S. W. BLEVINS.

GRADING MACHINE.

APPLICATION FILED DEC. 6, 1913.

1,120,179.

Patented Dec. 8, 1914.

5 SHEETS—SHEET 1.

Fig. 1.

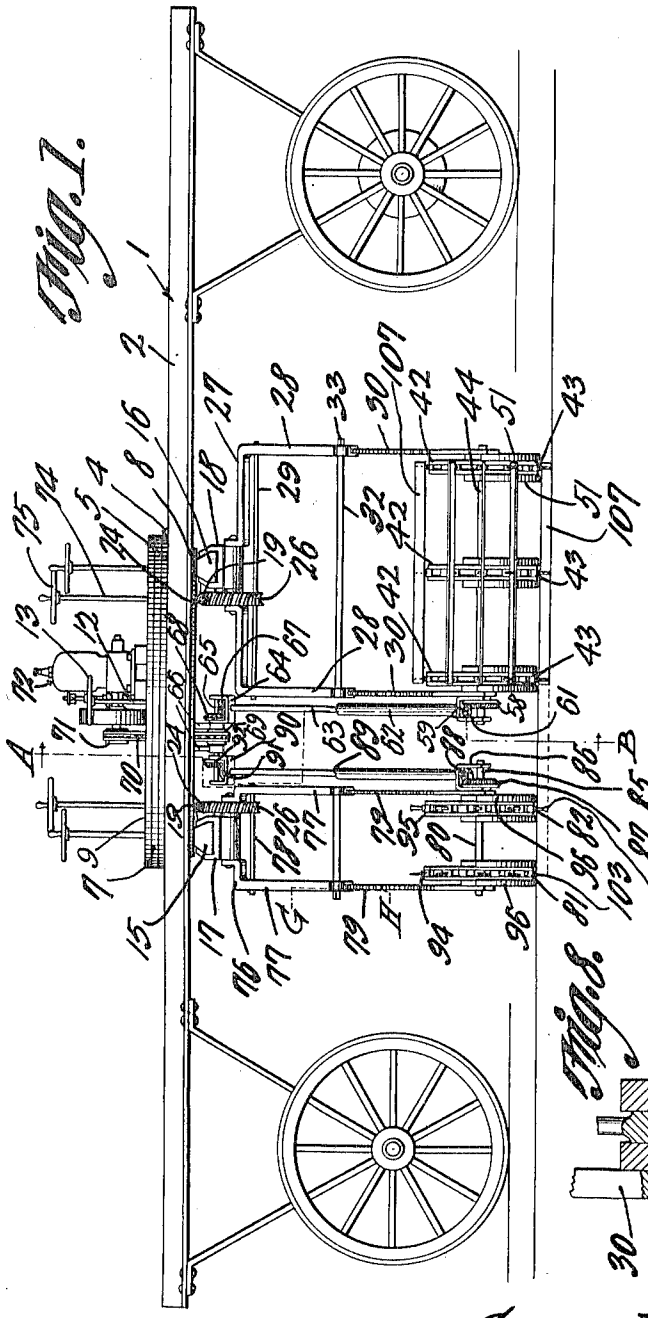


Fig. 14.

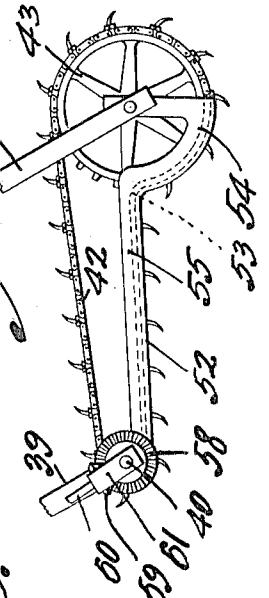


Fig. 9.

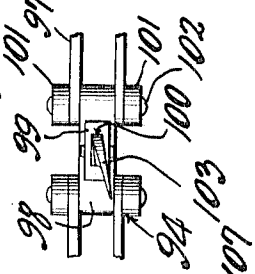
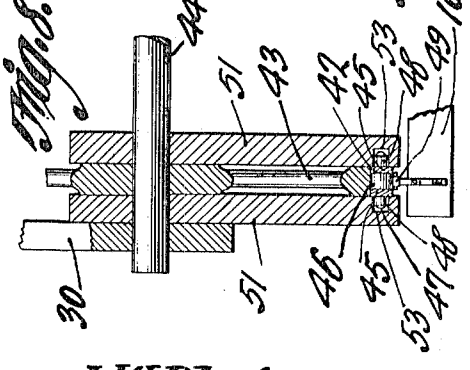


Fig. 8.



