B. McINTIRE.

EXCAVATING MACHINE.

APPLICATION FILED JAN. 19, 1918.

1,306,350.

Patented June 10, 1919.

7 SHEETS—SHEET 1.

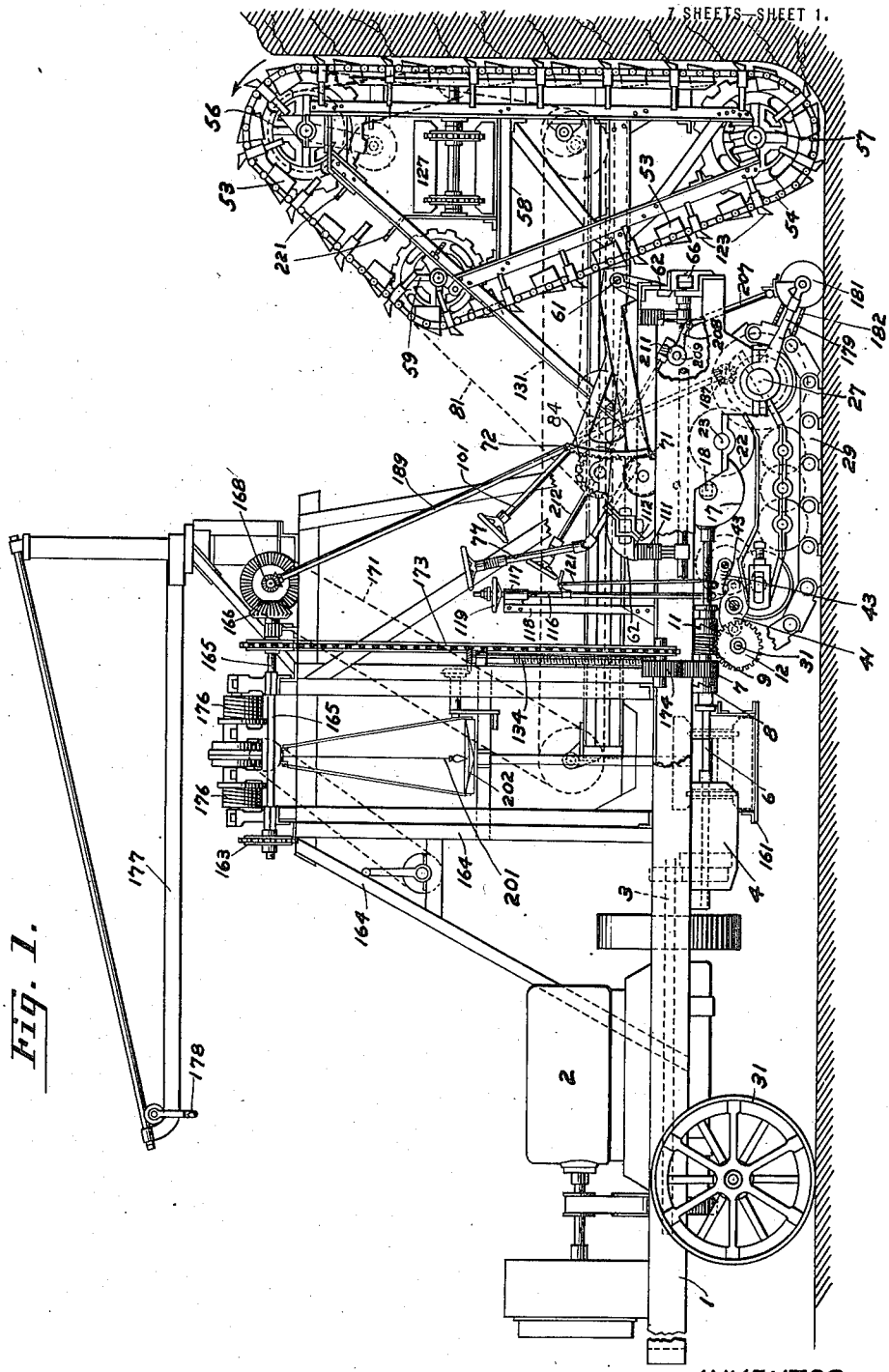

Fig. 1.

