Feb. 25, 1947. K. MEISENBURG 2,416,401

SUBGRADING MACHINE

Filed March 17, 1944 6 Sheets-Sheet 1

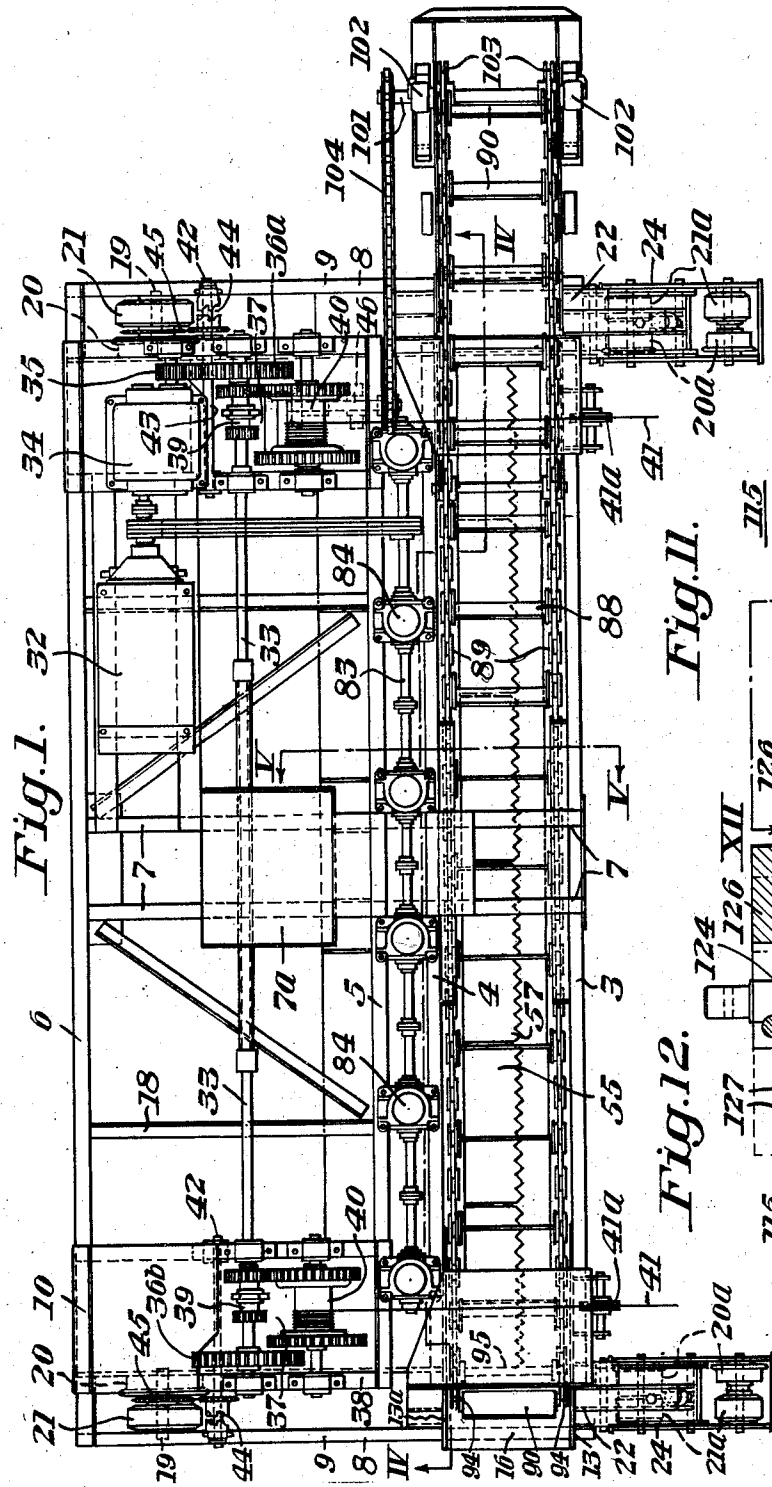

Fig. 1.

