No. 824,740. PATENTED JULY 3, 1906.

P. POULSON.

EXCAVATING MACHINE.

APPLICATION FILED MAR. 19, 1906.

4 SHEETS—SHEET 1.

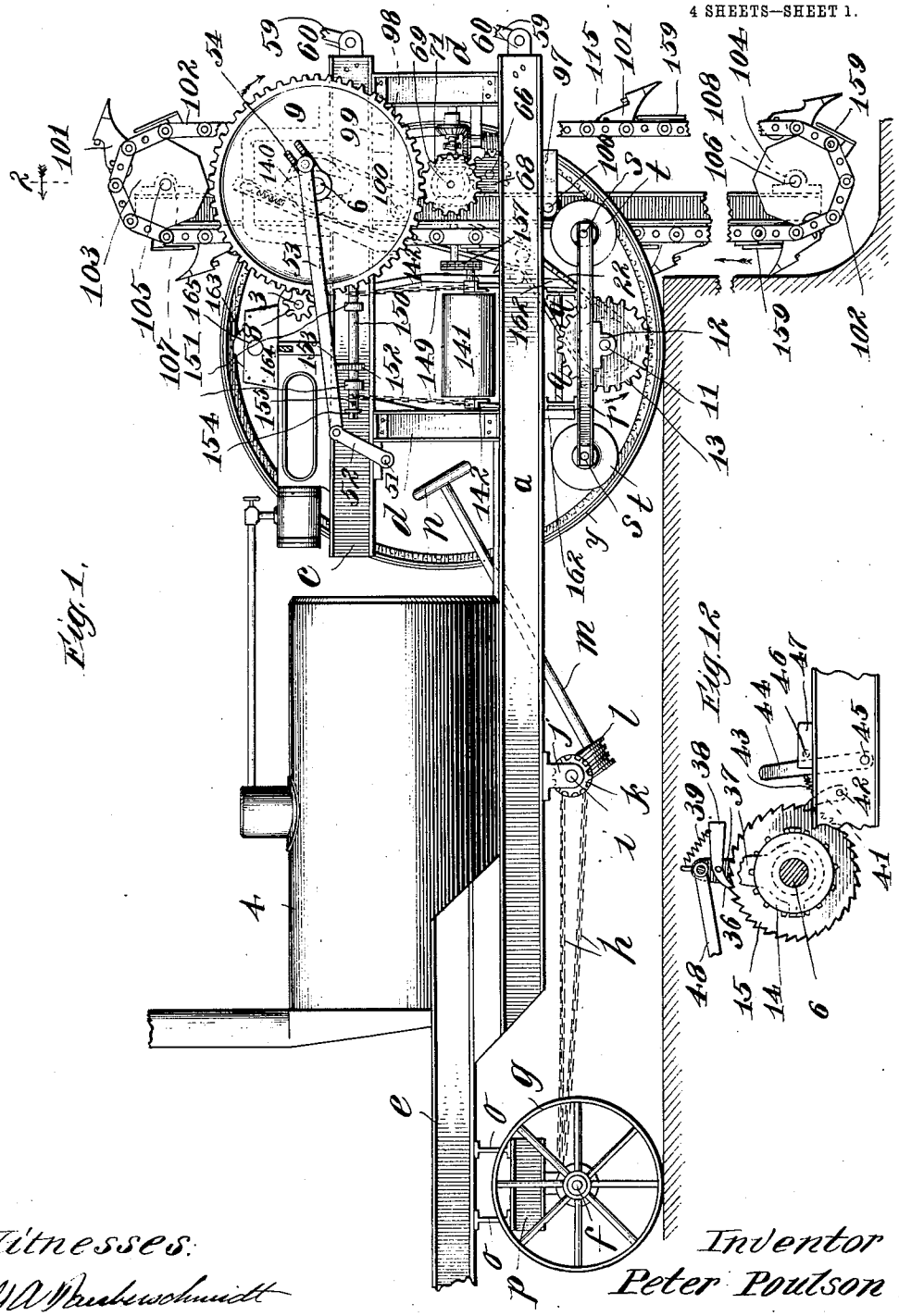

Fig. 1.

Fig. 12.

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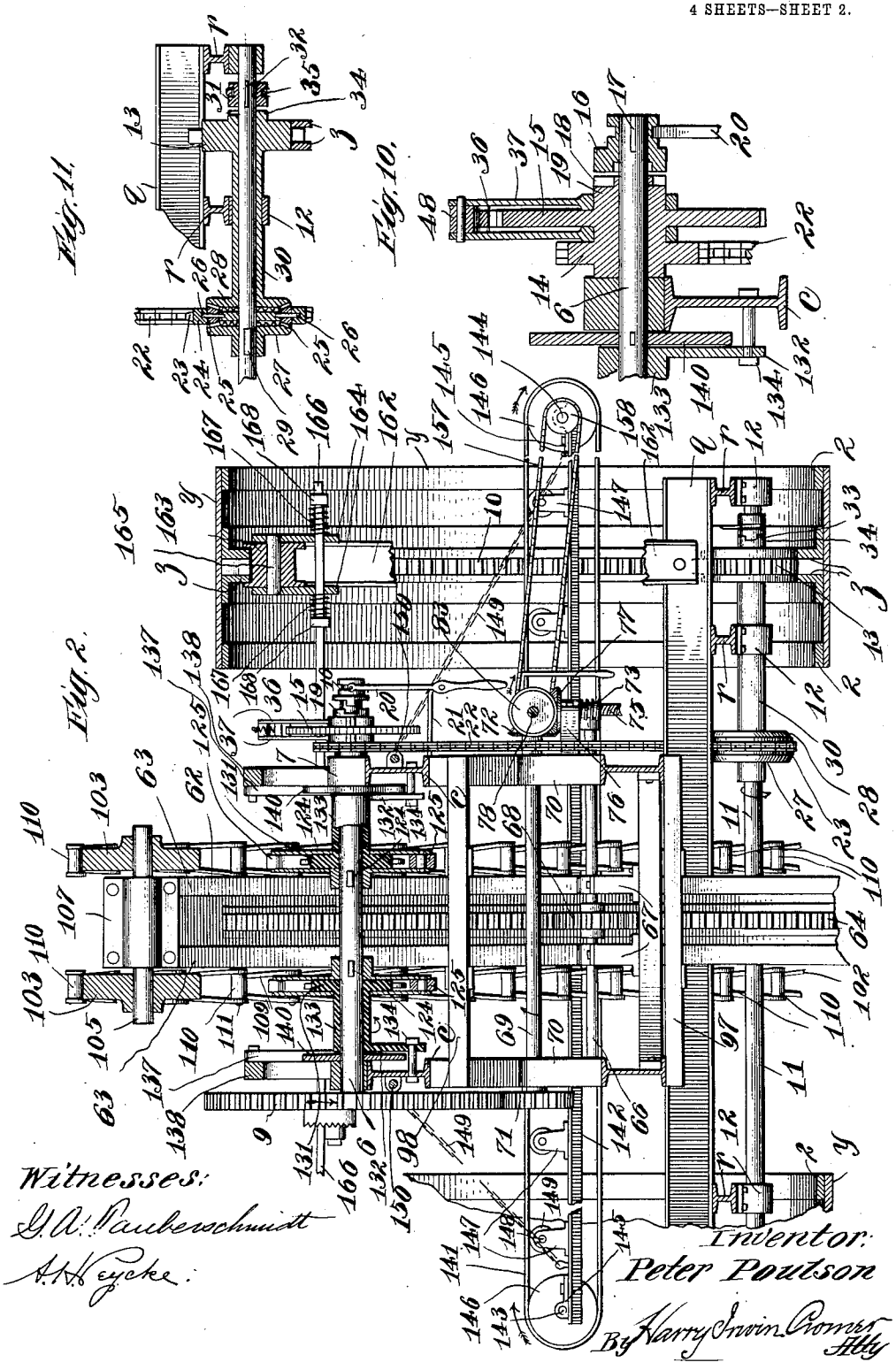
4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