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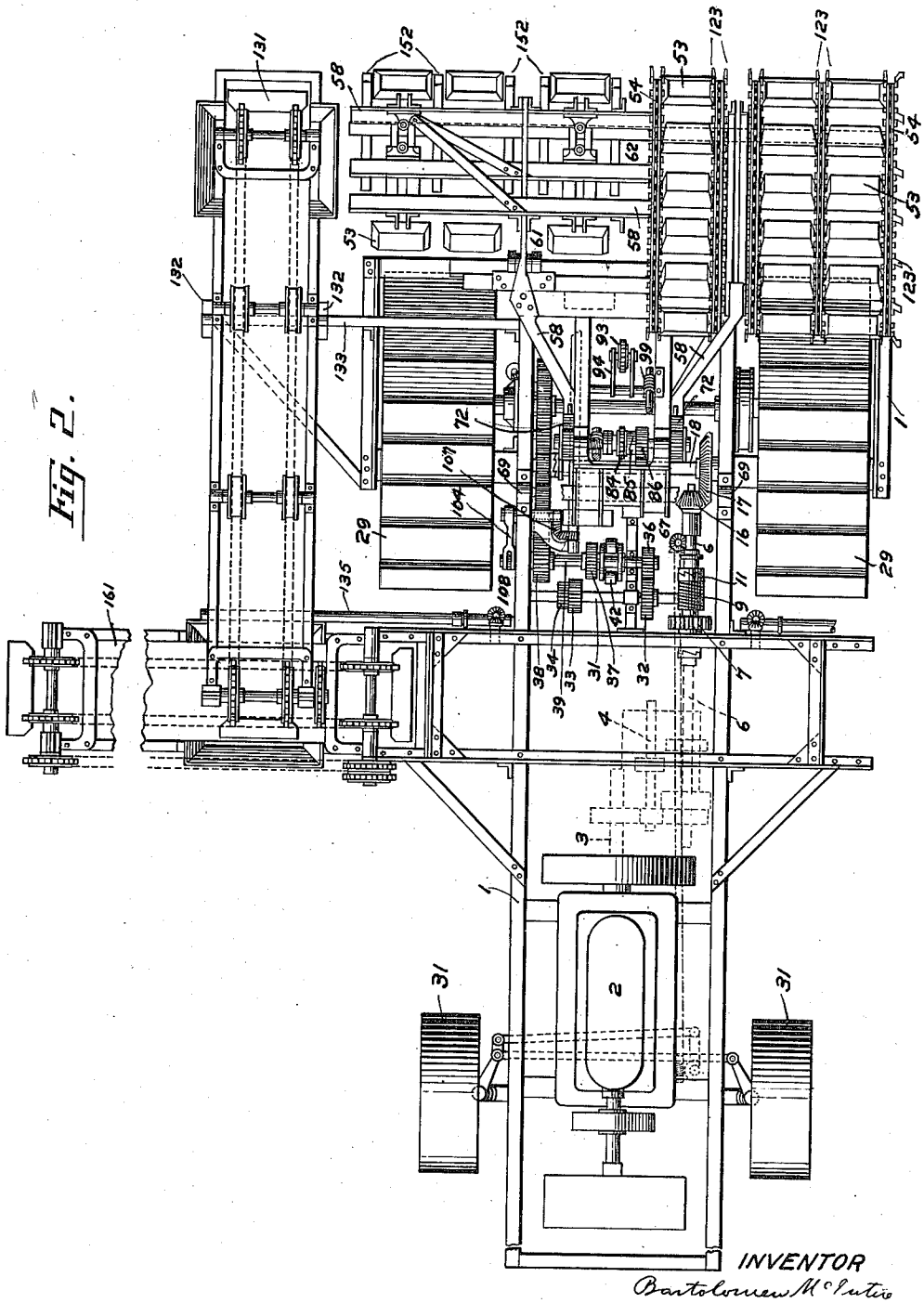
7 SHEETS—SHEET 2.

Fig. 2.



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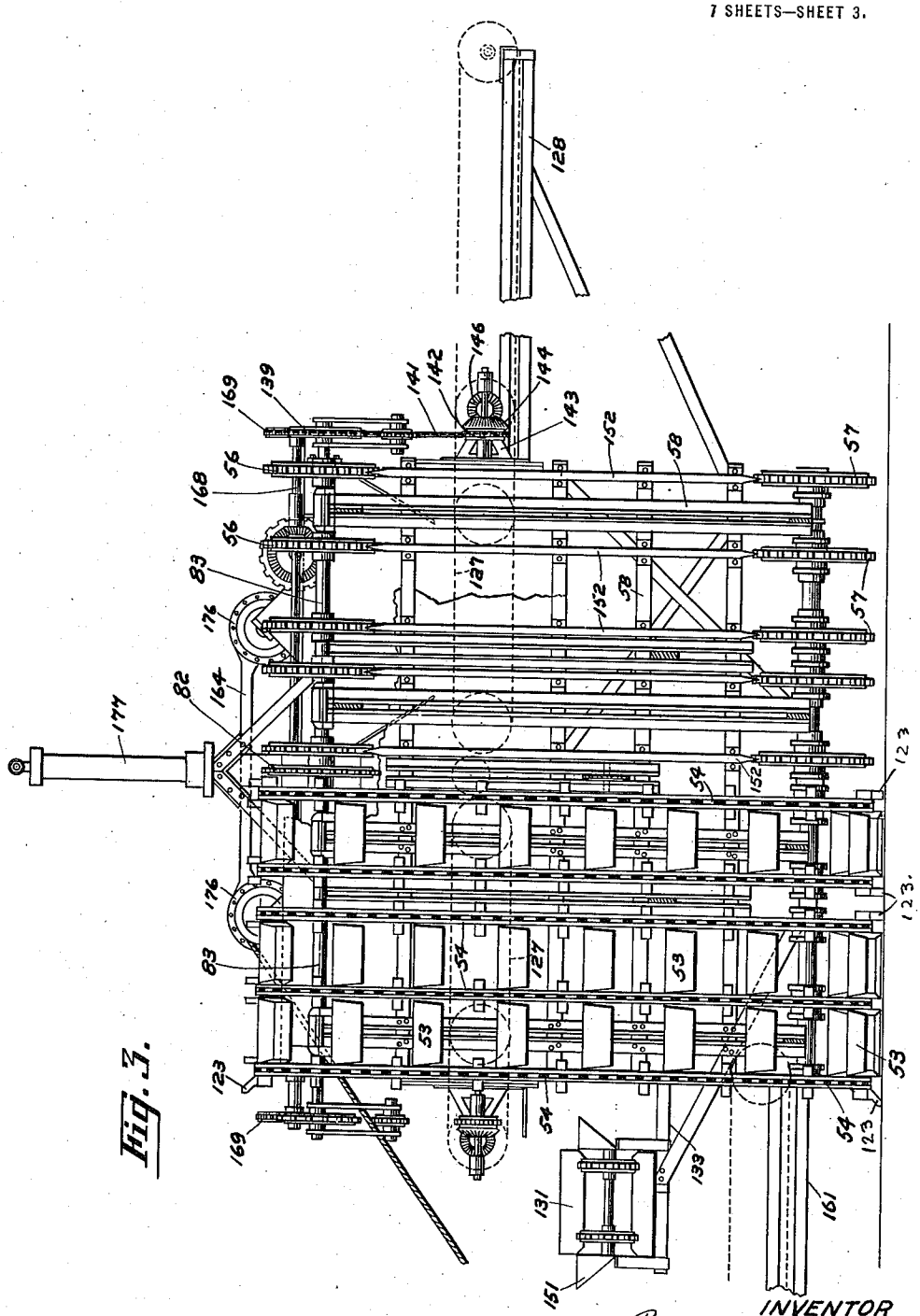

Fig. 3.

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7 SHEETS—SHEET 4.