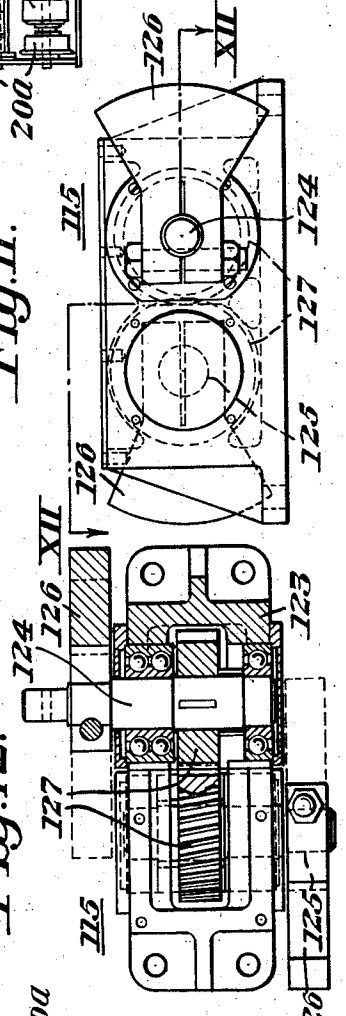

Fig. 11.

Fig. 12.

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SUBGRADING MACHINE

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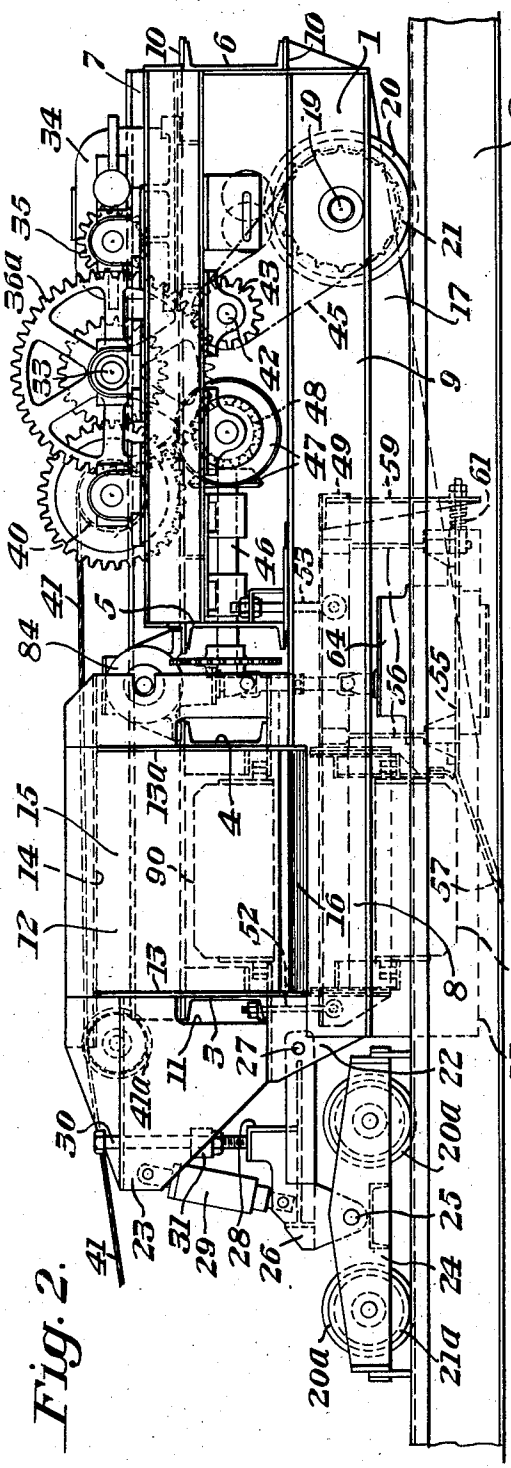

Fig. 2.

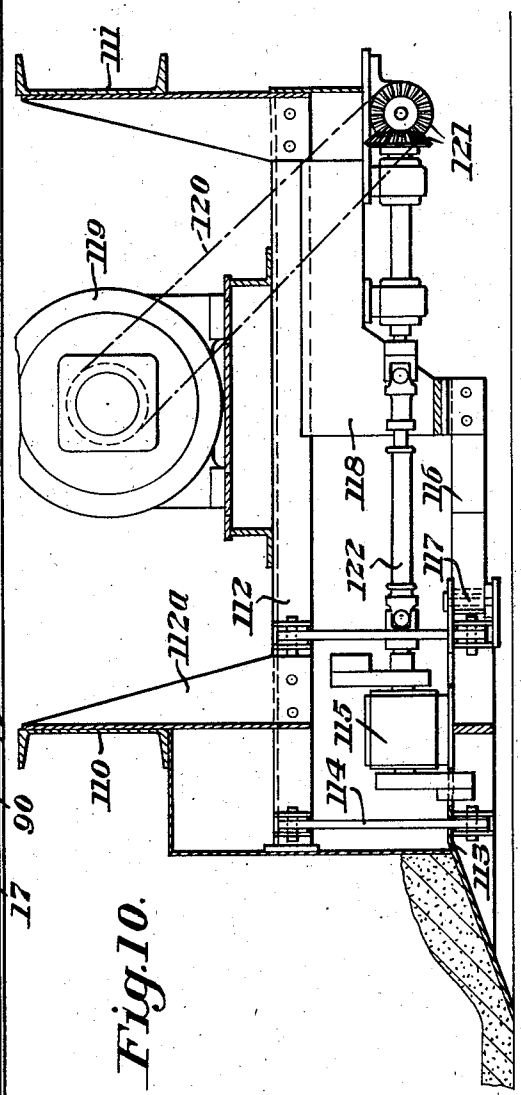

Fig. 10.