Witnesses

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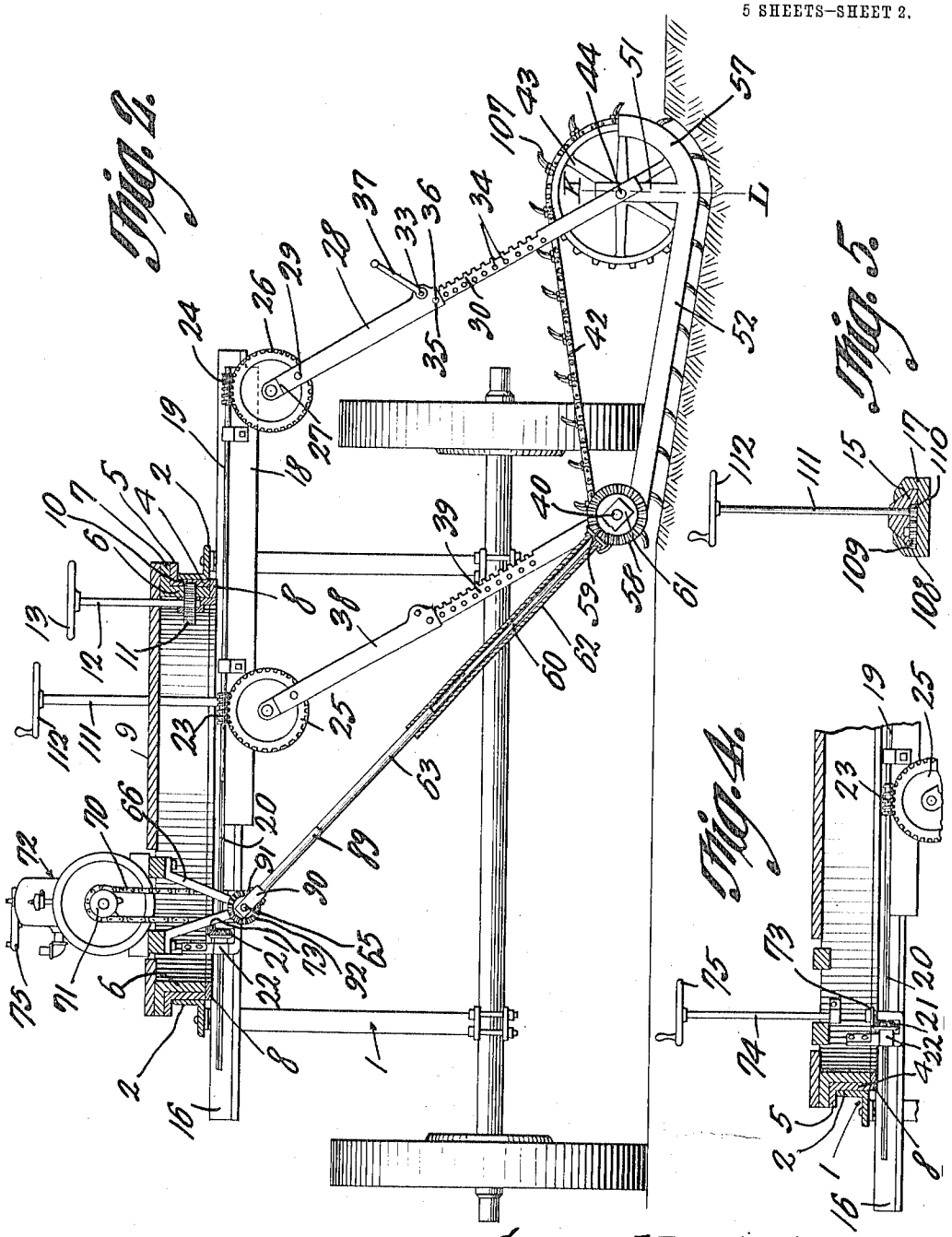
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5 SHEETS—SHEET 2.



Witnesses

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5 SHEETS—SHEET 3.

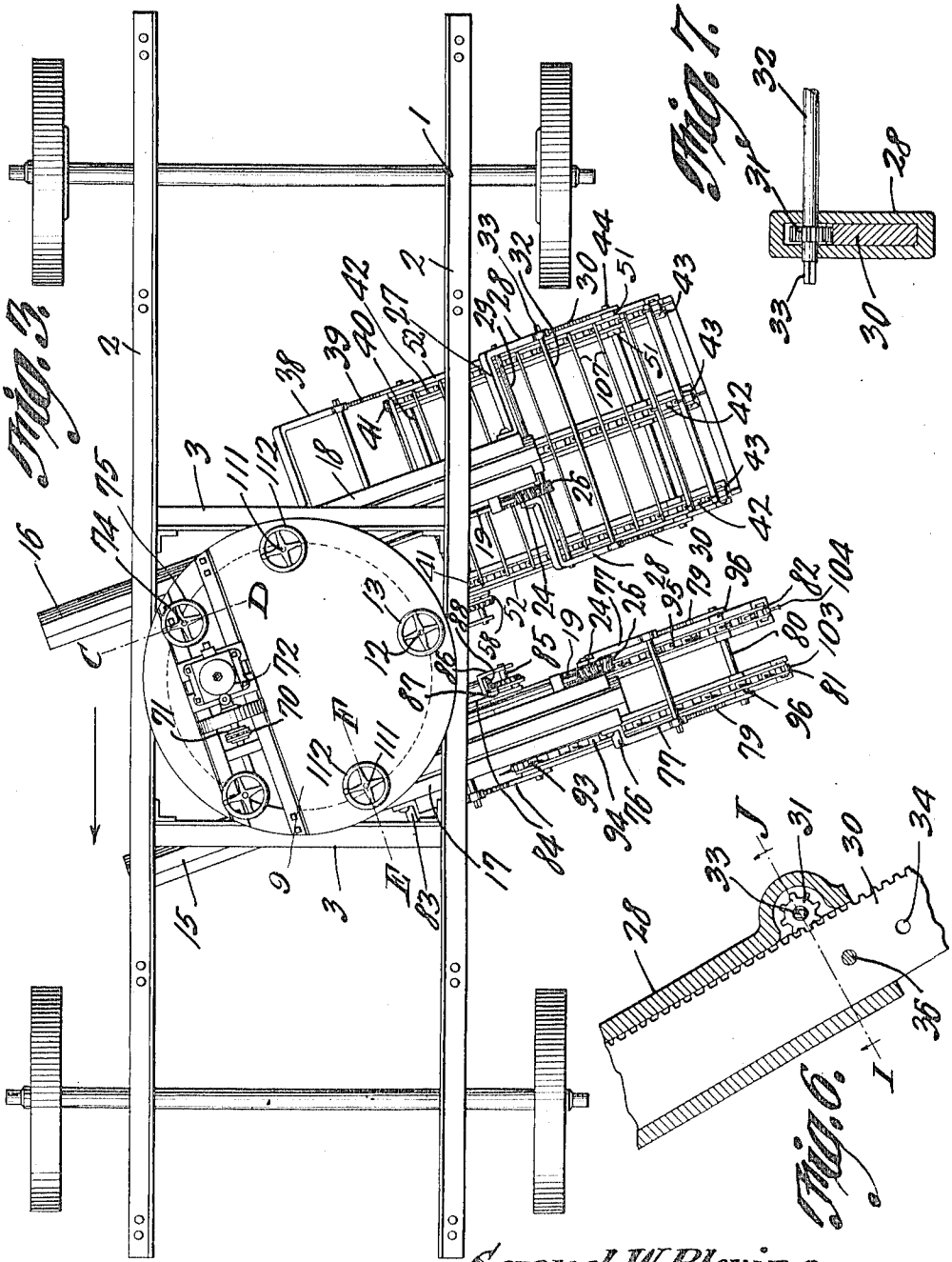


Fig. 5.