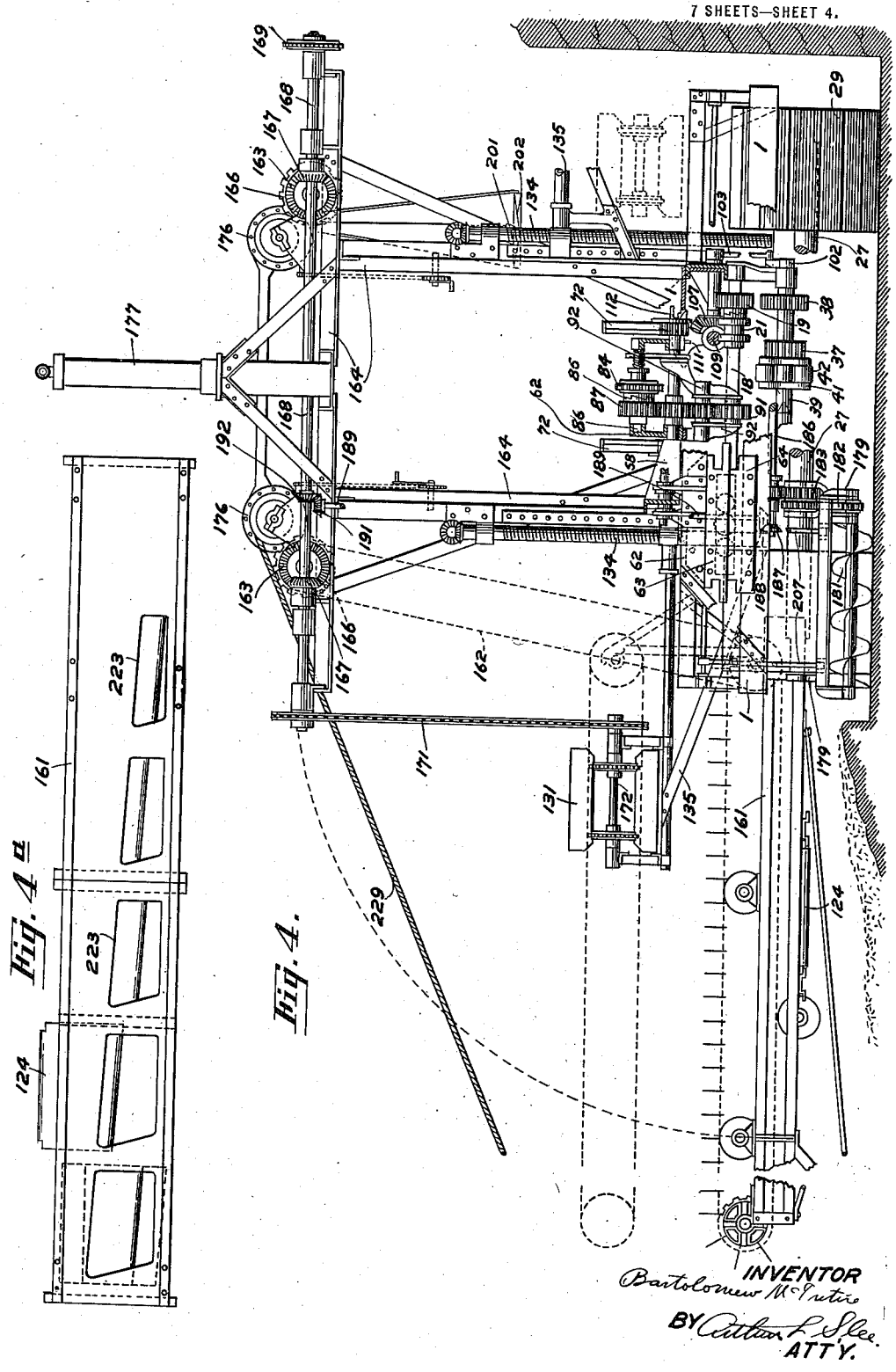

Fig. 4.

Fig. 4a.

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7 SHEETS—SHEET 5.

Fig. 5.