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SUBGRADING MACHINE

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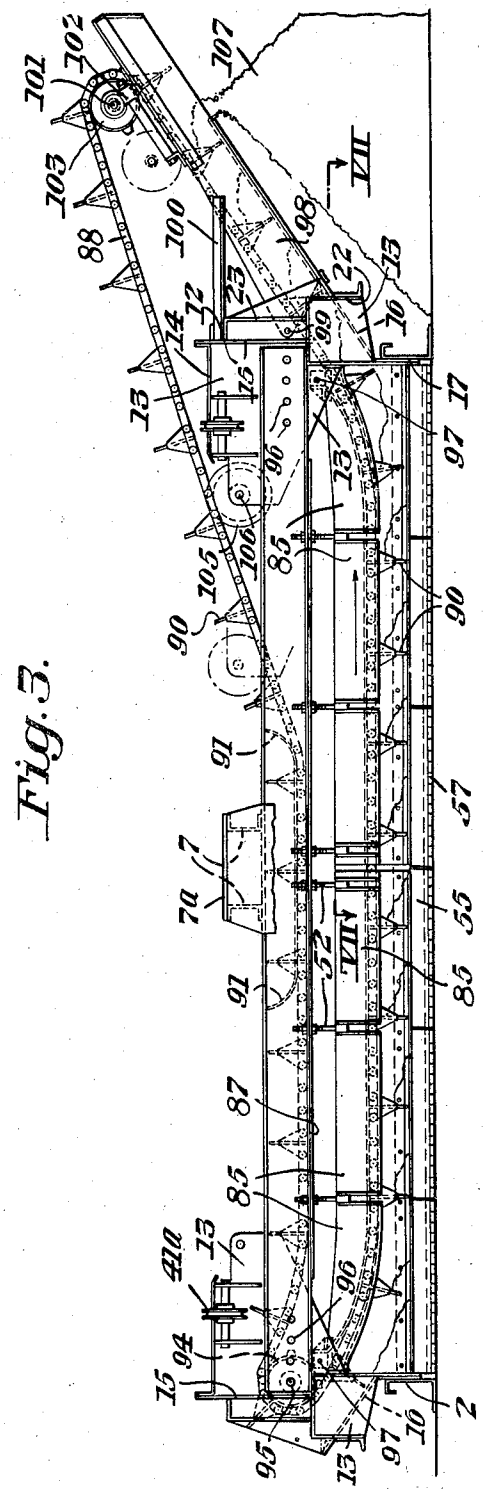

Fig. 3.

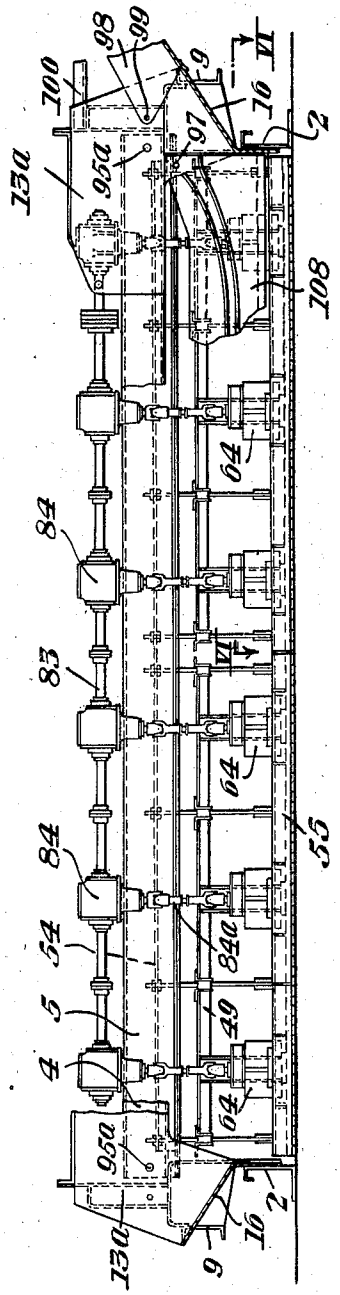

Fig. 4.