Fig. 7.

Fig. 6.

Witnesses

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5 SHEETS—SHEET 4.

Fig. 15.

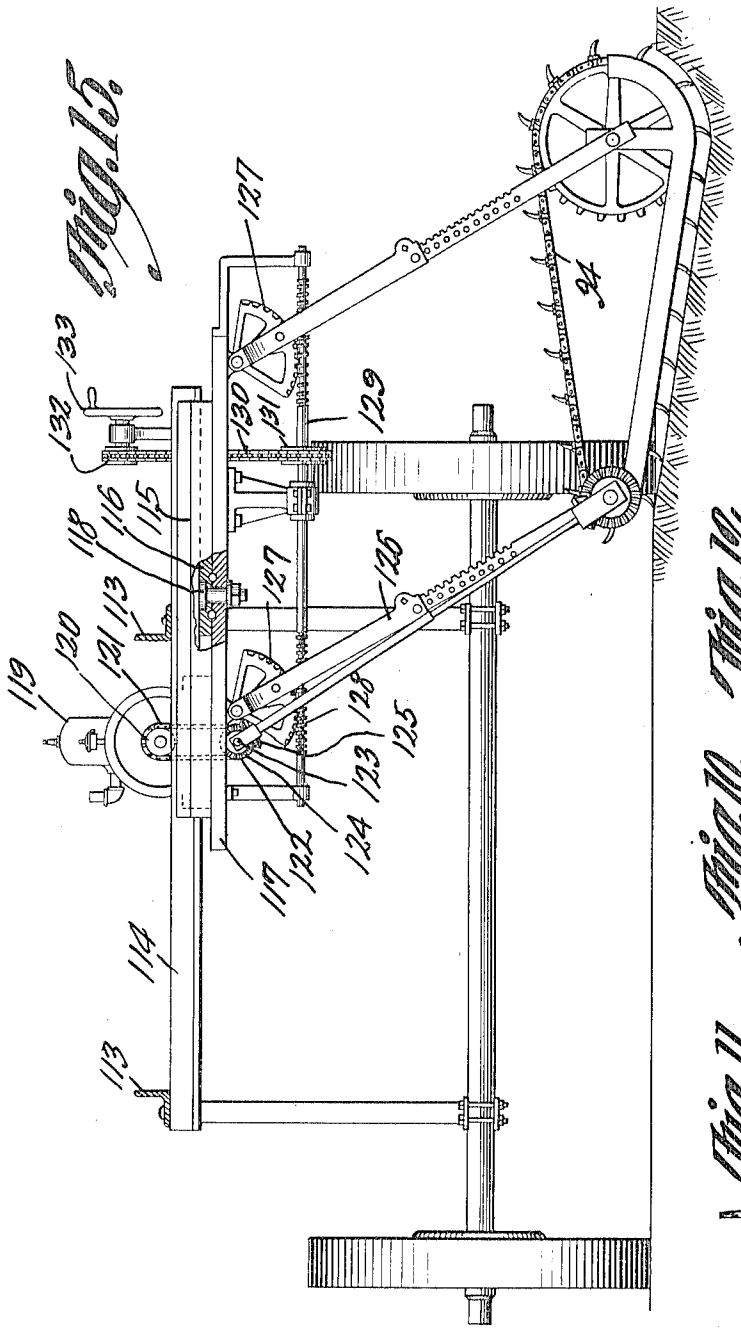


Fig. 13.

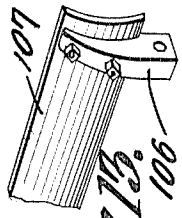


Fig. 12.

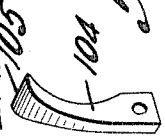


Fig. 10.

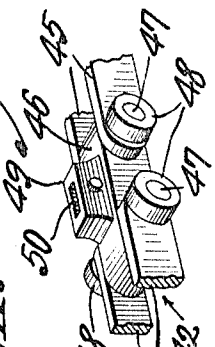
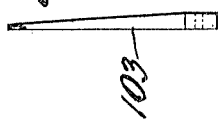


Fig. 11.



Witnesses

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5 SHEETS—SHEET 5.

