17.) By this construction it will be seen than an endless carrier-belt is formed which will prevent any particles of dirt from falling or sifting through the various places where the metal plates are joined to the leather belts 54 and yet is flexible enough to easily pass over the pulleys, as shown in Fig. 9.

In order to support the upper or carrying portion of the carrier-belts between the pulleys, a series of transversely-extending shafts 57 are secured to the outer surface of the belts 54 at equal distances from each other at their ends and provided with rollers 58, which in the case of the carrier-belt 35 roll upon the top surface of two longitudinally-extending rails 59. These rails 59 are secured to or formed integral with the inner surface of the side pieces 27 and 28 of the lower member of the swinging carrier-frame and near the lower edges thereof. (See Figs. 2 and 12.)

The side pieces 36 and 37 of the upper member of the swinging carrier-frame are provided will similar rails 60, secured to or formed integral with the inner surfaces thereof and upon which the rollers 58 of the upper carrier-belt 48 are adapted to travel.

The forward ends of the longitudinally-extending side pieces 36 and 37 terminate in bearings 61, and a horizontal shaft 62, upon which is mounted the excavating-cylinder, is journaled in said bearings 61. This excavating-cylinder is formed substantially as shown in Figs. 1, 2, 3, 4, 10, 11, and 19 and consists of a metal cylinder 63, which is mounted upon two rims 64, secured within the cylinder by screws, and a series of cutting-knives 65 and carrier-blades 66, which are fastened to the outer periphery of the cylinder-shell 63 and extend diagonally from edge to edge. The rims 64 are connected to two central hubs 67, through which the

shaft 62 passes, by radial arms 68, which are formed integral with the rims 64 and hub 67. The cutting-knives 65 are preferably secured to the cylinder-shell 63, as shown in Fig. 4. Each cutting-knife 65 is provided near its forward edge with an inwardly-extending screw-threaded stud or bolt 69, which passes through an opening in the cylinder-shell 63 and in a washer 70, which is fastened to the interior of the shell 63 by rivets 71 or similar means. The knife 65 is drawn into place and secured by means of a nut 72, which screws upon the end of the stud or bolt 69. In order to prevent the knife 65 from twisting, a pin 73 is driven into the bottom surface of the knife 65, near the rear edge thereof, and fits in an opening in the shell, as shown in Fig. 4. These knives 65 are fastened to one-half of the outer periphery of the cylinder-shell 63 and extend diagonally from edge to edge thereof. (See Fig. 11.)

The carrier or follower blades 66 are formed and secured to the cylinder-shell 63 substantially as shown in Figs. 2, 3, 10, 11, and 19. These carrier or follower blades 66 are preferably formed in one piece, which extends half-way around the outer periphery of the cylinder-shell 63 and occupies that part of the shell upon which the cutting-knives 65 are not placed. These blades 66 are formed with longitudinal portions and transverse portions 74, so as to extend diagonally across the periphery of the shell 63 from edge to edge and begin and end at opposite edges to the beginning and ending of the series of cutting-knives 65. The preferred method of securing the carrier or follower blades to the cylinder-shell is shown in Fig. 19. A series of angle-irons 75 are placed upon the shell 63 so that the vertical portions of the angle-irons are adjacent to the rear surfaces of the transverse portions 74 of the carrier-blades, and a bolt 76 is passed through each portion 74 of the carrier-blades and the vertical portion of the adjacent angle-irons 75. The bolt 76 has its head countersunk in the transverse portion 74 and is secured in place by a nut 17, screwed upon its opposite end. The horizontal portions of the angle-irons are secured to the cylinder-shell 63 by rivets 78 or any well-known means.

The excavating-cylinder is operated from the horizontal shaft 16 by a series of bevel gear-wheels. (See Figs. 2, 3, 10, and 11.)

The horizontal shaft 16 has a bevel gear-wheel 79 secured to the end opposite the gear-wheel 17, and said gear-wheel 79 meshes with a similar bevel gear-wheel 80, which is mounted upon the end of a short longitudinally-extending shaft. This shaft 81 is journaled in a bearing 82, which is secured by bolts to the outer surface of the longitudinal side pieces 28 of the lower carrier-frame member. One member, 83, of a universal joint is secured to the forward end of the shaft 81, and the member 83 is connected to the other member, 84, of the universal joint by the cross 85. Two of the arms of the cross 85 are loosely passed through openings in lugs which extend from the member 83 of the universal joint, and the other two arms of the cross 85 are loosely passed through openings in lugs extending from the other member 84. The member 84 of the universal joint is secured to the rear end of a diagonally-extending shaft 86, which is square in cross-section. This square shaft 86 is adapted to fit and slide in a hollow shaft 87, which is likewise square in cross-section and provided with a square opening in which the shaft 86 operates. The forward end of this hollow shaft 87 has a universal-joint member 88 secured thereto, which is attached to the other member 89 in precisely the same manner as above described for the rear universal joint.