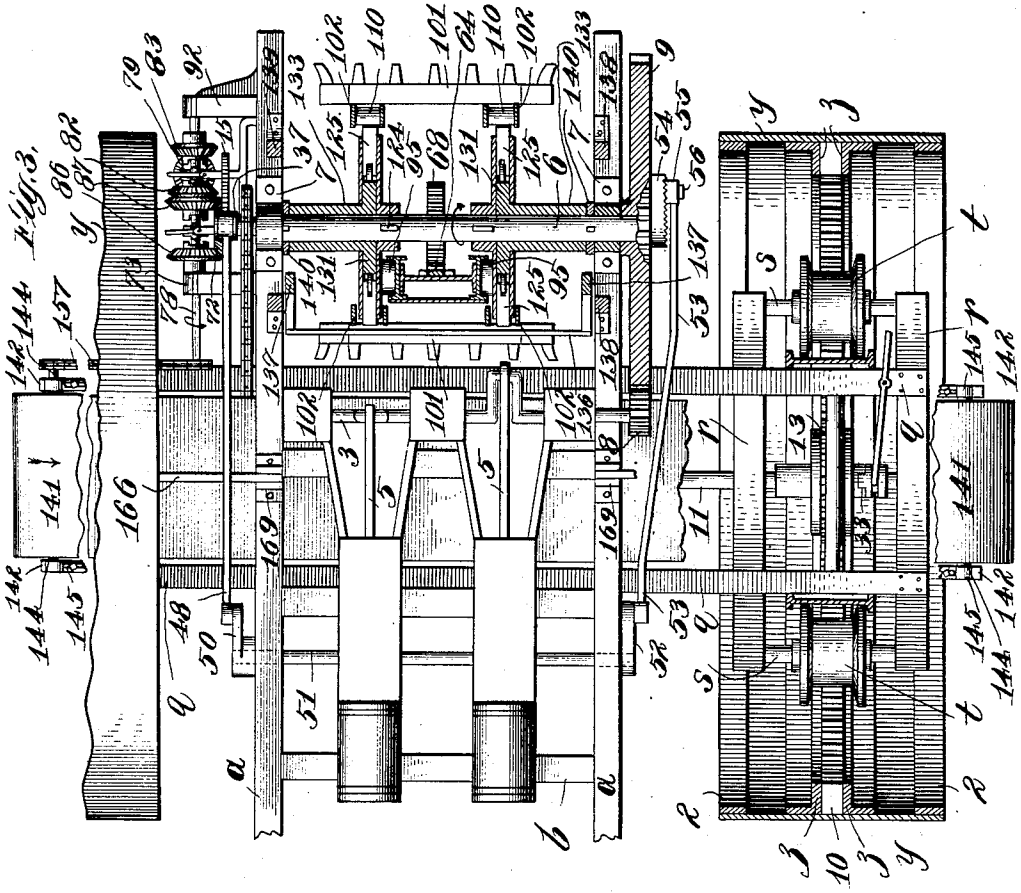

Fig. 3.

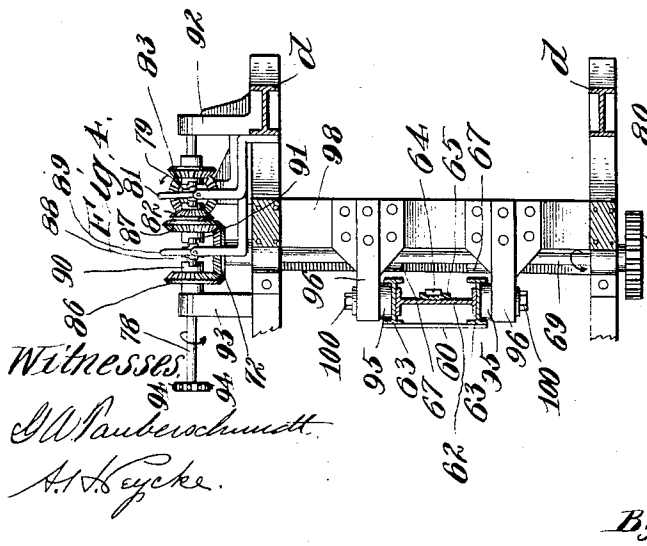

Fig. 4.

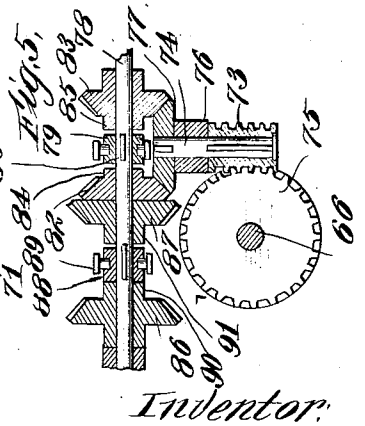

Fig. 5.

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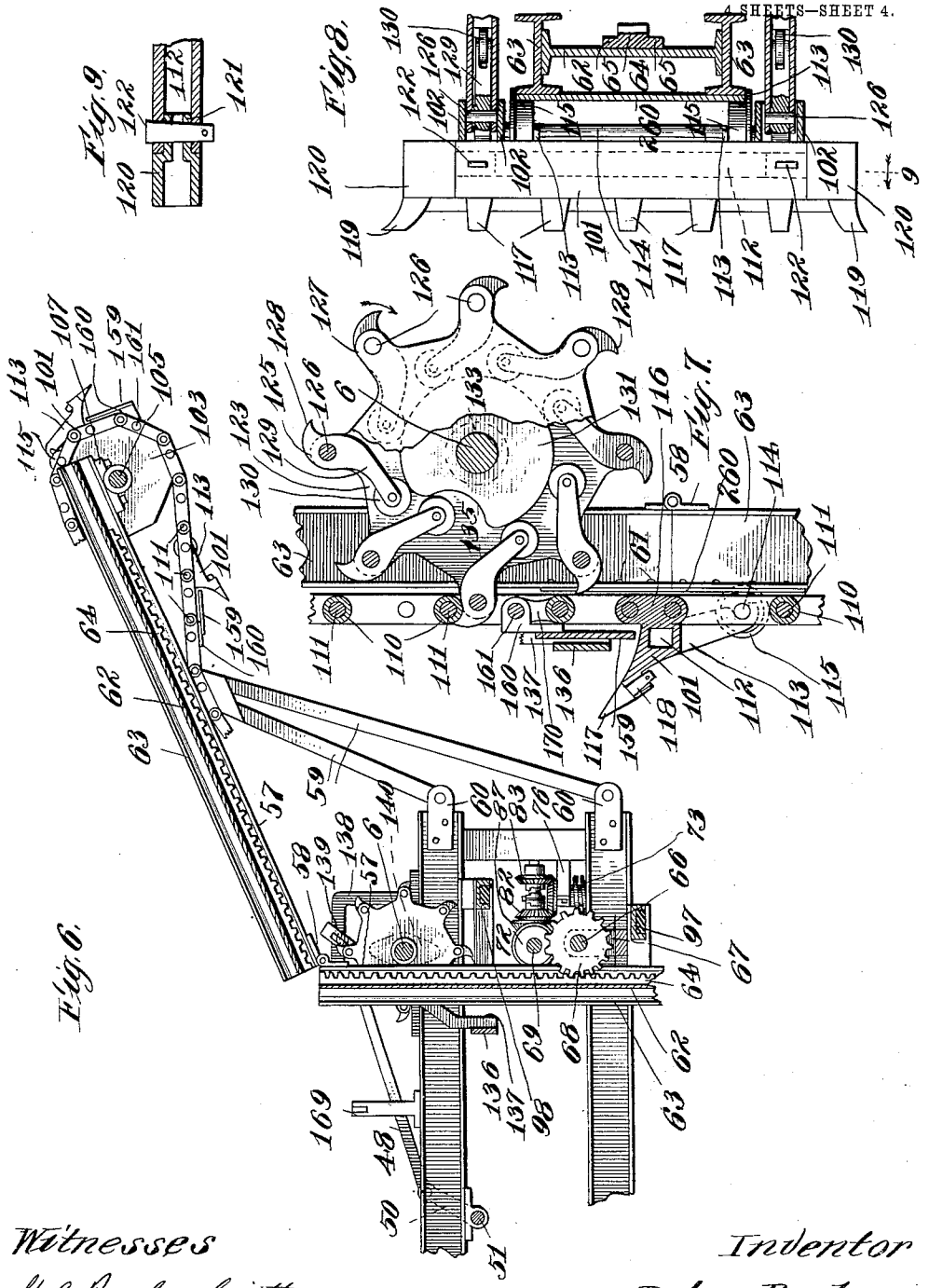
4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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EXCAVATING-MACHINE.