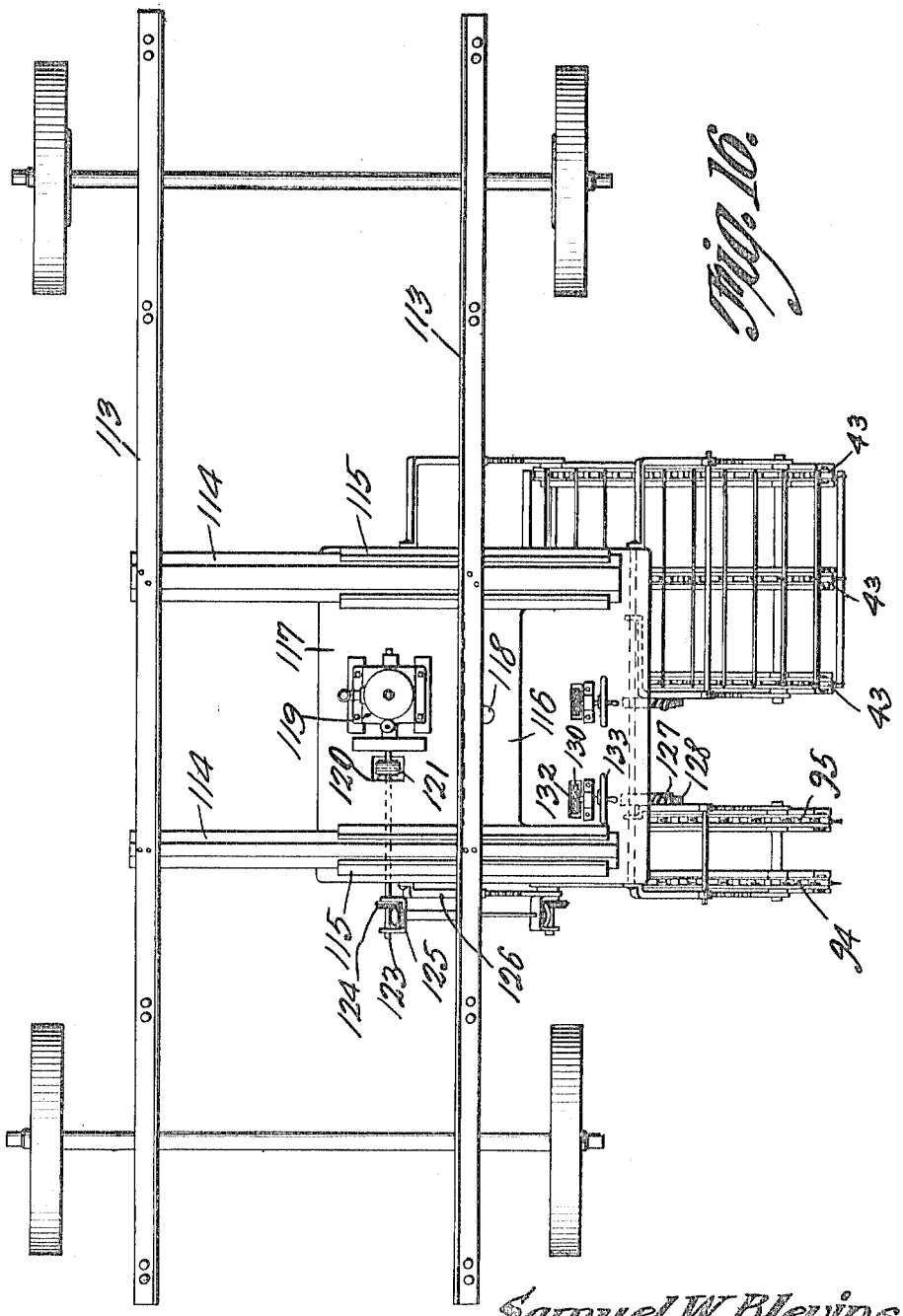


Fig. 10.

Witnesses

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UNITED STATES PATENT OFFICE.

SAMUEL W. BLEVINS, OF COOPER, TEXAS, ASSIGNOR TO COOPER ROAD MACHINE CO., OF COOPER, TEXAS.

GRADING-MACHINE.

1,120,179. Specification of Letters Patent. Patented Dec. 8, 1914.

Application filed December 6, 1913. Serial No. 805,151.

To all whom it may concern:

Be it known that I, SAMUEL W. BLEVINS, a citizen of the United States, residing at Cooper, in the county of Delta and State of Texas, have invented a new and useful Grading-Machine, of which the following is a specification.

This invention relates to grading machines particularly designed for use in building roads, although it is to be understood that the same can be employed for various other purposes.

One of the objects of the invention is to provide soil engaging elements arranged in an endless series extended laterally or obliquely beyond one side of the main structure of the machine, means being provided whereby the said soil engaging elements can be adjusted angularly either horizontally or vertically thereby to bring them into desired relation to the surface of the soil and to the main supporting structure.

Another object is to provide means whereby the soil engaging elements can be actuated in any positions to which they may be adjusted and during such adjustment.

A further object is to provide means whereby the soil engaging elements can be raised and lowered bodily relative to the soil and whereby they can be shifted into or out of active positions beyond one side of the main supporting structure.

A further object is to provide soil engaging elements so shaped as to eliminate back drag upon the chain or other flexible structure carrying them, thus to prevent the said carrying chain from becoming distorted or breaking under the transverse strains to which it might be subjected during the actuation of the machine.

A further object is to provide a machine of this character utilizing cutting and scraping elements, the cutting elements being disposed in advance of the scraping elements and being adapted to loosen the soil while the scraping elements are adapted to gather the loose soil and drag it laterally into position under the main supporting structure.

A further object is to provide a machine of this character which will not only operate to properly grade a road or the like, but can also be used for forming ditches along the sides of the road and for removing or trimming banks.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed, can be made within the scope of what is claimed, without departing from the spirit of the invention.

In the accompanying drawings the preferred forms of the invention have been shown.