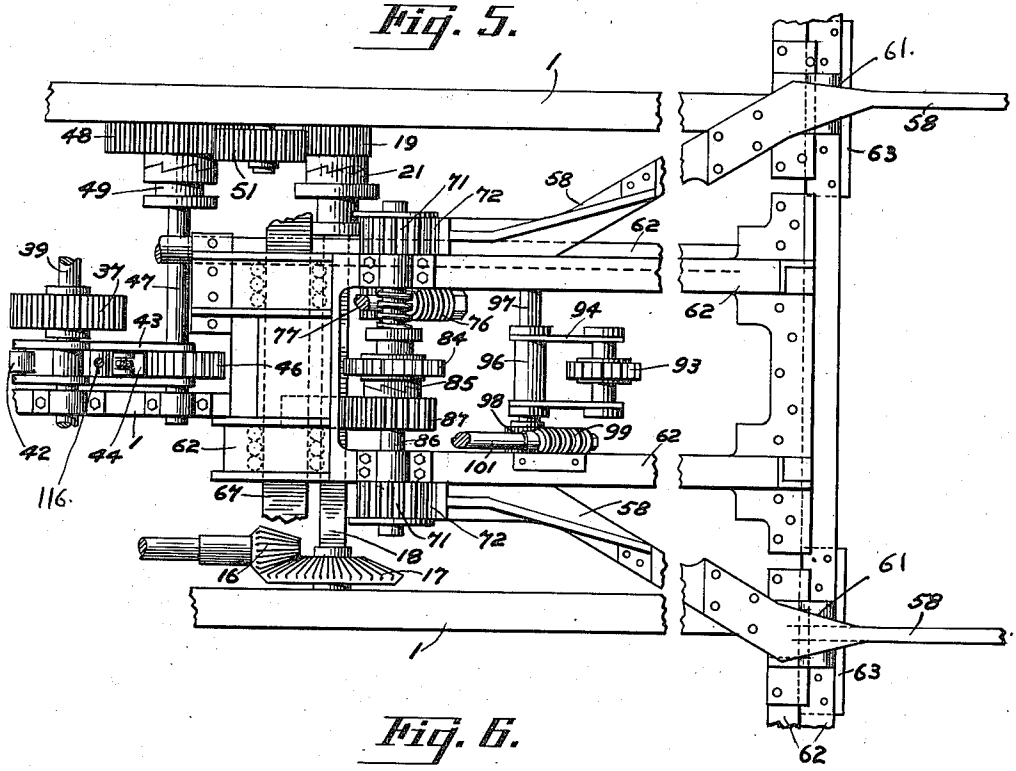
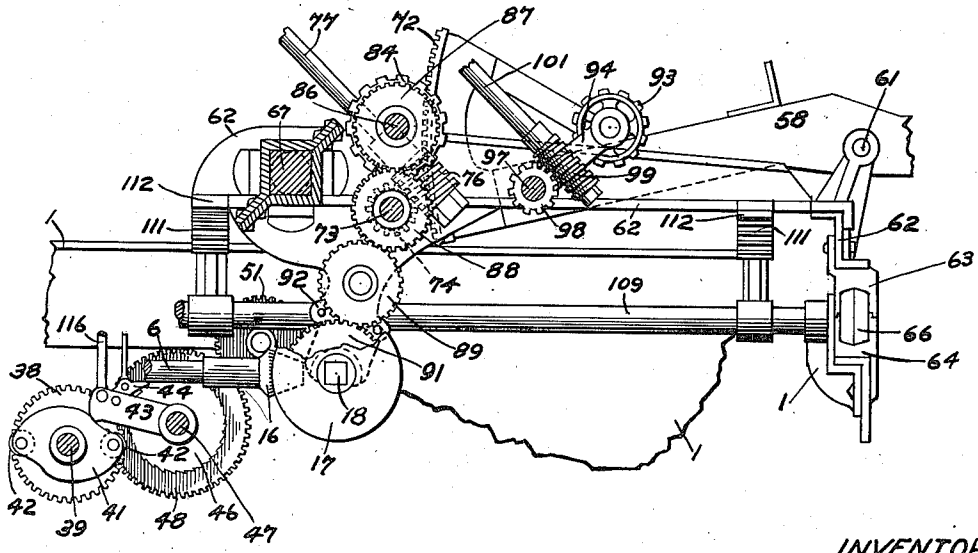


Fig. 6.



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7 SHEETS—SHEET 6.

Fig. 7a.

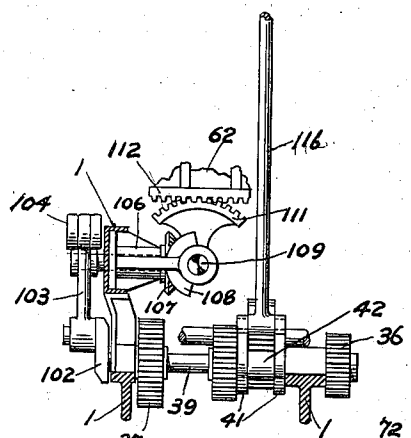

Fig. 7.

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7 SHEETS—SHEET 7.

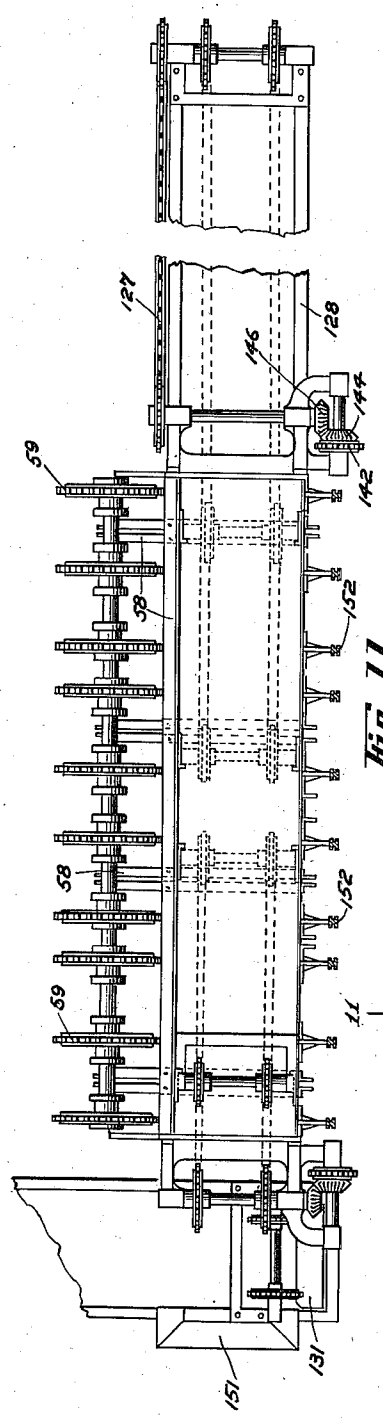

Fig. 8.

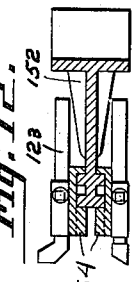

Fig. 12.

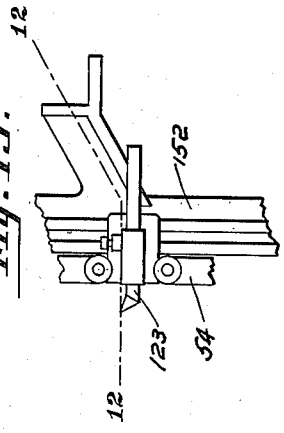

Fig. 13.

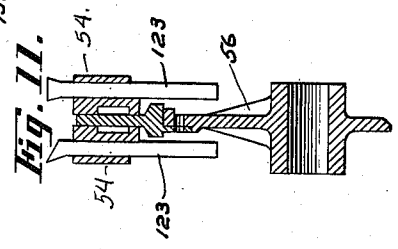

Fig. 11.