No. 824,740. Specification of Letters Patent. Patented July 3, 1906.

Application filed March 19, 1906. Serial No. 306,938.

To all whom it may concern:

Be it known that I, PETER POULSON, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Excavating-Machines, of which the following is a specification.

This invention relates to that class of excavating-machines adapted to be moved along the ground as desired while in operation and comprising excavating mechanism adapted to make a trench of the desired width and depth.

It relates particularly to the construction of the excavating mechanism and the means for operating it and moving the machine, whereby an excavating device which is movable to different positions with relation to the main frame may be operated by means of mechanism mounted in the main frame and adapted to be connected in a simple and efficient manner with the engine or source of power.

The principal object of the invention is to provide a simple, economical, and efficient excavating-machine.

Further objects are to provide a machine having an excavating device comprising a frame and excavating-chain bodily movable vertically to different operative positions with relation to the main frame and so constructed as to occupy a comparatively small space in the trench, thus enabling the sheeting for supporting the side walls to extend close to the part to be excavated and also enabling the excavating mechanism to be readily adjusted so as to pass over and cut as close to obstructions as possible, to provide improved rotatable operating mechanism mounted directly in the main frame and adapted to efficiently and directly engage a substantially straight vertical lap of the excavating-chain for operating it in any desired raised or lowered position, to provide simple and efficient means for rotating the traction-wheels intermittently while the excavating mechanism is in operative position and continuously when desired for the purpose of moving the machine from place to place, and to provide excavating shovels or buckets mounted upon a flexible supporting and driving mechanism or chain and so constructed that the size of such shovels or the length of their excavating portions may be increased or decreased without removing the portion of the shovels directly attached to such flexible supporting mechanism or chain.

A further object is to provide in a machine having excavating mechanism movable bodily upward and downward with relation to the main frame suitable means for discharging material from the excavating-shovels at the same elevation when the excavating mechanism is in different raised or lowered positions, or, in other words, independently of the raised or lowered position of the excavating-chain and its upwardly and downwardly movable supporting-frame.

Other and further objects of the invention will appear from an examination of the drawings and the following description of the claims.

The invention consists in the features, combinations, and details of construction hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a view in side elevation of an excavating-machine constructed in accordance with my improvements; Fig. 2, a transverse sectional elevation taken on line 2 of Fig. 1 looking toward the front of the machine with certain parts omitted; Fig. 3, a plan view of the rear portion of the machine, partly in section with certain parts omitted; Fig. 4, a detail plan view of the gear-and-shaft mechanism for operating the transverse conveyer; Fig. 5, a detail view in sectional elevation of the worm-and-gear mechanism for raising and lowering the excavating-chain or shovel mechanism and supporting-frame; Fig. 6, a view in elevation, showing the excavating chain and shovel supporting frame in folded or raised inoperative position with certain parts broken away and also showing the mechanism for discharging material from the shovels; Fig. 7, an enlarged detail view of the tiltable toothed gear-wheel for operating the excavating-chain and shovel mechanism; Fig. 8, an enlarged plan view in detail of one of the excavating-shovels, showing the supporting-chain in section and also the vertically-movable excavating-frame and ratchet; Fig. 9, a sectional detail view of one of the removable extension portions of an excavating-shovel, taken on line 9 of Fig. 8, showing the manner of connecting the parts; Fig. 10, an enlarged detail view in section, showing the ratchet, gear, and clutch mechanism for operatively connecting the main supporting-wheels with the source of power; Fig. 11, an enlarged detail view in section, showing the compensating-gear mechanism and the clutch

mechanism for locking it to the shaft; and Fig. 12 an enlarged detail view of the pawl-and-ratchet mechanism for enabling the supporting-wheels to be rotated intermittently when desired.

In constructing a machine in accordance with my improvements I provide a main frame having lower longitudinal sills *a*, connected by transverse beams *b*, and upper longitudinal sills *c*, mounted parallel with the lower longitudinal sills upon uprights *d*, all preferably of I-beam construction and secured rigidly together in any ordinary and well-known manner, forming a rigid framework. The forward portions *e* of the lower longitudinal sills are preferably elevated slightly above the rear portions, so that said sill portions, respectively, may be normally horizontal. The forward end of the main frame is mounted upon an axle *f*, and front supporting-wheels *g*, forming a forward running-gear mechanism which may be of any desired type and which is provided with suitable guiding mechanism, which may be also of any ordinary well-known type. The guiding mechanism here shown comprises a guiding-chain *h*, which is secured to the forward axle and wound upon transverse shaft mechanism *i*, mounted in suitable bearings *j* in the main frame. A worm-wheel *k* is mounted on the shaft *i* in toothed engagement with a worm *l* upon a rotatable guiding-shaft *m*, which is rotatably mounted in the frame and provided with a hand-wheel *n*, by means of which the guiding mechanism is operated. Transverse I-beams *o* and blocks *p* support the forward end of the main frame upon the forward axle and at a sufficient elevation to permit the front supporting-wheels to be turned with the axle in a horizontal plane to any desired angle in guiding the machine.

The rear end of the supporting-frame is provided with transverse I-beams *q*, which are supported at each side of the machine upon longitudinal frame members *r*, preferably of I-beam construction, the opposite ends of which are provided with axles *s*, upon which are mounted flanged supporting-wheels *t*. There are a pair of these flanged wheels on each side of the machine, and each pair is mounted inside of and supported by a wide supporting traction-wheel *y* of large diameter, one of which is arranged on each side of the rear end of the machine. These traction-wheels are formed of heavy metallic rims having inner annular track portions *z*, upon which are mounted the flanged wheels above described, a pair of such flanged wheels being arranged upon the inside of each outer traction wheel or rim, forward and rearward of the axial centers thereof. These large traction-wheels, which are without spokes or hubs, thus support the rear portion of the machine and may be entirely out of contact therewith except at points where their inner track portions engage the flanged wheels or where they are engaged by suitable guiding members. The traction wheels or rims are adapted to rotate either in unison or independently of each other when desired and are each provided with metallic inner strengthening-flanges 2, adapted to afford the desired rigidity and strength to withstand the stresses and strains to which the parts are subjected in use.