In said drawings:—Figure 1 is a side elevation of the machine. Fig. 2 is a section on line A—B Fig. 1. Fig. 3 is a plan view of the machine, the soil engaging elements being shown adjusted to extend obliquely beyond one side of the main supporting structure. Fig. 4 is a section through the turntable on the line C—D Fig. 3 and showing the means employed for shifting one of the soil engaging structures angularly in a vertical plane. Fig. 5 is an enlarged section through the turntable on the line E—F Fig. 3 and showing the means provided for shifting one of the soil engaging structures horizontally relative to the turntable and main supporting structure. Fig. 6 is a section on line G—H Fig. 1, said section being on an enlarged scale. Fig. 7 is a section on line I—J Fig. 6. Fig. 8 is a section on line K—L Fig. 2, this section being on an enlarged scale. Fig. 9 is a detail view of one of the cutting blades and the adjacent portion of its supporting chain. Fig. 10 is a perspective view of a portion of another chain. Fig. 11 is an edge view of the blade shown in Fig. 9. Fig. 12 is a perspective view of a digging element designed to be used in connection with the blade shown in Fig. 9. Fig. 13 is a perspective view of a portion of a scraping blade. Fig. 14 is a side elevation of one of the soil engaging structures and showing a guide whereby the soil engaging elements are conveyed along lines to produce a ditch. Fig. 15 is a view similar to Fig. 2 but showing a modified form of machine. Fig. 16 is a plan view of the structure shown in Fig. 15.

Referring to the figures by characters of reference 1 designates a wheel supported main structure which, in the present instance, includes a frame made up of side angle beams 2 and intermediate cross angle beams 3. This frame can either be a part of

a vehicle to be drawn or propelled along a road or the like, or it can be part of a car platform.

Secured to and between the beams 2 and 3 is a ring 4 having an outstanding annular flange 5 at its upper edge. This ring serves to support another ring 6 having an outstanding annular flange at its upper edge as shown at 7, the ring 6 fitting within the ring 4 and the flange 7 bearing downwardly on the flange 5. In order that the ring 6 may be prevented from lifting up out of the ring 4, a retaining ring 8 is bolted or otherwise secured to the lower edge of the ring 6 and extends under the lower edge of the ring 4. A circular platform 9 is carried by the ring 6, this ring and platform thus forming a turntable. Gear teeth are formed upon the inner surface of the ring 4, as shown at 10 and are engaged by a gear 11 secured to the lower end of a shaft 12 which, as shown in Fig. 2, extends upwardly through the platform 9 and is provided with a hand wheel 13 or the like whereby it can be rotated readily. Gear 11 extends through a slot 14 in the ring 6 as shown in Fig. 2. Thus it will be seen that when the shaft 12 is rotated, gear 11 will travel along the teeth 10 within the ring 4, thus causing the turntable to rotate upon the ring 4.

Secured to the retaining ring 8 so as to rotate with the turntable, are parallel guide beams 15 and 16 respectively, these beams being spaced apart a distance slightly less than the diameter of the turntable and each beam having its sides converging upwardly, as shown in Fig. 1. The beams extend beyond the turntable and beam 15 is engaged by a slidable carriage 17 while the beam 16 is engaged by a slidable carriage 18. The two carriages are of the same construction and each of them has a longitudinally extending shaft 19 journaled thereon, this shaft having its rear portion squared, as shown at 20 and extending slidably through a gear 21 which is supported by the shaft within a bracket 22 depending from the ring 6. Shaft 19 has inner and outer worms 23 and 24 respectively which rotate therewith, the worm 23 engaging a worm gear 25 which is supported by the carriage while the worm 24 engages a worm gear 26 likewise supported by the carriage. Pivotally connected to the carriage 18 so as to swing about the axis of the gear 26 are angular frame members 27 having depending arms 28 which are parallel and which are preferably connected together by a rod 29 which extends through the gear 26 thus to insure against independent movement of the frame members 27 and the gear 26. In other words, by arranging the parts in the manner described, the frame members 27 and the gear 26 will always move together about the axis of the gear.

The arms 28 are in the form of flat tubes in which racks 30 are adapted to slide, the teeth on these racks being engaged by gears 31 which are secured to the end portions of a transverse shaft 32 journaled in the arms 28. One end of shaft 32 can be angular, as shown at 33, so as to be engaged by a crank or other device whereby the shaft can be rotated readily for the purpose of raising or lowering the racks 30 relative to the arms 28. The racks have series of apertures 34 therein adapted to be brought into register with apertures 35 in the tubular arms 28 and holding pins 36 may be inserted into the registering openings, thus to secure the racks against movement relative to the arms 28. A crank for use in rotating the shaft 32 has been shown at 37 in Fig. 2.

Arms 38 similar to the arms 28 are secured to the inner portion of the carriage 18 and to the gear 25 so as to rotate with this gear and these arms 38 have racks 39 similar to the racks 30 and which are adjustable in the same manner as said racks 30.

A shaft 40 is journaled in the lower ends of the racks 39 and has sprockets 41 on which are mounted endless chains 42, these chains extending over sprockets 43 mounted on a shaft 44 which is supported by the racks 30. Chain 42 is made up of links 45 arranged in pairs and lapping and pivotally connected to interposed blocks 46, the pivot pins 47 which serve to connect the blocks and links, being projected beyond the sides of the links 45 so as to constitute bearings for rollers 48. Each block 46 has a boss 49 outstanding from the center thereof and provided with a socket 50.

Hangers 51 extend downwardly from the shaft 44 and are disposed in pairs, each sprocket 43 being extended between the hangers of one pair, as shown in Fig. 8. These hangers project, at their lower ends, from guide rails 52 having grooves 53 in their inner faces and within which the rollers 48 are adapted to travel. As shown in Fig. 14, the guides 52 can be provided with arcuate portions 54 concentric with the sprockets 43, these arcuate portions extending upwardly to and merging into straight guide portions 55 extending up to the sprockets 41. Thus it will be seen that the lower flights of the chains are held by the guides against upward movement while the machine is in operation. Instead of providing guides formed with arcuate portions such as shown at 54, guides such as illustrated in Fig. 2 may be utilized. In this figure each guide 52 extends straight from the large sprocket to the small sprocket in back thereof and the front end of each guide is curved upwardly in front of the large sprocket, as shown at 57 and is concentric therewith. Where this form of guide is used the lower flight of the chain is extended di-

rectly from one sprocket to the other whereas when a guide such as shown in Fig. 14 is provided, the lower flight of the chain is extended along an indirect line for the purpose hereinafter set forth.