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Fig. 5.

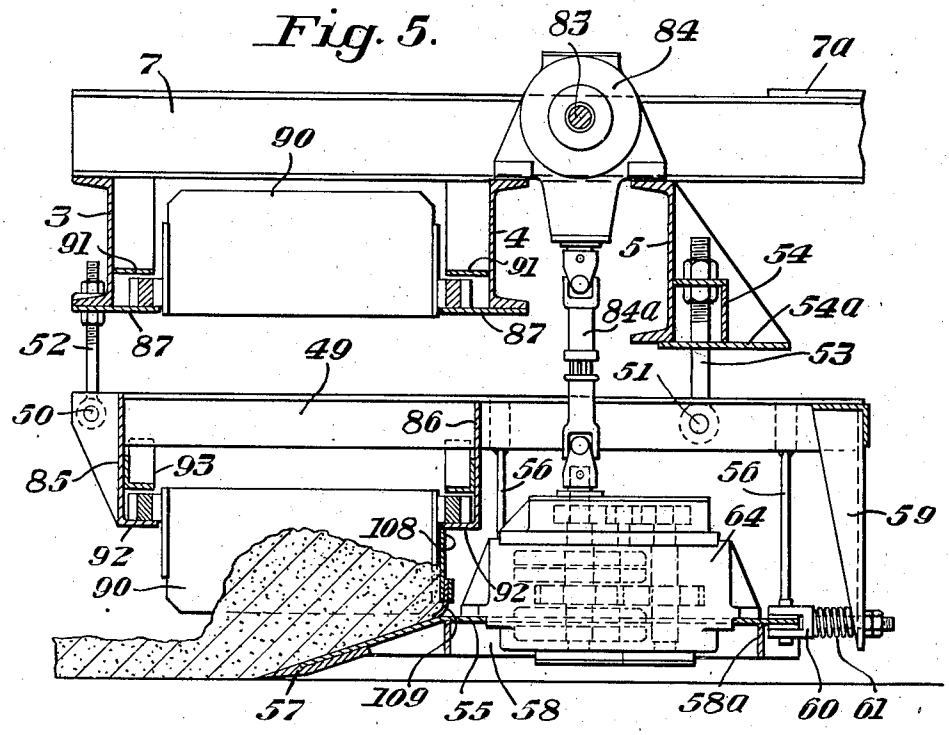

Fig. 6.

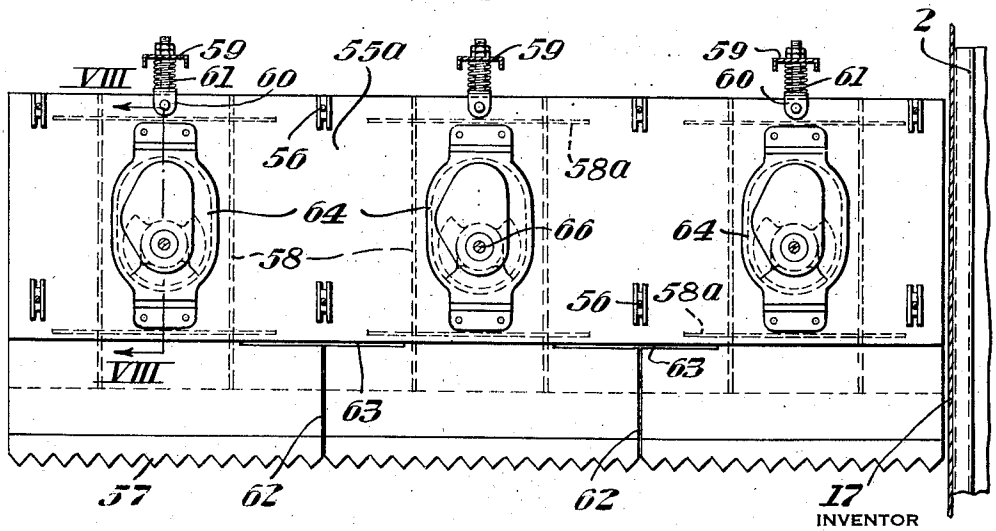

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Fig. 7.