A crank-shaft 3 is rotatably mounted in suitable bearings in the main frame and operatively connected with an engine or other suitable source of power by means of pitmen 5 or in any desired ordinary and well-known manner. The main driving crank-shaft 3 is operatively connected with the main operating or power-transmitting shaft 6, which is mounted in suitable bearings 7 in the main frame by means of a spur-pinion 8 upon said crank-shaft and a spur gear-wheel 9 upon the driven main operating-shaft.

In order to provide suitable means for operating the rear traction-wheels *y* in an intermittent or step-by-step manner when the machine is in operation and continuously when desired for moving the machine from place to place and to enable such traction-wheels to be rotated independently of each other or at the same or different speeds, as desired, the said traction-wheels are each provided with a large inner toothed annular gear or rack 10, mounted between the annular track portions *z*, and a transverse shaft 11 is rotatably mounted in suitable bearings 12 and provided with spur-gears 13 mounted on opposite sides of the machine between each pair of the flanged supporting-wheels above described and in toothed engagement with the inner gears 10 of the traction-wheels, respectively. One of the gears 13 is fixed to the shaft 11, and the other is rotatable thereon, as hereinafter described. The shaft 11 is operatively connected with the driven or main operating-shaft 6 as follows: A sprocket-wheel 14 is rotatably mounted upon the shaft 6 and in fixed relation to a ratchet-wheel 15, which may be cast integral therewith or secured thereto in any ordinary manner. A clutch member 16 is slidably mounted upon said shaft, to which it is connected by means of a spline 17, so as to rotate with the shaft and be movable into and out of engagement with the clutch-shoulder portions 18 upon the hub 19 of the sprocket and ratchet member. A clutch-operating lever 20 is operatively connected with the sliding clutch member for throwing it into and out of operative position.

A compensating-gear mechanism is mounted upon the shaft 11 and operatively connected with the shaft 6 by means of sprocket-chain 22, the upper portion of which is mounted upon the sprocket 14 above described and the lower portion of which is mounted upon

and in engagement with the toothed central sprocket member 24 of the compensating gear. This compensating gear is formed of said central sprocket member 24, the outer rim of which is provided with sprocket-teeth 23 and a plurality of bevel-pinions 25, rotatably mounted in said sprocket member between its toothed rim and axial center, the axes 26 of such pinions extending laterally of the sprocket. The said inner sprocket member is rotatably mounted upon the shaft 11, and bevel-pinions 27 and 28 are mounted upon opposite sides thereof upon said shaft and in toothed engagement with the bevel-pinions 25 above described. The bevel-gear 27 is secured in fixed relation to the shaft by means of a spline or cotter 29 or in any ordinary manner. The other bevel-gear member 28 is rotatably mounted on said shaft and provided with a preferably integral sleeve portion 30, upon and in fixed relation to which is mounted the spur gear-wheel 13 already described, which is in toothed engagement with the inner gear or annular rack of the corresponding traction-wheel. The spur-gear 13 at the opposite end of the shaft 11 is fixed to the shaft. These spur gear-wheels are thus adapted to rotate either in unison or at different speeds, as required, enabling the traction-wheels to be rotated correspondingly either in unison or at different speeds.

It is desirable to provide means whereby the traction-gear-driving wheels 13 may be held in fixed relation to each other when the traction-wheels are to be rotated at the same speed. A clutch member 31 is therefore mounted upon the shaft 11, with which it is slidably connected by means of a spline 32, so as to rotate with the shaft and be movable longitudinally thereof into and out of engagement with the clutch-shoulder portions 33 on the hub 34 of the gear, which is secured to the sleeve 30 above described. (See Fig. 11.) A hand-lever is mounted in operative engagement with this clutch member and pivotally secured to the frame of the machine in any ordinary manner. By this means the traction-wheels are operatively connected in such a manner that when the clutch 31 is in engaging position the wheels will rotate at the same speed, the bevel-gear members of the compensating gear and the gears 13 being locked in fixed relation to each other and to the shaft 11. Throwing the clutch out of engaging position will release the gear members 13 and 28, which are secured to the sleeve 30, and permit the independent rotation of the traction-wheels.

In order to enable the traction-wheels to be automatically rotated intermittently or in a step-by-step manner while the driven shaft 6, which transmits the power to such wheels, is rotated continuously, the ratchet-wheel 15, which is rotatably mounted on said driven shaft, is provided wth a pawl 63, pivotally mounted in the upper ends of supporting-arms 37, such arms being pivotally mounted upon the hub of the ratchet, as shown in Fig. 10. This pawl is provided with a weighted end portion 38, which is secured to one end of a tension-spring 39, the opposite end of such spring being removably secured in any ordinary and well-known manner to the pawl-supporting arms. When the traction-wheels are to be rotated intermittently, the spring 39 is connected in the manner described; but when they are to be rotated continuously, as in moving the machine from place to place, the spring is disconnected at one end and the pawl is held out of engagement with the ratchet by means of the weight. A second pawl 41 is pivotally mounted in the main frame upon a pivot 42 and provided with a compression-spring 43 for holding it in operative position in engagement with the ratchet-wheel 15 when such ratchet-wheel is in use. This spring 43 is secured at one end to the pawl and at its opposite end to an arm 44, which is pivotally mounted by means of a pivot-pin 45 upon the main frame.

A dowel-pin 46 is removably mounted in a suitably-perforated portion 47 of the frame, adapted to hold the arm 44, when on one side of such pin, in position to compress the spring 43, so as to press the pawl into operative engagement with the ratchet. When the arm is moved to the opposite side of the pin, it will hold the pawl out of engaging position.

In order to enable the ratchet 15 and gear 14 to be rotated in a step-by-step manner while the shaft 6, which supports them, is being rotated continuously, a pitman 48 is connected at one end with the pawl-carrying arms 37 by means of a crank-pin 49 and at its opposite end with the crank-arm 50 upon one end of a crank-shaft 51. Said crank-shaft is rockingly mounted and provided with a second crank-arm 52 upon its opposite end. A similar pitman 53 connects the last-mentioned crank-arm with a crank-arm 54 upon and in fixed relation to the rotatable shaft 6. The rotation of the shaft 6 thus rocks the crank-shaft 51 and produces a rocking movement of the pawl-carrying arms 37, thereby giving the ratchet-wheel 15 and the traction-wheels a step-by-step movement.

In order to control the length of each reciprocating movement of the pawl 36, and thereby govern the distance which the machine moves at each step, the pitman 53 is provided with an adjustable pin-supporting block 55, in which the crank-pin 56 is mounted. The adjacent surfaces of said adjustable block and the crank 54 are corrugated, so as to securely hold the block in any desired adjusted position.