Secured to the shaft 40 is a gear 58 which meshes with a small gear 59 secured to a shaft 60. This shaft is journaled within a yoke 61 mounted on shaft 40 and from which extends a tubular guide 62. A tubular shaft section 63 is slidably mounted in the guide and is slidably mounted on the shaft 60, said shaft 60 being angular in cross sectional contour and fitting snugly within the shaft section 63 so that when said shaft section 63 is rotated, motion will be transmitted therefrom to the shaft 60. The shaft section 63 bears snugly within the guide 62 and sagging of the telescopic shaft made up of the sections 60 and 63 is thus prevented. Shaft section 63 is journaled at its upper end within a bracket or yoke 64 carried by a shaft 65 which is journaled in brackets 66 depending from the platform 9 of the turntable. A gear 67 is secured to the telescopic shaft section 63 and meshes with a gear 68 secured to shaft 65. A sprocket 69 is secured to shaft 65 and receives motion, through a chain 70, from a sprocket 71 which is driven by a motor 72 mounted on the turntable.

The arms 28 and 38 are constantly parallel and in order that they may be adjusted angularly about their respective axes, it is merely necessary to rotate the shaft 19 so that the worms 23 and 24 will rotate the respective gears 25 and 26 in unison. While the arms are thus being swung upwardly or downwardly, the shaft sections 60 and 63 will slide relative to each other so that the telescopic shaft formed thereby will thus be either elongated or shortened. Rotation of shaft 19 is effected by means of a gear 73 secured to the lower end of an upwardly extending shaft 74 which is carried by the turntable and is provided with a handle 75 or the like whereby it can be rotated.

The slidable carriage 17 is provided with angular frame members 76 which are similar to the frame members 27 with the exception that their parallel arms 77 are much closer together than are the arms 28. These arms 77 are connected by a cross rod 78 which passes through the gear 26 so as to insure movement of the frame members with the gear.

The racks 79 which are slidably mounted in the arms 77 and are adjustable in the same manner as are the racks 30, support, at their lower ends, a shaft 80. This shaft has large sprockets 81 and 82 secured thereto. Pivotally connected to the inner portion of the carriage 17 are frame members 83 similar to the frame members 76, these frame members 83 being adapted to rotate with the gear 25 and being connected thereto in the same manner as the arms 38 are connected to the other gear 25. These frame members 83 have racks 84 slidably connected thereto, these racks being mounted in the same manner as are the racks 39 and carrying, at their lower ends, a shaft 85 on one end portion of which is mounted a yoke 86 similar to yoke 61. A gear 87 is secured to shaft 85 and within yoke 86 and meshes with a gear 88 secured to the lower end portion of a telescopic shaft 89 which is similar to the shaft 60—63 hereinbefore described. The upper end of the telescopic shaft 89 is journaled in a yoke 90 supported by shaft 65 and a gear 91 is secured to the upper end of shaft 89 and meshes with a gear 92 secured to shaft 65. Thus it will be seen that when shaft 65 is rotated, the two shafts 60—63 and 89 will be rotated together and will operate to drive the shafts 40 and 85 at the same speed.

Shaft 85 has small sprockets 93 secured thereto, these sprockets engaging endless chains 94 and 95 respectively which engage the sprockets 81 and 82 respectively. Hangers 96 extend downwardly from the shaft 80 and carry guides of the same type as those hereinbefore described and which have been illustrated at 56 and 57 in Fig. 2 and at 54 and 55 in Fig. 14. In other words, when the form of guide shown in Fig. 2 is used in connection with the shaft 44, the same type of guide is used in connection with shaft 80 but, should the guide shown in Fig. 14 be substituted for that shown in Fig. 2, the same kind of a guide will be used in connection with the chains 94 and 95. These chains 94 and 95 are of the same construction as that shown in detail in Fig. 9, each including links 97 arranged in pairs and lapping and pivotally connected to interposed blocks 98 provided with bosses 99 in which are formed sockets 100. Rollers 101 are mounted on the pivot pins 102 which extend through the blocks and links, these rollers being adapted to travel in the guides provided therefor.

The sockets 100 in the chain 94 are adapted to receive cutting blades or teeth 103 which, as shown in Figs. 9 and 11, are pointed and slightly curved, each tooth being slightly twisted so that the side faces of the tooth extend obliquely across the boss 99.

The sockets in chain 95 and which are similar to the sockets 100 receive small plows 104, one of which has been shown in detail in Fig. 12. Each plow has its sides diverging outwardly and its free end portion curved up to a straight edge 105 which is parallel with the pivots of the chain. The sockets 50 carried by the bosses 49 are adapted to receive shanks 106 extending from the end portions of scraping blades 107, these blades extending across the chains carried by the sprockets 43 and serving to

connect the same. Each blade will of course be provided with an intermediate shank 106 for extending into one of the sockets in the intermediate chain 42.

Each carriage 17 and 18 has gear teeth 108 formed along the inner side thereof and each guide beam 15 and 16 has a gear 109 therein meshing with the teeth 108 and also with a gear 110 secured to an upwardly extending shaft 111. This shaft is provided with a hand wheel 112 or the like whereby it can be rotated readily, the shaft 111 extending through the platform 9 of the turntable. Thus it will be seen that when shaft 111 is rotated, the carriage upon the guide beam adjacent thereto will be shifted longitudinally in either direction desired, thus to project the carriage beyond one side of the main supporting structure or to retract it back to position under the turntable.

The machine herein described is adapted to be propelled in any suitable manner. When it is employed for cutting or scraping extremely soft soil or sand, the guide beams 15 and 16 can be extended at right angles to the path of movement of the machine and, by means of the shaft 111, the carriages 17 and 18 can be shifted outwardly to any desired distances beyond one side of the machine. Where ordinary grading is to be done a guide such as shown at 52 in Fig. 2 is employed in connection with each chain and the racks 34, 39, 79 and 84 are adjusted longitudinally so as to support the various chains at desired distances from the gears 26 and 25. This adjustment will also bring the lower flights of the chains at desired angles to the horizontal.