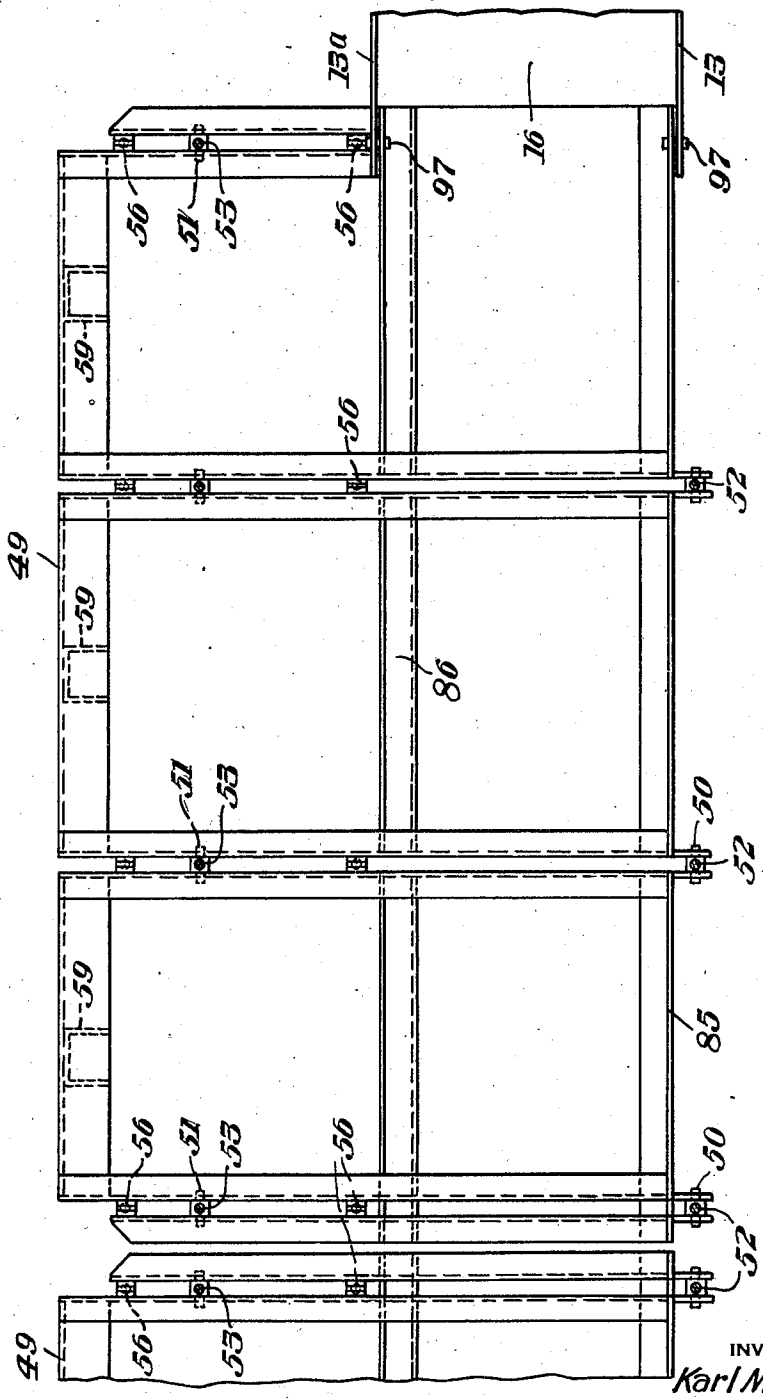

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Fig. 8.