A vertically-movable excavating-frame 57 is mounted in the main frame, preferably at the transverse center thereof and back of the axial centers of the traction-wheels. This frame is made foldable, as shown in Fig. 6, being provided near its center with a hinge 58, pivotally connecting its upper and lower sections. The upper section is thus adapted to be folded backward in position to rest upon supporting-arms 59, which are secured, by means of brackets 60, to the main frame. The machine is thus enabled to be transported from place to place without danger of injury to the parts by the long vertically-movable frame coming in contact with obstacles of any description. The upper and lower sections of the vertically-movable excavating-frame are rigidly connected in operative position by means of a metallic plate 260, which is bolted thereto on the side opposite the hinge 58 by means of bolts 61. These bolts may be removed from at least one of the folding sections when the frame is to be folded. This supplementary or excavating frame is formed of a central I-beam 62, having a pair of I-beams secured to its opposite edges with their web portions at right angles to the central web portion of the main or central I-beam. A toothed rack 64 is secured to the central I-beam member by means of bolts or rivets 65 and is also made in separate upper and lower sections, which are connected by means of the hinge 58, already described, so as to be foldable with the I-beam members of such frame. For raising and lowering this excavating-frame a transverse shaft 66 is rotatably mounted in suitable bearings 67 in the main frame and provided with a pinion 68, mounted upon and in fixed relation to such shaft and in toothed engagement with the toothed rack 64 upon the excavating-frame. This shaft 66 is operatively connected with the main operating-shaft 6 by means of an intermediate shaft 69, which is mounted in suitable bearings 70 in the main frame and provided at one end with a spur-pinion 71 in toothed engagement with the spur-gear 9 on the shaft 6. Upon the opposite end of the shaft 69 is mounted a bevel-gear 72. When the machine is employed in excavating, the shaft 69 always rotates in the same direction—that is to say, forward, or in the direction of the forward rotation of the traction-wheels.

In order to enable the excavating-frame to be raised or lowered, as desired, the connection between the shafts 66 and 69 is made in such a manner as to permit the direction of rotation of the shaft 66 to be changed when desired, while the direction of rotation of the shaft 69 remains unchanged. To accomplish this, a worm 73 is mounted upon and in fixed relation to a vertical stub-shaft 74 and in toothed engagement with a worm-wheel 75 upon the shaft 66, which is operatively connected with the supplementary frame. The stub-shaft 74 is mounted in a suitable bearing 76 in the main frame and provided at its upper end with a bevel-pinion 77 in fixed relation to such shaft. A shaft 78 is mounted over the pinion 77 in line with its axial center and extends at right angles to the shaft 66 and stub-shaft 74 and longitudinally of the machine upon the right-hand side thereof, as shown in Figs. 3, 4, and 5.

For operatively connecting shafts 78 and 66 a clutch member 79 is mounted upon the shaft 78, rotatable therewith and movable longitudinally thereof, being slidably connected with such shaft by means of a spline 80 and provided with an operating-lever 81. Spur-pinions 82 and 83 are loosely mounted upon the shaft 78 on opposite sides of the clutch member 79 and both in toothed engagement with the gear 77, which is on the worm-shaft 74, already described. By this means it will be seen that the direction of rotation of the worm 73 and shaft 66 may be changed with relation to the direction of rotation of the shaft 78 when desired by throwing the clutch member 79 into engagement with either the shouldered clutch member 84 upon the bevel-gear 82 or the clutch member 85 upon the bevel-gear 83.

The shaft 78 is operatively connected with the shaft 69, and thereby with the main driven shaft 6 and source of power, by means of bevel-gears 86 and 87, which are loosely mounted upon said shaft 78 and both in toothed engagement with the bevel-gear 72 upon the shaft 69. A clutch member 88 is mounted between the bevel-gears 86 and 87 upon the shaft 78, movable longitudinally thereof and rotatable therewith, and is provided with an operating-lever 89, by means of which such clutch member may be moved into engagement with either the shouldered clutch portion 90 of the gear member 86 or the clutch portion 91 of the gear member 87. By this means when the clutch is in operative engagement with the gear-wheel 86 the shaft 78 will be rotated in one direction, and when in engagement with the gear 87 said shaft will be rotated in the opposite direction with relation to the shaft 69. When the clutch member 88 is out of engagement with both its gears, the shaft 78 may remain stationary, and when the clutch member 79 is out of engagement with both its gears the worm-shaft 74 and transverse shaft 66 may remain stationary. The shaft 78 is rotatably mounted in suitable bearing-bracket portions 92 and 93 upon the main frame and is provided with a sprocket-wheel 94 upon its forward end, by means of which it is operatively connected with the transverse endless conveyer hereinafter described.

The above-described connections between the shafts 66 and 69 enable the vertically-movable excavating-frame to be raised or

lowered, as desired, to control the depth of the excavation when the machine is in operation or to permit the machine to be moved from place to place.

In order to provide suitable means for guiding the excavating-frame in its vertical movement and holding it, and thereby the excavating shovel and chain mechanism in operative position, guiding-rollers 95 are rotatably mounted between the flange portions of the vertical side I-beam members 63 at suitable intervals and supported in position by means of brackets 96, which are mounted upon transverse channel-iron frame members 97 and 98. The channel-iron 98 is secured to the longitudinal frame members *c*, being provided with filler-blocks 99 for holding it, and thereby the guiding-rollers which it supports, in operative position. The guiding-rollers 95 are mounted upon pins 100 in the brackets 96 and in position to hold the vertically-movable excavating-frame against horizontal play both transversely and longitudinally of the frame.

A plurality of excavating-shovels 101 are mounted upon a flexible supporting element in the form of a pair of excavating-chains 102 and supported in operative position in the vertically-movable excavating-frame upon supporting-wheels 103 and 104. These supporting-wheels are mounted upon shafts 105 and 106, which are mounted on and extend laterally across the upper and lower ends, respectively, of the supplementary frame 57, being mounted in supports 107 and 108. These excavating-chains are each formed of a multiplicity of links each having side link portions 109, which are integral with the hollow transverse end or hub portions 110 at one end of each link. The hollow ends or hubs of the links are each adapted to contain a connecting-pin 111, mounted in suitable perforations in the open end of the next adjacent link. The hollow transverse portions of the links are thus secured between the open ends of the side link portions and are made cylindrical, so as to be partly encircled by the tiltable hooked teeth of operating-sprockets hereinafter described and permit such teeth to move into and out of engagement with a substantially straight lap of the chain in an efficient manner. The raising and lowering of the excavating device is greatly facilitated by the use of an operating or power-transmitting device adapted to thus operatively engage a straight lap of the excavating-chain when such chain is in any raised or lowered operative position.

The excavating-shovels are each formed of a main body portion having a central perforation 112 extending from side to side of the shovel parallel with the edge which carries the cutters, such main body portion being provided with securing-lugs 116, which may be integral with the shovel and are secured to the chain by means of rivets or pins, as shown in Fig. 7. Lugs 113, which may be integral with the shovels, are provided, having lower ends which swing into and out of engagement with shafts 114, by means of which rollers 115 are connected with the chains. The rollers 115 are mounted on the chains at suitable intervals, being rotatably secured thereto by means of the shafts 114, already described, the peripheries of said rollers being in engagement with the flanges of the side I-beams of the frame, as shown in Figs. 7 and 8. Cutter-teeth 117 are mounted in perforations along the outer edges of the main body portions of the shovels to which they are secured by means of integral securing stems or studs 118, which extend into suitable perforations in the main body portions. The securing-stems of the cutters are slightly tapered, so as to be held rigidly in place. The outer teeth 119 are curved outward and mounted in a similar manner in removable extension portions 120 at the opposite sides of the main body portions of the shovels. These extension portions are each provided with a hollow securing stem or shank 121, which fits snugly in the perforation 112 of the main body portion of the shovel. These removable extension portions of the shovels are each held in place by means of a tapered dowel-pin 122, which is inserted through a corresponding perforation in the main body portion of the shovel and similar perforations in the extension end portions, as shown in Figs. 8 and 9. By this means it will be seen that the width of the shovels, and thereby the width of the excavation, may be increased or decreased, as desired, by the insertion or removal of the extension members without removing the main body portions of the shovels from the flexible supporting member or chain or disturbing the connections with the chain. When the extension members are removed, the curved teeth may be mounted in place of the outer teeth in the main body portions of the shovels, so as to produce the necessary clearance or width of cut to permit the efficient operation of the excavating mechanism.