The gears 25 and 26 upon the two carriages are rotated by means of the mechanisms provided therefor so as to support the various chains out of contact with the ground, and, after the machine has been brought to position where the grading is to take place, the various chains are lowered, shaft 65 is actuated, and the machine is caused to travel slowly forward. All of the chains will be driven in the same direction and the cutting teeth 103 will dig into the soil thus loosening it, while the plows 104 which are brought forward by the advancing machine, will further loosen the soil. The scraping blades 107 which are ultimately advanced to the points where the cutting and plowing has taken place, will engage the loosened soil and drag it laterally to position under the turntable. Thus, in the building of a road, the dirt will be scraped from the sides of the road and drawn toward the center thereof. Upward yielding of the chains while in operation is prevented by the guides provided therefor. Obviously by utilizing a guide such as shown in Fig. 14, the soil engaging devices carried by the chains will operate not only to produce the proper pitches or crown to the road being constructed but will also produce a ditch or gutter along the side of the road.

When the machine is acting upon hard soil it is not practical to have the chains extending at right angles to the path of movement but, instead, it is necessary to swing them rearwardly so that they will extend obliquely to the path of movement as shown for example in Fig. 3. Thus as the machine moves forward, the soil engaging elements will be pulled forwardly against the soil and the tendency of breaking off said elements is thus reduced.

Importance is attached to the fact that the cutting teeth 103 are obliquely disposed relative to their bosses 99. With this arrangement the back diagonally disposed faces of the teeth while working against the sides of the cuts produced tend to press the said teeth forwardly thus counter-acting any tendency of the soil to pull back upon the teeth.

Importance is attached to the fact that the various soil engaging elements and the chains carried thereby can be quickly adjusted laterally relative to the main supporting structure by means of the mechanism shown in detail in Fig. 5 and can be quickly raised and lowered out of and into contact with the soil, this last adjustment being effected by rotating the gears 25 and 26. It will be noted, furthermore, that by providing the adjustable connections between the various depending tubular arms 28, 38, 77 and 83, the chains can be raised at any desired angles to the surface of the soil so as thus to produce a desired crown upon the road. Furthermore by elevating the outer portions of the chains the mechanism can be used efficiently for trimming down banks along a road.

When the machine is not in use the carriages 17 and 18 can be adjusted to positions close to one side of the machine and the various chains can be swung upwardly out of engagement with the soil and, when thus elevated, will not project undesirable distances beyond the sides of the main supporting structure. Consequently, the machine can then be conveniently transported from place to place.

In Figs. 15 and 16 a modified form of machine has been illustrated. This machine utilizes the same means as has already been described for cutting, plowing and scraping the soil and the same means for adjusting the soil engaging elements upwardly and downwardly so as to be held at desired angles relative to the horizontal. The modified structure differs from that heretofore described, however, in that the side beams 113 of the main supporting frame are connected by fixed guide rails 114

which are not capable of swinging as are the guide rails or beams 15 and 16. These guide rails or beams 114 are engaged by slides 115 extending from the sides of a movable platform 116 to which the turntable 117 is connected, this turntable being supported under the platform and held thereto by a pivot member 118 shown in Fig. 15. The motor 119 is carried by the turntable and motion is transmitted therefrom through a sprocket 120 and a chain 121 to a sprocket 122 secured to a shaft 123 carried by the turntable and which, in turn, transmits motion through gears 124 and 125 to the chain actuating shafts. The means for swinging the chain supporting arms 126 includes worm gears or segments 127 engaging worms 128 carried by shafts 129 which may be rotated in any suitable manner, as by means of a chain 130 engaging sprockets 131 and 132, there being a hand wheel 133 or the like for rotating sprocket 132. These parts are all carried by the turntable.

The structure differs from that previously described primarily in that the carriages 115 cannot be adjusted forwardly independently of each other. In the preferred structure herein described, this independent adjustment of the carriages 17 and 18 can be effected so that it thus is possible to move the chains 94 and 95 greater or lesser distances beyond the sides of the main supporting structure than the chains on the sprockets 43.

What is claimed is:—

1. A grading machine including a main supporting structure, a turntable carried thereby, elements suspended from the turntable, means for simultaneously swinging said elements, an endless series of soil engaging devices carried by said elements, means carried by the turntable for actuating said series of devices independently of said swinging movement of the elements and a slidable connection between said elements and the turntable.

2. A grading machine including a main supporting structure, a turntable carried thereby, parallel telescopic elements suspended from the turntable, means for simultaneously swinging said elements, an endless chain supported by the elements, soil engaging devices carried by the chain, means carried by the turntable for actuating the chain independently of said swinging movement of the telescopic elements, and a slidable connection between said elements and the turntable.

3. A grading machine, including a main supporting structure, a turntable carried thereby, a member slidable on the turntable parallel telescopic elements suspended from the said member, means for simultaneously swinging said elements, an endless chain supported by the elements, soil engaging devices carried by the chain, means carried by the turntable for actuating the chain independently of said swinging movement of the telescopic elements, and means for shifting said slidable member horizontally relative to the turntable.

4. A grading machine including a main supporting structure, a turntable carried thereby, parallel telescopic elements suspended from the turntable, means for simultaneously swinging said elements, an endless chain supported by the elements, soil engaging devices carried by the chain, means carried by the turntable for actuating the chain independently of said swinging movement of the telescopic elements, said elements being slidable horizontally relative to the main supporting structure.