The member 89 of the forward universal joint is secured to the rear end of a short longitudinally-extending shaft 90, which is journaled in a bearing 91, bolted to the outer surface of the longitudinal side piece 37 of the upper carrier-frame member and near its forward end.

The forward extremity of the shaft 90 has a bevel gear-wheel 92 secured thereto, which meshes with a bevel gear-wheel 93, formed integrally with one of the rims 64 of the excavating-cylinder.

A small bevel gear-wheel 94 is secured to the shaft 90 between the bearing 91 and universal-joint member 89 and meshes with a similar bevel gear-wheel 95, which is secured to the outer end of the forward horizontal shaft 44. By means of these bevel gear-wheels the upper carrier-belt 48 is operated.

In order to provide room for the gear-wheels 92, 94, and 95 and the bearing 91, the forward end of the side frame-piece 37 is formed in a peculiarly irregular manner, as shown in Fig. 10, being curved downward and then curved sharply upward and inward at its extreme end.

A curved shield 96 is supported from the shaft 62 so as to swing therefrom by two arms 97, the ends of which loosely encircle said shaft, and said shield 96 provides a curved surface along which the dirt is carried by the cutter-knives 65 and carrier-blades 66 and 74 until it is thrown upon the upper carrier-belt 48. (See Fig. 2.) The curved shield 96 is adjusted in position by a rod 98, which is fastened at its forward end to an ear or lug 99, formed upon the shield 96, and extends rearwardly within convenient reach of the operator. (See Fig. 1.)

A stationary metal shield 100 is secured to the top surface of the side pieces 36 and 37 of the upper carrier-frame member by bolts 101 and prevents any dirt from being thrown over the top of the carrier-frame by the rotation of the excavating-cylinder.

The swinging carrier-frame is supported in its vertically-adjusted position by a yoke and cable. (See Fig. 1.)

The yoke 102 has its lower ends pivotally secured by pins 103 to the outer surface of the side pieces 36 and 37 of the upper swinging frame member and has an eye 104 formed at the juncture of its two arms 102. (See Figs. 10 and 11.) A rope or cable 105 is passed through the eye 104 and secured and is then carried over the top of a pulley or sheave 106, which is supported in a bracket 107. This bracket 107 is loosely secured to a horizontal plate 108, which is bolted to the top of a derrick 109. (See Fig. 1.) The object of securing the bracket 107 in this manner is to allow the pulley 106 to move sidewise as the carrier-frame is swung to the right or left. The rope 105 is then carried beneath a pulley or sheave 110, which is pivoted by a pin 111 to a bracket 112. This bracket 112 is bolted to the standard 10 by bolts 113. (See Fig. 2.)

The rear end of the rope 105 is wound around a windlass 114, supported from the derrick 109 by a shaft 115 and operated by an intermeshing gear 116 and pinion 117 and which in turn are operated by a crank 118 in the usual manner.

The derrick 109 is supported by guy-ropes or cables 119 in the usual manner.

The swinging carrier-frame is swung horizontally by means of a segmental worm-wheel 120, which is secured by bolts 121 to the upper portion of the rectangular frame 13 and operated by a worm 122. The worm 122 is secured to the outer end of a horizontal shaft 123, which is journaled in bearings 124 and 125, secured to and extending from the vertical portion of the standard 10. The rear end of the shaft 123 is provided with a hand-wheel 126, by means of which the shaft may easily be rotated.

The dirt and similar material is conveyed from the excavating-cylinder to the upper carrier-belt 48, and from the carrier-belt 48 it is deposited upon the lower carrier-belt 35. The carrier-belt 35 carries the material rearwardly and deposits or drops it upon a transverse carrier-belt 127, which is arranged vertically below the pivotal frame 13. This carrier-belt 127 is substantially similar in construction to the carrier-belts 35 and 48 heretofore described.

Two side frame-pieces 128 and 129 are arranged transversely between the standards 9 and 10 and are supported from said standards 9 and 10 and from the plate 6 by brackets 130.

The side frame-pieces 128 and 129 are connected by cross-pieces 131, as shown in Figs. 2 and 9.