In order to provide simple and efficient means for driving the excavating-chain, and thereby operating the shovels, the main operating-shaft 6, which is journaled in the main frame in fixed bearings, is provided with a pair of tiltable toothed sprockets each formed of a pair of side disk portions 123, which are secured in fixed relation to the shaft by means of keys or splines 124. Each pair of side disk portions is provided with a multiplicity of tiltable teeth 125, mounted therebetween upon supporting-pivots 126, which connect the side disk portions and extend across the space therebetween at regular intervals, each of such pivots being mounted in laterally-projecting portions 127

around the outer periphery of the disk, as shown in Fig. 7. These teeth are each provided with an outer hooked end portion 128 and an inner arm or body portion 129, upon the inner end of which is rotatably mounted an antifriction-roller 130. Between each pair of disks and in engagement with the inner surfaces of these antifriction-rollers is mounted a stationary cam 131, which encircles the shaft and is secured in fixed position by means of an outer arm 132, which is preferably integral with the sleeve portion of the cam. The arm 132 is connected with the main frame in any ordinary manner, as shown in Fig. 2, so as to hold the cam against rotation. The peripheral surface of this cam is circular throughout a greater portion of its circumference, but is provided with a recessed portion 135 in the proper position between the shaft 6 and the excavating-chain to permit the tilting teeth to be released from such chain when they reach the desired position. The engaged face of the cam is thus adapted to hold the teeth in extended operative or chain-engaging position until such releasing position is reached, as shown in Fig. 7. As soon as the rear or inner ends of the teeth are released from engagement with the cam they swing out of engagement with the chain independently of the cam. By this arrangement it will be seen that the tilting teeth are held by the cam in operative engagement with the chain and permitted to pass out of engagement therewith at the proper time in such a manner as to enable a substantially straight portion of the chain to be engaged by the teeth of such rotating gear mechanism and disengaged therefrom in an efficient manner. The portion of the cam which engages the inner ends of the tiltable teeth or the antifriction-roller members thereof while the teeth are in actual engagement with the chain should be of such contour as to cause the chain-engaging portions of the teeth to move in a comparatively straight path while in engaging position as compared with their path of movement when released from engagement with the chain. The operating-lap of the excavating-chain being vertical and substantially straight, the excavating-frame, with its chain-and-bucket mechanism, may thus be raised or lowered to any desired position with relation to the tilting toothed gear mechanism without injuriously affecting the operation of the parts. The gear mechanism, in other words, may be mounted upon the main frame portion and efficiently connected with the source of power, and the excavating-chain, with its vertically-movable frame, may be readily moved bodily up or down without disturbing or moving the tilting toothed driving-gear, and the power may at all times be applied to the chain at the same elevation.

In order to provide suitable means for enabling the material to be discharged from the excavating and conveyer buckets always at the same elevation regardless of the raised or lowered position of the excavating mechanism, a scraper 136 is mounted upon supporting-arms 137, which are pivotally secured to supporting-arm portions 138 of the main frame by means of pivots 139, and cams 140 are mounted upon and secured in fixed relation to the rotatable shaft 6 in alinement with the pivoted arm portions of such scraper. These cams each have two arm portions projecting laterally in opposite directions from the shaft, so that each projecting cam portion alternately engages the adjacent supporting-arm of the scraper at the proper time to move it out and slightly upward from the rear edge to the forward cutting and discharging edge of each shovel as each shovel is in turn brought into position below the scraper, so as to be emptied thereby. As the scraper is released by the engaging cam-arms it is permitted to fall back into position over the next excavating-bucket to be operated in a similar manner for each bucket in its turn. The material may thus be discharged from a straight lap of the chain-and-shovel mechanism at any desired elevation.

Each shovel is provided with a back plate 159, having perforated lugs 160 extending at right angles to the back plate and pivotally secured to the chain by means of pivots 161. The scrapers pass in front of these back plates, ejecting the material from the shovels.

For discharging the material from the machine after it has been emptied from the shovels an endless conveyer-belt 141, which may be of any ordinary and well-known form, is mounted upon a transversely-movable conveyer-frame, which extends transversely across the machine and laterally beyond either or both sides thereof. This conveyer-frame is formed of a pair of side angle-iron members 142, which form the sides of the frame, and shafts 143 and 144, which are mounted in suitable bearings 145 and connect the ends of the side angle-iron members. Supporting-wheels 146 are mounted upon such shafts respectively, and the endless conveyer is mounted thereon.

Supporting-brackets 147 are arranged at suitable intervals upon the side frame or angle-iron members of the conveyer-frame and are provided with shafts 148, upon which supporting-rollers 149 are mounted in supporting engagement with the inner side of the upper lap of the endless conveyer-belt. The conveyer-frame thus formed is movable transversely of the main frame to any desired position and is adapted to be secured removably in any desired adjusted position. For moving the conveyer-frame, together with the endless conveyer, transversely to the main frame and for holding it in any de-

sired adjusted position, chains 149′ are secured to such conveyer-frame near the opposite ends thereof, respectively—one upon each side of the conveyer-frame.

An operating-shaft 150 is mounted upon the main frame at each side thereof in suitable bearings 151, each of such shafts having a ratchet 152 thereon.

A pawl 153 is mounted upon the main frame in engagement with the teeth of each of such ratchets respectively. Each shaft is also provided with a squared or laterally-perforated portion 154, adapted to be engaged by an operating-lever of any ordinary type for rotating such shafts, and thereby moving the conveyer-frame transversely of the main frame to any desired position. The side angle-iron members of the conveyer-frame rest upon suitable supports 156 upon the main frame.

The endless conveyer is operatively connected with the shaft 78, and thereby with the main operating driven shaft 6 and source of power, by means of a sprocket-chain 157 the outer portion of which is mounted upon a sprocket-wheel 158 upon the shaft 144 and the inner portion of which is mounted upon the sprocket-wheel 94 on the shaft 78, already described. The conveyer is thus adapted to be driven in either direction corresponding to the direction of rotation of the shaft 78, and it may be moved bodily transversely of the machine into position to discharge material carried thereby at any desired distance beyond either side of the machine.

Guiding-arms 162 for limiting the transverse movement of the traction-wheels are pivotally mounted on the main frame and provided at their upper ends with flanged guiding-wheels 163 in engagement with the inner annular track portions *z* of the traction-wheels. Gusset-plates 164 are secured to and connect the upper ends of the angle-iron guiding-arms 162 and form a support for the stub-shaft 165, upon which the flanged pulley on each side of the machine is mounted, and a transversely extending shaft or arm 166 is mounted on each side of the machine for limiting the transverse movements of the guiding-arms 162, and thereby the upper portions of the traction-wheels. Means for providing a yielding resistance to such transverse movement is provided in the form of compression-springs 167, which are mounted on opposite sides of each guiding-frame or pair of arms 162, between the gusset-plates and collars 168 on the arms 166. These collars are on opposite sides of the guiding-frames and limit the transverse movements of the traction-wheels. The transverse arms 166 are each pivoted at their inner ends to brackets 169 upon the main frame, and their outer portions pass loosely through perforations in the gusset-plates 164.

The links to which the back members 159 of the excavating-shovels are secured are the same to which the main body portions of such shovels are secured, such links each being provided with a stud 170, which projects up beyond the top pivot of the link and supports the back member 159 of the shovel in position.