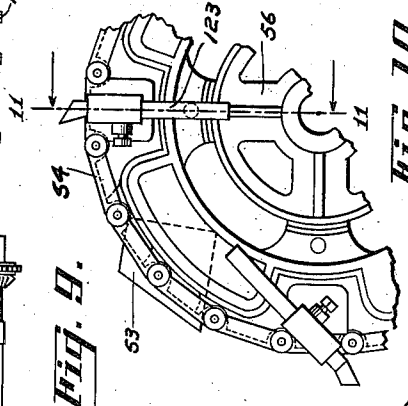

Fig. 9.

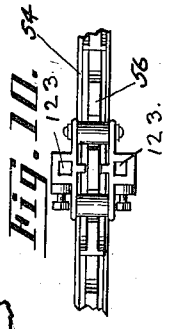

Fig. 10.

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UNITED STATES PATENT OFFICE.

BARTOLOMEW McINTIRE, OF SAN FRANCISCO, CALIFORNIA.

EXCAVATING-MACHINE.

1,306,350. Specification of Letters Patent. Patented June 10, 1919.

Application filed January 19, 1918. Serial No. 213,798.

To all whom it may concern:

Be it known that I, BARTOLOMEW McINTIRE, a citizen of the United States, and a resident of the city and county of San Francisco and State of California, have invented a new and useful Improvement in Excavating-Machines, of which the following is a specification.

The present invention relates to excavating and grading machines wherein tractive elements operate in conjunction with laterally reciprocating digging or excavating elements to provide a continuous path or roadway.

In the present invention I have provided means for automatically reciprocating the digging or excavating elements laterally and at regular intervals for the purpose of providing an excavated path of greater width than the extreme width of the machine.

A main frame is mounted upon steering wheels and caterpillars which traverse the finished path and supports various conveyers for the removal of excavated material as well as the digging or excavating frames.

A sub-frame is slidably mounted upon the main frame and operates in conjunction with mechanism for automatically moving the digging or excavating elements alternately in opposite directions and transversely to the main frame or support, to produce an excavated path or roadway whose width is in excess of the width of the entire machine when operating against or through an embankment or the like thereby providing a path through which the remainder of the machine may pass when the roadway has been finished.

Digging or excavating frames are pivotally mounted upon the sub-frame to permit adjustment of the digging elements relatively to the main frame whereby the gradient of the road may be controlled.

A means for indicating the slope or inclination of the main frame, and consequently of that portion of the roadway on which it rests, is provided whereby the position of the digging elements and the gradient being produced may be determined.

Gradient reducing devices are provided as auxiliaries between the excavating elements and the main frame to remove or decrease any excessive discrepancy in the produced or excavated grade after having been passed by the digging elements.

Primary detachable and adjustable conveyers are provided adjacent the digging elements to receive the excavated material and convey the same to intermediate conveyers which in turn convey to adjustable stackers arranged at the rear of the main frames.

The intermediate conveyers and stacker are also detachable and adjustable to deposit the excavated material at various elevations and distances from the machine, and are also capable of being transferred from one side of the machine to the other to conform with the contour of the adjacent territory and range.

The means for alternately reciprocating the sub-frame and the digging elements transversely to the excavated path are adjustable in that the periods of reciprocation may be increased or decreased to subject the sides adjacent the area exposed to the digging elements to shorter or longer periods in consideration of the nature of said exposed area. A hard, firm soil will naturally resist the digging or excavating elements to a greater extent than a soft sandy loam, therefore in the case of the latter soil the reciprocations will occur at greater frequency than where the soil is rocky, hard and firm.

The various relative positions of the excavating elements, sub-frame and reciprocating means are controlled, adjusted and altered by various controlling elements arranged collectively at a convenient point, as well as the control of the power which operates the machine.

I accomplish these various objects by means of the preferred form of the device disclosed in the drawings forming a part of the present specification wherein like characters of reference are used to designate similar parts throughout the said specification and drawings, and in which—

Figure 1 is a side elevation of my improved excavating machine illustrated as operating against an embankment;

Fig. 2 is a partly broken plan view of Fig. 1; with a portion of the reciprocating mechanism and the excavating elements removed to disclose the supporting structure below;

Fig. 3 is a broken front elevation of Fig. 1 also having a portion of the excavating elements removed to disclose a front eleva-

tion of a portion of the supporting structure;

Fig. 4 is a front elevation of the machine with the entire excavating element and supporting structure therefore removed;

Fig. 4ª is a detailed plan view of the spreading and distributing stacker disclosed in elevation in the lower left hand corner of Fig. 4;

Fig. 5 is a plan view on an enlarged scale disclosing a portion of the main frame and the manner in which the excavating element supporting structure is mounted thereon;

Fig. 6 is a broken side elevation of Fig. 5;

Fig. 7 is a side elevation of the forward portion of the main frame and the excavating element supporting frame disclosing the manner in which the latter is pivotally and slidably mounted, to move laterally or transversely, upon the main frame;

Fig. 7ª is a slightly enlarged detailed end elevation of the left end of Fig. 7;

Fig. 8 is a broken plan view of the forward portion of the excavating element supporting frame and idler sprockets for the bucket carrying chains, with one of the conveyers extended beyond said frame;

Fig. 9 is a broken side elevation of one of the sprockets for carrying the excavators, disclosing the manner in which the cutting knives are carried around said sprockets;

Fig. 10 is a broken plan view of Fig. 9;

Fig. 11 is a vertical sectional view taken on line 11—11 of Fig. 9 in the direction indicated;

Fig. 12 is a horizontal, or transverse sectional view, on an enlarged scale, through one of the vertical guideways of the excavating element supporting frame as shown on line 12—12 on Fig. 13; and

Fig. 13 is a side elevation of Fig. 12.

Referring to the drawings the numeral 1 is used to designate in general what I term a tractor which constitutes the main frame of the machine. A suitable motor 2 is mounted upon the frame 1 and has its shaft 3 operatively connected in any suitable manner with a suitable variable speed transmission mechanism 4 shown in dotted lines in Fig. 2 of the drawings.

A drive shaft 6 extends from the transmission 4 and has loosely mounted thereon a gear 7, which may be connected to the shaft 6 by means of a suitable clutch 8, and a worm 9 also loosely mounted and connectible to said shaft 6 by means of a second clutch 11 to rotate a worm gear 12 to drive the digging and propelling mechanism hereinafter more fully described.