Two horizontal shafts 132 and 133 are journaled in bearings 134 and 135 at the extremities of the side frame-pieces 128 and 129, the shaft 132 having two pulleys 136 mounted thereon and the shaft 133 having two similar pulleys 137 mounted upon it.

The leather belts 54 of the carrier-belts 127 are mounted upon and run over these pulleys 136 and 137 precisely as above described for the carrier-belts 35 and 48, and the rollers on the shafts run upon the top surface of the side frame-pieces 128 and 129, as shown in Figs. 2, 6, and 7.

The shaft 132 is provided with two additional bearings 138 and has a bevel gear-wheel 139 mounted at its forward end. This bevel gear-wheel 139 meshes with a similar bevel gear-wheel 140, secured to one end of a transversely-extending shaft 141, which is journaled in bearings 142, bolted to the plate 6. An additional central bearing 143 is provided for the shaft 141 and is secured to the vertical portion of the standard 9 by bolts 144.

The shaft 141 is operated by a sprocket-wheel 145, mounted thereon, which is connected, by means of a sprocket-chain 146, with a similar sprocket-wheel 147, mounted upon the horizontal driving-shaft 20. (See Fig. 6.)

A vertical shield 148 is secured to the vertical portion of the standard 10 by brackets 149 in such a manner as to guide the dirt onto the transverse carrier 127 and prevent the dirt from falling to one side of the said transverse carrier.

The transverse carrier-belt 127 deposits the dirt upon a longitudinally-extending carrier-belt 150, which is arranged to one side of the traction-engine and extends from the front to the rear thereof. This carrier-belt 150 is constructed substantially similar to the carrier-belts heretofore described and has two longitudinally-extending side frame-pieces 151, which are connected by cross-pieces 152 and supported by brackets 153 from the side frame-pieces 1 of the traction-engine. (See Fig. 1.)

Front and rear transverse shafts 154 and 155 are journaled in the ends of the side pieces 151 and are provided with pulleys 156, over which the carrier-belts run.

The front shaft 154 is operated by a sprocket-wheel 157, which is mounted thereon and connected by a sprocket-chain 158 with a similar sprocket-wheel 159, mounted upon one end of the shaft 141.

When it is desired to convey the dirt to any considerable distance from the traction-engine, additional carrier-belts are used which are supported by trucks, as shown in Figs. 15 and 16. These trucks are provided with wheels 160 and an upright frame 161.

The rear ends of the longitudinal side pieces of the carrier-belts are supported in the bent ends of a metal yoke 162, which is supported from the upright frame 161 by a cable or rope 163, one end of which is secured to the yoke 162 and the other end of which is passed over pulleys 164 and wound around a windlass 165. This windlass 165 is secured to the upright frame 161 and is operated by a crank 166 to raise or lower the metal yoke 162. The forward end of the succeeding carrier-

belt frame is supported from the rear end of the preceding carrier-belt frame by means of substantially reversed-S-shaped rods 167, having their bent ends hooked around the projecting bearings in which the shafts are mounted and are additionally secured by rods and chains 168, as shown in Figs. 15, 16, and 18.

The operation of the apparatus is as follows: When the apparatus has been moved into proximity to a bank of earth it is desired to remove, the excavating-cylinder is lowered, by means of the cable, as heretofore described, until it rests upon the bank and the cutting-knives 65 and carrier-blades 66 and 74 begin to cut into the earth. The dirt is carried upon the upper carrier-belt 48 and from the carrier-belt 48 to the carrier-belt 35. The carrier-belt 35 deposits the dirt upon the transverse carrier-belt 127, which in turn deposits the dirt upon the longitudinal carrier 150. From the carrier-belt 150 the dirt is deposited in any desired place by means of additional carrier-belts, as heretofore described.

We claim as our invention—

1. In an excavating apparatus, the combination with a power mechanism and an excavator, of a carrier mechanism from which the excavator is supported, said carrier being adjustable vertically, horizontally and longitudinally.

2. In an excavating apparatus, the combination with a power mechanism and an excavator, of a carrier mechanism from which the excavator is supported, said carrier mechanism being adjustable in length.

3. In an excavating apparatus, the combination with a power mechanism and an excavator, of a carrier mechanism from which the excavator is supported, said carrier mechanism, including in part, a frame having a plurality of members adjustable relatively to vary the length of the frame, and a plurality of overlapping carrier-belts having operative support in said members.