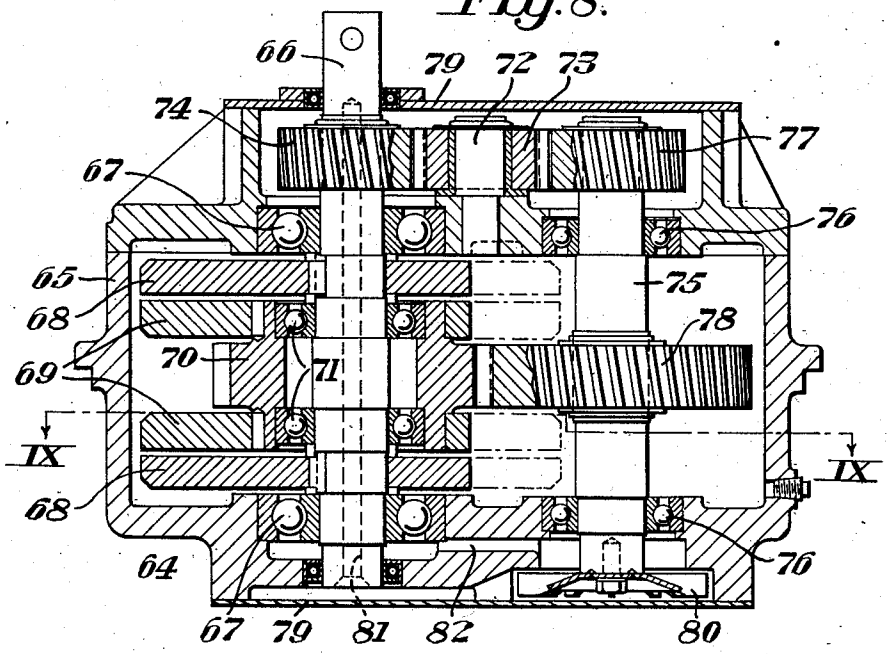
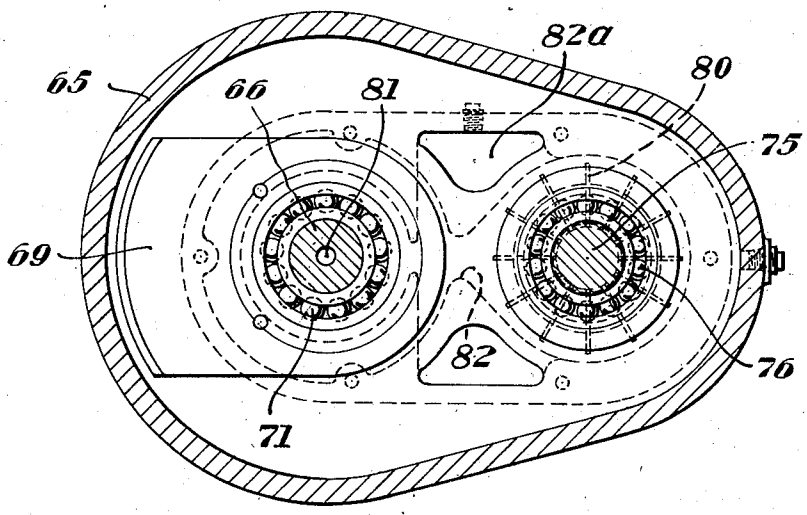


Fig. 9.



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Patented Feb. 25, 1947 2,416,401

UNITED STATES PATENT OFFICE

2,416,401

SUBGRADING MACHINE

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Application March 17, 1944, Serial No. 526,992

13 Claims. (Cl 37—108)

1

This invention relates to a machine for preparing a smooth earth surface, usually a subgrade upon which a hard pavement is to be laid.

Subgraders of several types are in common use in preparing the base for concrete roads. In using such machines, the procedure is to grade the earth upon which the pavement is to be laid, and to roll or otherwise compact it to an elevation a few inches higher than the desired final level, and then to cut the surplus soil as accurately as practicable to the desired grade. In practice, the machines hitherto available for this work seldom leave the surface in a sufficiently compact condition without re-rolling, and are incapable of cutting into very hard soil. Attempts to overcome the latter defect hitherto have involved making the machines unduly heavy, introducing difficulties in respect to their supports and increasing the cost of the roadbuilding process as a whole.

One object of this invention is to provide a machine able to trim the subgrade to a hard, smooth surface of the contour desired and to remove the trimmed soil laterally at or in advance of the cutting means, without permitting any loose earth to accumulate behind the latter, thus leaving the subgrade, after my machine passes thereover, in exactly the condition in which it is left by the cutting means and not in that condition resulting from the scraping up of surplus material from above the cut surface.

Another object of this invention is to operate the cutting means in a manner which will not impose shocks or jars of any magnitude upon the framework of the machine proper and thence onto the road rails or sub-soil upon which the machine is supported. The cutting means of the machine are mounted resiliently with respect to the machine itself, and are advanced on the whole at the same speed as the machine, but the motion imparted to them to cause the cutting action is brought about by a series of rotating weights so mounted as to impart an oscillatory motion to the cutting means as they advance with the machine along the roadway. This arrangement relieves the frame of the machine or the mechanism by which the machine is moved forward from the reaction of the impacts of the cutting means on the soil. My novel subgrader, herein described, is capable of finishing the subgrade to the desired degree of smoothness for pouring concrete without re-rolling, and is capable of cutting into very hard and difficultly penetrable soil. The invention will be explained in the course of the following complete description referring to the accompanying drawings which illustrate a preferred embodiment and certain modifications. In the drawings,

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Figure 1 is a plan view of the subgrader with certain parts omitted;

Figure 2 is a side elevation.