The shaft 6 terminates in a bevel pinion 16 which meshes with and drives a bevel gear 17 mounted upon a transverse shaft 18 on the opposite end of which is loosely mounted a pinion 19 connectible to said shaft 18 by means of a suitable clutch 21, said parts being disclosed in Figs. 5 and 7 of the drawings.

The pinion 19 meshes with a gear 22 mounted upon a shaft 23 and carrying a second pinion 24 which meshes with and drives a gear 26 upon the axle shafts 27 of sheaves 28 which carry caterpillars 29.

For transportation purposes the hereinbefore described propelling mechanism is used to propel the entire machine forward or backward at a constant speed being steered meanwhile by the wheels 31 mounted upon the rear end of the frame 1 and operated by means of any suitable steering mechanism.

In the digging operation, however, it is desired to feed the machine forward intermittently through reduced gearing to reduce the speed of the mechanism and to simultaneously increase the propelling power whereby the digging elements may be held rigidly and unyieldingly to the face of the embankment being excavated.

During the intermittent forward movement the motor 2 is disconnected by releasing the clutch 21.

The following driving mechanism is then brought into use:

The worm 9 is connected to the shaft 6 by means of the clutch 11 to rotate the worm gear 12 on a transverse shaft 6 by means of the clutch 11 to rotate the worm gear on a transverse shaft 31 provided with gears 32, 33 and 34 of various diameters which may be shifted by any suitable type of mechanism, not shown, to mesh separately with gears 36, 37 and 38 thereby forming a variable speed transmission to impart various speeds to the shaft 39 upon which said last mentioned gears are mounted, as disclosed in Fig. 2 of the drawings.

The shaft 39 is provided with parallel cheek plates 41 having diametrically opposed rollers 42 therein arranged, when the shaft 39 is rotated to engage and oscillate an arm 43 carrying a pawl 44 to engage a ratchet 46 secured to a shaft 47 having a gear 48 thereon which may be connected to the shaft 47 by means of a suitable clutch 49 as disclosed as in Fig. 5 of the drawings.

The gear 48 rotates the gear 19 by means of an idler pinion 51 to rotate the caterpillar 29 as hereinbefore described for the constant forward movement.

It is obvious that as the shaft 39 is rotated at variable speeds the rollers 41 will operate the pawl and ratchet 44 and 46 and intermittently move the machine forward.

The excavating or digging elements and their operating and adjusting mechanism consist principally of a series of buckets or scoops 53 mounted upon a series of vertically disposed and parallel endless chains 54 and carried by upper and lower sprockets 56 and 57 respectively, said sprockets being rota-

tably mounted in the upper and lower portions of the excavating frame designated in general by the numeral 58 and also by an idler 59. The frame 58 is pivotally mounted as at 61 to a sub-frame 62 having its forward end mounted to move laterally upon the forward part of the frame 1 by means of runways 63 and 64 engaging rollers 66. The rear end of the frame 62 is slidably mounted upon a square shaft 67 whose outer ends are secured in suitable bearings 69 disclosed in Fig. 2 of the drawings on the sides of the main frame 1. The position of the frame 58 relatively to the sub-frame 62 and the main frame 1 is adjusted by means of pinions 71 which engage toothed sectors 72 secured to the rear of the frame 58 as disclosed in Figs. 1, 2, 5, 6 and 7 of the drawings. The pinions 71 are mounted upon a shaft 73 in turn rotatably mounted upon the frame 62. The shaft 73 is provided with a worm gear 74 in mesh with a worm 76 upon an operating shaft 77. The buckets 53, and chains 54 are rotated by means of a suitable sprocket chain 81 indicated in dotted lines in Fig. 1 of the drawings. This sprocket chain 81 after passing over a main sprocket 82 of a shaft 83 carrying all of the upper sprockets 56 passes over a sprocket 84 on a shaft 86 and connected by means of a clutch 85 to a gear 87 meshing with an idler 88 geared to a gear 89 in turn meshing with a gear 91 slidably mounted upon a shaft 18 as disclosed in Fig. 6 of the drawings. As the frame 62 oscillates connection of the gear 89 with the gear 91 which is mounted on the main frame 1 is maintained by means of extensions 92 on either side of the gear 91 so that as the said frame 62 reciprocates laterally the gear 91 will be moved upon its square shaft 18 thereby continuing to rotate the gear train for operating the buckets and excavating elements hereinabove described. As the position of the frame 58 is adjusted relatively to the sub-frame 62 it is evident that the distance between centers of the sprockets 84 and 82 will be altered. This is adjusted by passing the sprocket driving chain 81 over an idler 93 pivotally mounted between levers 94 secured to a sleeve 96 upon a shaft 97. The shaft 97 is provided with a worm gear 98 in turn operated by a worm 99 on a controlling shaft 101.

The subframe 62 and the digging frame 58 are reciprocated laterally to excavate a path of greater width than said excavating element by means of the mechanism which may be described as follows:

The shaft 39 has mounted on one end thereof a crank 102 having a connecting rod 103 to an arm 104 of greater length than the crank 102 whereby a continuous rotation of the shaft 39 will oscillate the arm 104 and a shaft 106 connected thereto and provided with a sector 107 meshing with a second sector 108 secured to a longitudinally disposed shaft 109 rotatably mounted in the forward end of the main frame 1 and provided with upstanding sectors 111 which engage racks 112 on the lower surface of the sub-frame 62 as disclosed in Figs. 1, 6, 7 and 7[a] of the drawings. It is obvious from the foregoing that as the shaft 39 is constantly rotated, a reciprocation will be imparted by means of the connecting rod 103, arm 104, sectors 107 and 108, shaft 109 and sectors 111 and rack 112, which will reciprocate the digging frame 58 laterally.

Thus it will be seen that while the buckets 53 and other mechanism used for operating the excavating elements are being operated that the machine will be moved forward intermittently by means of the rollers 42 operating the pawl 44 and ratchet 46.