4. In an excavating apparatus, a carrier-frame adjustable in length, carrier-belts having operative support in said frame, an excavating-cylinder journaled in the forward extremity of the carrier-frame, and power means for operating the carrier-belts and the excavating-cylinder.

5. In an excavating apparatus, a carrier-frame adjustable in length, carrier-belts having operative support in said frame, an excavating-cylinder journaled in the forward extremity of the carrier-frame, and power means for operating the carrier-belts and the excavating-cylinder including an adjustable shaft connection.

6. In an excavating apparatus, a carrier-frame adjustable in length, carrier-belts having operative support in said frame, an excavating-cylinder journaled in the forward extremity of the carrier-frame, and power means for operating the carrier-belts and the excavating-cylinder, including a shaft, and a connection slidably mounted on said shaft.

7. In an excavating apparatus, a carrier-frame adjustable in length, carrier-belts having operative support in said frame, an excavating-cylinder journaled in the forward extremity of the carrier-frame, and power means for operating the carrier-belts and the excavating-cylinder, including a shaft of square cross-section and a connection slidably mounted on said shaft.

8. In an excavating apparatus, the combination with a power mechanism and a carrier mechanism, of an excavating-cylinder having a series of cutter-blades extending in a diagonal row across the periphery of the cylinder from edge to edge thereof.

9. In an excavating apparatus, the combination with a power mechanism and a carrier mechanism, of an excavating-cylinder having a series of peripheral cutter-blades extending diagonally across the face of said cylinder and a series of peripheral follower-blades.

10. In an excavating apparatus, the combination with a power mechanism and a carrier mechanism, of an excavating-cylinder having a series of peripheral cutter-blades and a series of peripheral follower-blades.

11. In an excavating apparatus, the combination with a power mechanism and a carrier mechanism, of an excavating-cylinder having a series of diagonally-arranged peripheral cutting-blades and a like series of diagonally-arranged peripheral follower-blades.

12. In an excavating apparatus, a carrier mechanism including a carrier-frame having a plurality of adjustable members, means for adjusting said members to lengthen or shorten the frame and an excavating element at the forward extremity of the carrier-frame.

13. In an excavating apparatus, a carrier mechanism including a carrier-frame having a plurality of adjustable members, means for adjusting said members to lengthen or shorten the frame and an excavating-cylinder journaled at the forward extremity of the carrier-frame.

14. In an excavating apparatus, a carrier mechanism including a carrier-frame having a plurality of adjustable members, means for adjusting said members to lengthen or shorten the frame, an excavating-cylinder journaled at the forward extremity of the carrier-frame and means for rotating said cylinder.

15. in an excavating apparatus, a carrier mechanism including a carrier-frame having a plurality of adjustable members, means for adjusting said members to lengthen or shorten the frame, an excavating-cylinder journaled at the forward extremity of the carrier-frame and means for rotating said cylinder including an adjustable power-transmitting device.

16. In an excavating apparatus, a traction-engine, a forward carrier having adjustable support in front of said traction-engine, a side carrier arranged on one side of the traction-engine, and an excavating element at the forward extremity of the forward carrier.

17. In an excavating apparatus, a traction-engine, a plurality of carriers and an excavating element having support at the forward extremity of one of the carriers.

18. In an excavating apparatus, a traction-engine, a plurality of carriers and an excavating element having support at the forward extremity of one of the carriers, said carriers being arranged to convey the dirt from the excavating element to the desired point.

19. In an excavating apparatus, a traction-engine, a plurality of carriers, some of which are arranged at one side of the traction-engine and some of which are arranged in front of said engine, and an excavating-cylinder journaled in the front extremity of a front carrier.

20. In an excavating apparatus, a power means, a carrier mechanism operatively connected to said power means and adjustable in length, and an excavating element having support from the carrier mechanism.

21. In an excavating apparatus, a power means, a carrier mechanism operatively pivoted to said power means and adjustable in length, and an excavating element having support from the carrier mechanism.

22. In an excavating apparatus, a traction-engine or the like, a carrier having a frame pivoted to the frame of the traction-engine so as to swing both horizontally and vertically and an excavating-cylinder at the forward extremity of said carrier-frame.

23. In an excavating apparatus, a traction-engine or the like, a carrier having an adjustable frame pivoted to the frame of the traction-engine so as to swing both horizontally and vertically and an excavating-cylinder at the forward extremity of said carrier-frame.

JOSEPH T. RICHMOND.
NORMAN H. BEEBE.

Witnesses:
F. A. NOFTZGER,
L. G. JENNINGS.