Figure 3 is a front elevation with certain parts omitted;

Figure 4 is a transverse section taken along the line IV—IV of Figure 1;

Figure 5 is a partial longitudinal section taken along the plane of line V—V of Figure 1, with parts omitted;

Figure 6 is a horizontal section taken along the plane of line VI—VI of Figure 4 showing one form of soil-cutting member;

Figure 7 is a partial horizontal section taken along the plane of line VII—VII of Figure 3 with parts omitted;

Figure 8 is an enlarged vertical section taken along the plane of line VIII—VIII of Figure 6;

Figure 9 is a horizontal section taken along the plane of line IX—IX of Figure 8;

Figure 10 is a partial section similar to Figure 5 showing a modification;

Figure 11 is an elevation of a modified detail utilized in the structure shown in Figure 10; and

Figure 12 is a view partly in section and partly in elevation taken along the planes of line XII—XII of Figure 11.

For the sake of clarity and ease of understanding the following complete description of the invention is divided into sections under these subtitles: (1) Car and drive mechanism, (2) Cutting members and actuating mechanism, (3) Conveyor and pusher plate, and (4) Modifications.

Car and drive mechanism

The subgrader of my invention is embodied in a car 1 adapted to travel on road rails 2 (which constitute the side forms for the pavement slab of a road) or on a pavement slab or slabs on one or both sides thereof. The car has a frame composed of cross members 3, 4, 5 and 6 and spaced, central longitudinal members 7. An operator's platform 7a is mounted on the members 7. To permit the adjustment of the machine for roads of different widths, side frames or carriages 8 adapted to be adjusted laterally are mounted at the extreme outer sides of the machine and secured in adjusted position by bolts or the like, not shown. The side frames include longitudinal members 9 extending below the cross members 3 and 6. The rear ends of the side frames are slidable in guides 10 secured to cross member 6. At the forward end of each side frame, a

box 12 having sides 13, 13a, a top 14, an end wall 15 and a bottom 16, extends upwardly and inwardly between the cross members 3 and 4. The boxes are slidable between cross members 3 and 4 when the side frames are adjusted laterally, and are adapted for cooperation with the conveyor to be described later. Retaining plates 17 depend from the side frames just inside the rails 2. The main and side frames are preferably fabricated from structural shapes and plates as shown in the drawings. The remaining details of the construction thereof will be apparent without further description. Stub shafts 19 are journaled in the side frames near the rear end thereof and are provided with flanged steel wheels 20 adapted to travel on the rails 2. The shafts 19 are also provided with rubber-tired wheels 21 adapted to travel on the shoulder of an adjacent pavement slab. The adjustability of the side frames permits the machine to be set for roads of various widths.

At the front end of the machine, each side frame has a housing 22 extending inwardly beneath the cross member 3. The housing is provided with a bearing box 23 thereon. Wheel trucks 24 are pivoted at 25 to arms 26. The arms are pivoted to the housing 22 at 27 and have bearing shoulders 28 formed thereon. The housings, bearing boxes, wheel trucks and arms may conveniently be fabricated from plate and structural shapes. The trucks are provided with wheels 20a and 21a similar to the rear wheels 20 and 21. A hydraulic lift is pivoted to each arm 26 adjacent its forward end and to the overhanging end of the adjacent bearing box 23. Operation of the lift thus causes the car 10 to be tilted upward at the front end about the rear wheels. This permits the machine to be moved along the rails without interference with the ground, when it is not engaged in cutting the subgrade. The normal operating position of the frame which is illustrated in Figure 2, is determined by bearing bolts 30 extending downwardly through the box 23 and blocks 31 secured thereto. The bolts are adapted to seat on the shoulders 28 of the arms 26. Nuts threaded on the bolts serve as stops to limit the downward tilting movement of the car frame when engaged by the blocks 31.

The car 1 and the cutting member and conveyor mounted thereon, to be described in detail later, are driven by any convenient source of power such as an internal-combustion engine 32. The engine drives a telescoping cross shaft 33 through a speed-reducer 34. A pinion 35 on the low-speed shaft of the reducer meshes with a gear 36a on the shaft 33. The engine and speed-reducer are mounted on suitable supports built into the car frame. The shaft 33 connects duplicate transmissions 37 on opposite sides of the frame. The transmissions are mounted on spaced longitudinal members 38 extending between the transverse members 5 and 6. Bearings for the various shafts to be described are secured to the members 38.

In each transmission, a quill 39 is slidably mounted on the shaft 33 and is provided with pinions of different sizes adapted alternately to mesh with gears secured to the drum of a winch 40. The winches are provided with cables 41 adapted to be secured to the road rails in advance of the point at which the subgrader is operating, to provide the traction necessary to advance the machine. The cables pass over floating guide sheaves 41a mounted on the boxes 12. The two-speed drive for the winches incorporated in the transmissions makes it possible to speed up or slow down one side of the machine relative to the other, as may be necessary to maintain the desired position of the car normal to the road rails, when rounding curves in the road.