In addition to the number of rotations of the shaft 39 as provided by the transmission formed by the gears 32, 33 and 34 meshing with the gears 36, 37 and 38 respectively as hereinbefore described the amount or degree of the forward movement may be regulated by limiting the period of engaging relation of the rollers 42 with the arm 43 by means of the following described mechanism. A rod 116 leads upward from the outer end of the pawl carrying arm 43 to a sleeve 117 secured to a standard 118 the upper end of the rod 116 being threaded to receive a hand wheel 119. The hand wheel 119 is rotated to lift or lower the arm 43 thereby regulating its period of engaging relation with the rollers 42 so that the pawl 44 may engage various numbers of teeth on the ratchet 46 depending upon the arc through which the said arm 43 is permitted to rotate as adjusted by the rod 116. As the roller 42 lifts the arm 43 the rod 116 sliding through the sleeve 117 raises the wheel 119 but the downward movement of the rod 116 is regulated by said wheel 119 according to its position on said rod 116.

The intermittent forward movement may at any time be suspended by releasing the pawl 44 from the ratchet 46 by means of the rod 121.

The chains 54 are provided with knives or disintegrators 123, those on the outside of the machine being offset as disclosed in Fig. 2 of the drawings to cut a path in excess of the width of the moving parts of the excavating element and the supporting frame 58.

The digging or excavating frame 58 is provided with transverse conveyers 127. When making an excavation, whose contour is as disclosed in Fig. 4 of the drawings, and it is desired to carry the excavated material to this lower side of the road being excavated an extension conveyer 128 is detachably mounted upon that side of the machine adjacent the lower portion of the road.

Under other certain conditions however, it

is desirable to carry the excavated material to the rear of the machine and spread the same evenly over the ground. In this case, I have provided detachable longitudinally disposed conveyers 131 which are pivotally mounted as at 132, in Fig. 2 of the drawings to front bracket 133 and loosely mounted upon brackets 135 screwed upon threaded supports 134. The brackets 133 and conveyers 131 are detachable so as to be capable of being placed on either or both sides of the machine so as to conform to the topography of the ground being excavated. The conveyers 128 are driven from detachable sprockets 139 arranged on each side of the machine over which sprocket chains 141 may be mounted to engage sprockets 142 secured to detachable yokes 143 and having secured thereto bevel gears 144 meshing with bevel gears 146 operatively connected to the detachable conveyers 128.

Thus it will be seen from the foregoing, that the extensible detachable conveyers 128 may be detached or moved from one side of the machine to the other as may be required. The intermediate conveyers 131 are provided with suitable hoppers 151 to receive the excavated material from the conveyers 127 when the excavated material is to be conveyed to the rear of the machine.

Fig. 3 of the drawings discloses one of the intermediate conveyers in position on its bracket 133 on one side of the drawing and on the other side discloses an extended conveyer 128 in position. It is obvious that the position of the extended detachable conveyer 131 may be changed from one side of the machine to the other to conform to the contour of the ground being excavated.

In order to hold the excavating buckets 53 and knives 123 rigidly and unyieldingly against the face of the embankment being excavated I have provided a series of slightly convexed guides 152 on the forward face of the digging frame 58. As the chains 54 and buckets 53 pass upward from the lower sprockets 57 to the upper sprockets 56 said chains are fed onto said guide ways 152, said guide ways in turn delivering the chains onto the upper sprockets 56. A spreading stacker 161 may be detachably secured to the central portion of the main frame 1 on either side of the machine. This stacker is driven by means of a sprocket chain 162 meshing with sprockets 163 on a shaft 165 rotatably mounted on either side of a superstructure 164, and having bevel pinions 166 meshing with bevel gears 167 on a shaft 168 having sprockets 169 on each end thereof from either one of which a sprocket chain 171 may drive the driving shaft 172 of the intermediate or longitudinally disposed conveyer 131.

To indicate the adjustability of parts the intermediate conveyers as well as the stacker 161 are illustrated in different positions in dotted lines in Fig. 4 of the drawings.

The position of the intermediate conveyer 131 may be altered by rotating the same on the bearings 132 of the bracket 133. The length of the chain 171 being adjusted according to the position of the driving shaft 172 to its respective sprockets 169. Either shaft 165, there being one on each side of the machine, is rotated by means of a chain 173 which in turn is driven from a countershaft having a gear 174 meshing with the gear 7 on the shaft 6 as disclosed in Fig. 1 of the drawings.

Power drums 176 are mounted on the upper portion of the superstructure 164 which with the assistance of a frame 177 having a traveler 178 may be utilized to convey the conveyers and extension thereto as well as the stacker 161 from one side of the machine to the other.

Gradient corrective devices for altering or reducing the grade between the bottom of the excavating elements and the front of the caterpillars 29 are provided and operate as follows:

From the main shaft 27 of each caterpillar 29 a pair of arms 179 are pivotally mounted and extend toward the digging elements. A worm conveyer 181 is rotated by means of a sprocket chain 182, in turn operated by means of a gear 183 meshing with a pinion on a shaft 186 provided with a bevel gear 187 meshing with a similar gear 188 on the lower end of a shaft 189, extending upwardly and provided with a beveled pinion 191 meshing with a bevel pinion 192 on the shaft 168 mounted in the upper portion of the superstructure 164.

The worm conveyer 181 may be raised or lowered by means of rods 207 connected to arms 208 on a shaft having a worm gear 209 operated by a worm 211 on an operating rod 212.

A gradient indicating device consisting of a plumb-bob 201 is suspended from the superstructure 164 over a circular plate 202 which may be graduated to indicate the lateral and longitudinal gradients of that portion of the road upon which the machine rests.

In Figs. 9 to 13 inclusive I have illustrated in detail the construction of the chain 54 and the cutting knives 123. In the left hand side of Fig. 9 I have disclosed a modified form of the cutting knives wherein the said knife is arranged at an angle to the chain whereby a longer section of digging member may be used. In Fig. 12 the knife 123 is illustrated as being offset on the outermost chains. It will be seen that this knife extends beyond the mechanism, which extension in conjunction with the laterally

reciprocating feature of the machine tends to produce an excavated path of greater width than the entire width of the machine.