I claim—

1. In an excavating-machine, the combination of a main supporting-frame, a movable supplementary frame mounted thereon and provided with upper and lower chain supporting and guiding members, excavating-chain mechanism mounted on and having a substantially straight upwardly-movable excavating-chain portion extending from the upper to the lower chain supporting and guiding members, excavating-shovels secured to such excavating-chain mechanism, and chain-operating mechanism mounted in stationary supports on the main frame in engagement with the upwardly-movable substantially straight portion of the excavating-chain mechanism at points intermediate the upper and lower chain-supporting members.

2. In an excavating-machine, the combination of a main supporting-frame, a vertically-movable excavating-frame mounted in the main frame and provided with excavating mechanism mounted thereon comprising a substantially straight upwardly-movable excavating-chain portion having attached excavating-shovels, upper and lower supporting-wheels upon which such chain mechanism is mounted and between which such substantially straight portion of the chain extends, and chain-operating mechanism mounted in fixed supports in the main frame and provided with tiltable tooth mechanism in engagement with the upwardly-movable substantially straight portion of the excavating-chain at points intermediate the upper and lower chain-supporting wheels.

3. In an excavating-machine, the combination of a main supporting-frame, a vertically-movable excavating-frame mounted in the main frame and provided with excavating mechanism mounted thereon comprising a substantially straight upwardly-movable excavating-chain portion having attached excavating-shovels, upper and lower supporting-wheels upon which such chain mechanism is mounted and between which such substantially straight portion of the chain extends, chain-operating mechanism mounted in the main frame and provided with tooth mechanism in engagement with the upwardly-movable substantially straight portion of the excavating-chain at points intermediate the upper and lower chain-supporting wheels, and means for operatively connecting such chain-operating mechanism with a suitable source of power.

4. In an excavating-machine, the combination of a main supporting-frame, a verti-

cally-movable excavating-frame mounted in the main frame and provided with excavating mechanism mounted thereon comprising a substantially straight upwardly-movable excavating-chain portion having attached excavating-shovels, upper and lower supporting-wheels upon which such chain mechanism is mounted and between which such substantially straight portion of the chain extends, a shaft mounted in fixed supports in the main frame and provided with sprocket mechanism in toothed engagement with the upwardly-movable portion of the excavating-chain at points intermediate the upper and lower chain-supporting wheels, and means for operating such shaft.

5. In an excavating-machine, the combination of a main frame, supporting-wheels upon which such frame is mounted, a substantially vertical supplementary frame extending and movable upward and downward and provided with excavating-chain mechanism with attached excavating and carrying shovels, a shaft mounted on the main frame, a sprocket provided with tiltable teeth mounted upon such shaft, and cam mechanism mounted in operative engagement with such tiltable teeth for positively holding them in engagement with the chain and permitting them to move freely to releasing position.

6. In an excavating-machine, the combination of a supporting-frame, excavating mechanism supported thereby, and operating mechanism provided with tiltable teeth movable into and out of engagement with such excavating mechanism.

7. In an excavating-machine, the combination of a supporting-frame, a supplementary frame movably mounted thereon, flexible excavating and elevating mechanism mounted on such movable supplementary frame, and sprocket mechanism having tiltable teeth movable into and out of operative engagement with such excavating and elevating mechanism.

8. In an excavating-machine, the combination of a supporting-frame, sprocket-chain mechanism having attached excavating-shovels, a shaft journaled on said frame, and a sprocket mounted on said shaft provided with teeth having concave working faces movable into engagement with the excavating sprocket-chain mechanism.

9. In an excavating-machine, the combination of a supporting-frame, a normally vertical beam or frame mounted thereon, a flexible excavating and elevating device, mounted on such vertical frame comprising sprocket-chain mechanism having attached excavating and elevating shovels, sprocket mechanism having tiltable teeth provided with concave faces movable into engagement with the chain and means for positively holding such teeth in chain-engaging position and adapted to permit the teeth to tilt freely out of engagement with the chain.

10. In an excavating-machine, the combination of a supporting-frame, a sprocket-chain mechanism having attached excavating-shovels, means for supporting such sprocket-chain and shovel mechanism in operative position, sprocket mechanism provided with tiltable teeth having concave surface portions movable into and out of engagement with such sprocket-chain mechanism, and means for supporting such sprocket mechanism.

11. In an excavating-machine, the combination of a main supporting-frame, an excavating-chain having a substantially straight portion, a shaft mounted on said frame, a sprocket provided with tiltable teeth and mounted on said shaft, and mechanism for holding the teeth in engagement with a substantially straight portion of the excavating-chain provided with means for allowing said teeth to tilt at the desired point for disengagement from said excavating-chain.

12. In an excavating-machine, the combination of a main frame, an excavating device mounted thereon comprising a normally vertical beam or frame movable vertically and provided with an endless flexible excavating and elevating device mounted on such vertically-movable beam or frame, a shaft journaled on the supporting-frame, a sprocket mounted on said shaft and provided with tiltable teeth movable into engagement with the flexible excavating and elevating device, a stationary cam loosely mounted on said shaft in engagement with such tiltable teeth for holding them in operative position and releasing them from engagement with the flexible excavating and elevating device, and means for raising and lowering such vertically-movable excavating mechanism.

13. In an excavating-machine, the combination of a supporting-frame, endless flexible excavating and elevating mechanism movable to different operative positions, and a sprocket having tiltable teeth for operating such endless flexible excavating and elevating mechanism.

14. In an excavating-machine, the combination of a supporting-frame, a shaft mounted on said frame, a relatively upright beam or frame carrying a flexible excavating and elevating device, a series of excavating and elevating shovels having pointed projections for loosening the material to be excavated, and having body portions for elevating such material, a scraper pivoted to a supporting-frame portion and adapted to be forced outward and upward slightly in advance of each of the excavating and elevating shovels successively for discharging the excavated material carried thereby, and cam mechanism for operating such scraper.

15. In an excavating-machine, the combi-

nation of a supporting-frame, a relatively upright beam or frame provided with an endless excavating and elevating device mounted thereon comprising a series of excavating and elevating shovels, a scraper or ejector mounted on a stationary portion of the frame and situated in the path of said shovels and adapted to discharge material therefrom at the desired point, and a transverse conveyer adapted to convey the excavated material laterally beyond the sides of the excavating-machine.

16. In an excavating-machine, the combination of a supporting-frame having suitable traction-wheels, a power-transmitting shaft mounted on said supporting-frame, a crank mounted on said shaft, pawl-and-ratchet mechanism, a pitman having one end pivotally connected to such crank and the other end operatively connected with the pawl-and-ratchet mechanism, means for shifting the point of pivotal connection between the pitman and crank, and gear mechanism for connecting the pawl-and-ratchet mechanism with the traction-wheels for transmitting a variable step-by-step motion thereto.

17. In an excavating-machine, the combination of a supporting-frame, a vertically-movable frame or beam carrying an endless flexible excavating and elevating device comprising a sprocket-chain provided with a series of excavating and elevating shovels, a prime motor mounted on said supporting-frame, a power-transmitting shaft journaled on said supporting-frame and provided with a spur-gear, a shaft connected with the motor and provided with a pinion in engagement with the spur-gear mounted on the said power-transmitting shaft and provided with teeth adapted to positively engage the sprocket-chain mechanism of said flexible excavating and elevating device while said sprocket-chain mechanism is passing said sprocket in a practically straight line.