5. A grading machine including a main supporting structure, a turntable carried thereby, longitudinally adjustable elements disposed in pairs and extended from the turntable, an endless series of soil loosening devices supported by one pair of elements, an endless series of soil scraping devices carried by the other pair of elements, said devices being movable along lines intersecting the path of movement of the main supporting structure, and means for independently adjusting said series of soil engaging devices angularly in vertical planes.

6. A grading machine including a main supporting structure, a turntable carried thereby, longitudinally adjustable elements disposed in pairs and extended from the turntable, an endless series of soil loosening devices supported by one pair of elements, an endless series of soil scraping devices carried by the other pair of elements, said devices being movable along lines intersecting the path of movement of the main supporting structure, and means for independently swinging said series of soil engaging devices bodily in vertical planes.

7. A grading machine including a main supporting structure, a turntable carried thereby, longitudinally adjustable elements disposed in pairs and extended from the turntable, an endless series of soil loosening devices supported by one pair of elements, an endless series of soil scraping devices carried by the other pair of elements, said devices being movable along lines intersecting the path of movement of the main supporting structure, means for independently swinging said series of soil engaging devices bodily in vertical planes, and means for simultaneously actuating the soil engaging devices independently of said adjustment.

8. A grading machine including a main supporting structure, a turntable carried thereby, longitudinally adjustable elements disposed in pairs and extended from the turntable, an endless series of soil loosening devices supported by one pair of elements,

an endless series of soil scraping devices carried by the other pair of elements, said devices being movable along lines intersecting the path of movement of the main supporting structure, means for independently swinging said series of soil engaging devices bodily in vertical planes, and means for horizontally adjusting all of the soil engaging devices bodily and in unison.

9. A grading machine including a main supporting structure, a turntable carried thereby, longitudinally adjustable elements disposed in pairs and extended from the turntable, an endless series of soil loosening devices supported by one pair of elements, an endless series of soil scraping devices carried by the other pair of elements, said devices being movable along lines intersecting the path of movement of the main supporting structure, means for independently swinging said series of soil engaging devices bodily in vertical planes, all of said soil engaging devices being constantly movable along parallel paths.

10. A grading machine including a main supporting structure, a turntable thereon, separate endless series of soil engaging devices suspended from and movable with the turntable, means for independently swinging said series of soil engaging devices upwardly and downwardly relative to the turntable and without changing their angles to the surface of the soil, and means for independently adjusting said series of soil engaging devices to change their angles relative to the surface of the soil.

11. A grading machine including a main supporting structure, a turntable thereon, separate endless series of soil engaging devices suspended from and movable with the turntable, means for independently swinging said series of soil engaging devices upwardly and downwardly relative to the turntable and without changing their angles to the surface of the soil, and means for independently adjusting said series of soil engaging devices horizontally relative to the turntable.

12. In a grading machine, the combination with a main supporting structure, of tubular arms adjustably connected thereto and depending therefrom, racks slidably mounted in the arms, means for adjusting the racks relative to the arms, means for holding the racks against movement relative to the arms, shafts carried by the racks, sprockets upon the shafts, an endless chain supported by the sprockets, and soil engaging devices.

13. In a grading machine, outer and inner pairs of tubular arms, a shaft journaled in the arms of each pair and carrying gears, a rack slidably mounted in each arm and engaged by the adjacent gear, means for holding the racks against movement relative to the arms, and chains supported by the racks, and soil engaging devices carried by the chains, said racks being independently adjustable relative to their arms.

14. In a grading machine, the combination with a supporting structure, of gears, a pair of arms connected to and revoluble with each gear, means for simultaneously rotating the two gears, an endless chain, soil engaging devices carried thereby, and independently adjustable connections between the chain and the arms of the respective pairs.

15. In a grading machine, the combination with a supporting structure, of gears, a pair of arms connected to and revoluble with each gear, means for simultaneously rotating the two gears, an endless chain, soil engaging devices carried thereby, racks engaging the arms, the racks of each pair of arms being adjustable together and independently of the other racks, an endless chain carried by the racks, and soil engaging devices upon the chain.

16. In a grading machine, the combination with a supporting structure, and gears mounted for rotation, of means for simultaneously rotating the gears, an endless chain, and separate adjustable connections between opposite portions of the chain and the respective gears, said connections being adapted to rotate with the gears thereby to bodily raise and lower the chain.

17. In a grading machine, the combination with outer and inner sprockets, an endless chain mounted thereon, and soil engaging devices carried by the chain, of a supporting structure, independently adjustable connections between the said structure and the respective sprockets, and means for simultaneously swinging said connections to bodily raise or lower the chain without changing its angle to the surface of the soil.

18. In a grading machine the combination with a main supporting structure, of a turntable, guide beams carried thereby, a carriage upon each beam, means for rotating the turntable, means for independently shifting the carriages along their respective guide beams, gears mounted upon each carriage, extensible connecting elements movable with the respective gears, shafts carried by said elements, endless chains supported by the shafts, soil engaging devices carried by the chains, and means for simultaneously rotating the gears on each carriage to bodily raise or lower the chain connected to the carriage.

19. A grading machine including a main supporting structure, an endless series of soil loosening devices movable along lines intersecting the path of movement of the main supporting structure, an endless series of scrapers back of said soil loosening devices for engaging the loosened soil and

scraping it along lines intersecting the path of movement of the main supporting structure and into position under said structure, and means for independently adjusting the soil loosening devices and the scrapers horizontally relative to the main supporting structure.

20. In a grading machine, an endless chain having sockets, teeth detachably mounted in the sockets and having their side faces disposed obliquely to the path of movement of the chain, said faces converging toward the advancing side of the chain, a main supporting structure, and connections between said structure and the chain, the said chain being movable in a path intersecting the path of movement of the main supporting structure.

In testimony that I claim the foregoing as my own, I have hereunto affixed my signature in the presence of two witnesses.

SAMUEL W. BLEVINS.

Witnesses:
SELINA WILLSON,
I. E. SIMPSON.