The operation is as follows:

By means of the rod 77, the worm 76 rotates the worm gear 74 on the shaft 73 to rotate the pinions 71 which meshing with the sectors 72 of the digging frame 58 adjusts the position of said frame 58 and the buckets 53 thereon to the required position. The motor 2 operating through its shaft 3 and transmission 4 rotates the shaft 6, pinion 16, bevel gear 17 and square shaft 18, which in turn rotates the gear 91 slidably mounted between the cheek plates 92 carried by the sub-frame 62. The gear 91 in turn operates the train consisting of the gears 89, 88 and 87, the last named being mounted on the shaft 86 which carries the sprocket 84 and drives the chain 81 engaging the sprocket 82 on the shaft 83 rotatably mounted in the upper portion of the digging frame 58 which operates the chains 54 and buckets 53 in the direction indicated by the arrows in Figs. 1 and 7 of the drawings, thereby excavating material from the face of the cliff or embankment as disclosed in Fig. 1 of the drawings. The excavated material carried upward by the buckets or scoops 53 is dumped onto an apron 221 which deflects said material onto the conveyers 127 by means of which said material is conveyed into the forward end of the intermediate or longitudinal conveyer 131. The conveyer 131 in turn carries the excavated material to the stacker 161 which is provided with a series of openings 223 adjusted or controlled by shutters 124 as disclosed in Fig. 4ª of the drawings so that said excavated material may be spread over a portion of the adjacent territory or by closing the shutters 124 the material may be stacked a distance from the excavated road. The outer end of the stacker 161 may be raised or lowered to conform to the contour of the locality by means of a guy line 229 extending from one of the drums 176.

While the excavating buckets 53 are being operated the machine is moved forward intermittently by means of the worm 9 on the shaft 6 which rotates the gear 12 on the shaft 31 to rotate the gear 32 and the shaft 39 to rotate the rollers 42 between the cheek plates 41 thereby operating a pawl 44 and the ratchet 46 which intermittently, through the train of gears hereinbefore described, operates the caterpillars 29 to move the machine forward at regular intervals.

It is obvious that by connecting the gears 36, 37 or 38 with either of the gears 32, 33, or 34 respectively on the shaft 31 that the frequency of operation of the pawl 44 may be regulated and adjusted as well as increasing or decreasing the power by means of which the machine is moved forward.

While the machine is being moved forward intermittently, the sub-frame 62 and excavating frame 58 are reciprocated laterally by means of the sectors 111 operating on the racks 112 on the under surface of said frame 62, said sectors 111 being in turn operated by the shaft 109, sectors 108, 107 and the arms 104, connecting rod 103 and crank 102 on the end of the shaft 39 as hereinbefore described.

It is obvious from the foregoing that I have provided an improved excavating machine adapted to excavate a comparatively finished roadway as well as means for reciprocating the excavating elements laterally to produce an excavation of greater width than the width of the machine.

It is also obvious that I have provided improved means for indicating the transverse and longitudinal gradient being produced as well as means for altering said gradient after being excavated.

The details of construction are so susceptible to variation that I do not wish to confine myself to the precise construction shown herein but rather to avail myself of any modification that may fall properly within the scope of the invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is—

1. An excavating machine comprising a tractor; excavating elements slidably mounted to move transversely upon the tractor; means for reciprocating the excavating elements to excavate a path or roadway of greater width than the extreme width of said excavating elements; and means for regulating the frequency of the reciprocating mechanism to subject the side or face of an excavation to longer or shorter periods of contact with the excavating element in proportion to the density of the material being excavated.

2. An excavating machine comprising a main frame; means for supporting and transporting the main frame; excavating elements movably and pivotally mounted upon the main frame whereby said elements may be altered relatively to the main frame to produce various gradients; and adjustable gradient corrective means mounted between the main frame and the excavating elements to alter the gradient as produced by said excavating elements.

3. An excavating machine comprising a main frame; means for supporting and transporting the main frame; excavating elements movably and pivotally mounted upon the main frame whereby said elements may be altered relatively to the main frame to produce various gradients; and adjust-

able gradient corrective means mounted between the main frame and the excavation elements to alter the gradient as produced by said excavating elements; and means for indicating the gradient of that portion of the finished roadway on which the main frame is resting.

4. An excavating machine comprising a tractor; excavating elements pivotally and slidably mounted upon the tractor; means for laterally reciprocating the excavating elements upon the tractor; means for regulating and controlling the frequency of said reciprocations as produced by the reciprocating means; means for altering the relative position of the excavating elements to the tractor; and means for conveying excavated material from the excavating elements and conveying said material beyond the machine.

5. An excavating machine comprising a tractor; excavating elements slidably and pivotally mounted upon the tractor; means for reciprocating laterally the excavating elements to produce an excavation of greater width than the machine; a detachable stacker arranged to be attached to either side of the machine; conveyers for conveying excavated material from the excavating elements; and intermediate conveyers for conveying said material from the conveyers to the stackers.

6. An excavating machine comprising a tractor; excavating elements slidably and pivotally mounted upon the tractor; means for reciprocating laterally the excavating elements to produce an excavation of greater width than the machine; a detachable stacker arranged to be attached to either side of the machine; conveyers for conveying excavated material from the excavating elements; and intermediate conveyers for conveying said material from the conveyers to the stackers; and means for indicating the gradient of the excavation as produced by the excavating elements; and gradient reducing devices arranged between the excavating elements and the tractor to reduce the grade of the excavation after having been passed by said excavating elements.

7. An excavating machine comprising a tractor; excavating elements slidably and pivotally mounted upon the tractor; means for automatically reciprocating the excavating elements transversely to the tractor to excavate a path of greater width than the width of the machine; conveyers for receiving excavated material from the excavating elements; a detachable stacker arranged to be mounted on either side of the machine; and means for conveying excavated material from the conveyers to the stackers.

In witness whereof I hereunto set my signature.

BARTOLOMEW McINTIRE.