18. In an excavating-machine, the combination of a supporting-frame, sprocket-chain mechanism having attached excavating-shovels, means for supporting such sprocket-chain and shovel mechanism in operative position, a sprocket member provided with side disk portions and having tiltable teeth mounted intermediate such side disk portions and movable into and out of engagement with the sprocket-chain mechanism, and cam mechanism mounted between the disk portions of the sprocket member and in operative engagement with the pivoted teeth for holding them in chain-engaging position and permitting them to move to releasing position.

19. In an excavating-machine, the combination of a supporting-frame, sprocket-chain mechanism provided with attached excavating-shovels, means for supporting such sprocket-chain and shovel mechanism in operative position, a sprocket-wheel having side body portions provided with a space therebetween, perforated tiltable teeth mounted between such side body portions of the sprocket-wheel, pivot-pins extending through the perforations in such tiltable teeth and having their opposite ends mounted in the side portions of the sprocket-wheel, and means for holding such tiltable teeth in extended position and permitting them to move to retracted releasing position.

20. In an excavating-machine, the combination of excavating chain and shovel mechanism, a sprocket member having side body portions provided with a space therebetween, tiltable teeth mounted between such side body portions each provided with antifriction-rollers on its inner end, and cam mechanism mounted in engagement with the antifriction-rollers for holding such teeth in extended chain-engaging position and permitting them to move to retracted releasing position.

21. In an excavating-machine, the combination of a frame, provided with traction-wheel mechanism, excavating mechanism supported by such frame, means for operating such excavating mechanism, a shaft provided with gear mechanism connected with the traction-wheel mechanism, and means for rotating such shaft intermittently and thereby imparting a step-by-step movement to the machine.

22. In an excavating-machine, the combination of a frame, traction-wheels for supporting such frame, excavating mechanism mounted upon the frame, shaft-and-gear mechanism connected with the traction-wheels for rotating them, and means for rotating such shaft-and-gear mechanism intermittently or continuously as desired and thereby rotating the traction-wheels either continuously or intermittently.

23. In an excavating-machine, the combination of a frame, hollow traction-wheels upon which the rear portion of such frame is mounted, a shaft provided with gear mechanism in engagement with such traction-wheels, a motor mounted upon such frame, and mechanism operatively connecting such shaft with the motor and provided with means for intermittently rotating the shaft and thereby the traction-wheels.

24. In an excavating-machine, the combination of a frame, excavating mechanism mounted upon such frame, spokeless traction-wheels, supporting-wheel mechanism connected with the frame and supported by such spokeless traction-wheels eccentric thereto, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, and means for rotating such shaft.

25. In an excavating-machine, the combi-

nation of a frame, excavating mechanism mounted upon such frame, spokeless traction-wheels, supporting-wheel mechanism connected with the frame and supported in such spokeless traction-wheels, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, compensating-gear mechanism operatively connected with such traction-wheel-operating gear-and-shaft mechanism, and means for connecting such compensating-gear mechanism with a suitable source of power.

26. In an excavating-machine, the combination of a frame, excavating mechanism motuned upon such frame, spokeless traction-wheels, supporting-wheel mechanism connected with the frame and supported by such spokeless traction-wheels, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, compensating-gear mechanism operatively connected with such traction-wheel-operating gear-and-shaft mechanism, means for locking all of the compensating-gear members in fixed relation to each other and to the shaft upon which they are mounted, and means for operating such compensating gear and thereby the traction-wheel mechanism.

27. In an excavating-machine, the combination of a frame, excavating mechanism mounted upon such frame, spokeless traction wheels, supporting-wheel mechanism connected with the frame and supported by such spokeless traction-wheels, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, means for securing such gears in fixed relation to each other and to the shaft upon which they are mounted and for releasing one of such gears from fixed engagement with such shaft, compensating-gear mechanism operatively connected with such traction-wheel-driving gears, and mechanism mounted upon such frame and operatively connected with the compensating-gear mechanism for operating it and thereby the traction-wheels.

28. In an excavating-machine, the combination of a frame, excavating mechanism mounted upon such frame, spokeless traction-wheels, supporting-wheel mechanism connected with the frame and supported by such spokeless traction-wheels, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, an engine mounted upon such frame, means for operatively connecting the engine with such traction-wheel-driving shaft-and-gear mechanism for rotating the same continuously when desired, and means for operatively connecting the engine with such traction-wheel-driving shaft-and-gear mechanism or rotating the same intermittently when desired.

29. In an excavating-machine, the combination of a frame, excavating mechanism mounted upon such frame, traction-wheels for supporting and moving such frame, an annular gear for each traction-wheel, a shaft provided with toothed gear-wheels in toothed engagement with such annular gears, and mechanism operatively connected with the excavating mechanism and with the traction-wheel-driving shaft-and-gear mechanism for simultaneously operating the excavating mechanism continuously and the traction mechanism intermittently.

30. In an excavating-machine, the combination of a main frame, spokeless supporting traction-wheels mounted on opposite sides of the longitudinal center of such frame, excavating mechanism mounted upon such frame, means for operating such excavating mechanism, and conveyer mechanism extending transversely of the main frame and through the spokeless-traction-wheel mechanism.

31. In an excavating-machine, the combination of a main frame, spokeless supporting traction-wheels mounted on opposite sides of such frame, means for holding the frame in position with relation to the traction-wheels, excavating mechanism mounted upon such frame, conveyer mechanism extending transversely of such frame and through the spokeless-traction-wheel mechanism, and means for operating such excavator mechanism, traction-wheel mechanism and transverse conveyer mechanism simultaneously.

32. In an excavating-machine, the combination of a main frame, spokeless supporting traction-wheels mounted on opposite sides of such frame, means for holding the frame in position with relation to the traction-wheels, excavating mechanism mounted upon such frame, conveyer mechanism extending transversely of such frame and through the spokeless-traction-wheel mechanism, a shaft-and-gear mechanism operatively connected with the traction-wheels for rotating them, means for operatively connecting such shaft-and-gear mechanism with a source of power, means for operating the excavating mechanism and means for operating the transverse conveyer mechanism.

33. In an excavating-machine, the combination of a main frame, hollow traction-wheels mounted upon opposite sides of the longitudinal center of such frame, supporting-wheels connected with the frame and eccentrically mounted in the hollow traction-wheels, excavating mechanism extending between such spokeless traction-wheels and movable to different raised or lowered operative positions, means for operating such excavating mechanism, and means for rotating the traction-wheels.

34. In an excavating-machine, the combination of a main frame, spokeless traction-wheels mounted upon opposite sides of the longitudinal center of such frame, excavating mechanism extending between such spokeless traction-wheels and movable substantially vertically to different raised or lowered operative positions, means for operating such excavating mechanism, means for rotating the traction-wheels simultaneously with the operation of the excavating mechanism, and conveyer mechanism extending transversely across the frame and through the traction-wheel mechanism for discharging material laterally beyond the side of the machine.

35. In an excavating-machine, the combination of a shovel having a main body portion and removable extension portions secured to and extending laterally beyond the sides of such body portion, and means for supporting such main body portion and extension portions in operative position.

36. In an excavating-machine, the combination of chain mechanism, excavating-shovels having main body portions secured to such chain mechanism and provided with extension portions removably secured to and extending laterally beyond the sides of such excavating-shovels.

37. In an excavating-machine, the combination of chain mechanism, and excavating-shovels having main body portions secured to such chain mechanism and provided with extension portions removably secured upon opposite sides of such main body portions of the shovels and extending laterally beyond the sides of the shovels and chain mechanism.

38. In an excavating-machine, the combination of chain mechanism, excavating-shovels having main body portions secured to such chain mechanism, extension members for each of such shovels, and means for securing such extension members in position to extend laterally beyond the main body portions of the shovels and chain mechanism.

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Witnesses:
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