Each transmission also includes a stub shaft 42 having a pinion 43 splined thereon meshing with gears 36a and 36b on shaft 33. A jaw clutch 44 is mounted on the outer end of each shaft 42 and the driven member thereof includes one sprocket of a chain-and-sprocket drive 45 for the shafts 19. When the clutches 44 are engaged the rear wheels are driven to move the machine backward. The shafts 42 are slidable in their bearings to move with the side frames on adjustment thereof. The right-hand transmission also includes a longitudinal shaft 46 extending through the cross member 5. This shaft is driven through bevel gearing 47 by gear 36a which meshes with a gear 48 formed integral with the driving bevel gear. The shaft 46 drives the conveyor to be described later. The shaft 46 and bevel gearing 47 may be provided in both transmissions, if desired.

Cutting members and actuating mechanisms

A plurality of subframes 49 disposed side-by-side and articulated together in groups are suspended from the cross members 3 and 4. The subframes are fabricated from structural shapes as shown in Figure 7, and are arranged in two groups, as shown in Figure 4, each extending over half the width of the machine. The subframes are suspended by means of pins 50 and 51 carried by eyebolts 52 and 53 depending, respectively, from the cross member 3 and a fabricated angle 54a mounted on a plate 54 secured to the cross member 5. The pins 50 have a relatively loose fit in the subframes 49 and thus provide an articulated relation between adjacent subframes. The bolts 52 and 53 may be adjusted vertically by means of nuts threaded thereon.

The bolts 52 and 53 when adjusted, being very rigid and firmly anchored at their upper ends by means of their nuts, support the subframes 49 in fixed position relative to frame 7. Bolts 53 are further supported laterally by a suitable fit in holes in plate 54a.

A group of separate oscillating members 55 is suspended from the subframes 49 by flexible hanger bars 56 of spring steel adapted to permit free oscillation of the members relative to their supporting subframe. The bars 56 may be of circular section with flattened ends, the upper ends being secured between adjacent subframes as by means of shims and bolts, and the lower ends being secured between adjacent cutting members in the same manner. There is sufficient looseness of fit in these parts to permit the deflection at the joints resulting from the vertical adjustment of bolts 52 for giving desired crown to the subgrade. As shown in Figure 5, each cutting member 55 is generally horizontal and comprises a plate having its forward portion bent downwardly and provided with a hardened toothed cutting edge 57. Stiffener bars 58 and 58a are welded edgewise to the lower surface of the plate forming the cutting member. A thrust arm 59 depending from the subframe 49 supports a clevis 60 bolted to the rear edge of the cutting member. A spring 61 between the clevis and thrust arm resiliently tends to maintain the cutting member in its mean position between the limits of its oscillation as the car advances. The connection of the clevis to the cutting member and the thrust

arm is sufficiently loose to permit oscillation of the former in a horizontal plane. As shown in Figure 7, the bars **56** intermediate the subframes on one side of the central plane through the machine are common to adjacent members **55**. If desired, each cutting member may independently be supported from the subframe above by a separate group of spring bars **56**, one at each corner, there being provided for a group of three cutting members twelve such bars instead of eight as shown on the drawings. In this case each cutting member may oscillate separately, although it is preferred that they all be synchronized as to phase and frequency, whether the suspension of adjacent cutting members be common or separate.

Figure 6 is a plan view of an integral cutting member **55***a* adapted to replace the three separate cutting members **55** on one side of the machine as shown in Figure 1. The cutting member **55***a* comprises a single flexible plate slotted at **62** and **63** to permit deflection in conformity with the contour desired in the finished subgrade. Since the maximum crown of the roadbed ordinarily used in road construction is no more than 4 or 5 inches, the desired curvature may easily be produced by bending the cutting member **55***a*. This is faciliated by the slots **62** and **63**. In the construction shown in Figure 3, the articulated joints between adjacent subframes suspending the several individual cutting members permit the adjustment of the latter to a generally curved contour.

Actuating mechanisms **64** are mounted on the cutting members **55**, as shown in Figure 4. In the case of the cutting member **55***a*, a plurality of actuating mechanisms are disposed thereon, as shown in Figure 6. The actuating mechanisms are centrifugal oscillators constructed as shown in Figures 8 and 9. Each oscillator **64** comprises a housing **65** adapted to be set down into a hole of suitable shape formed in the horizontal portion of the cutting member, as clearly shown in Figure 5. A shaft **66** is journaled in bearings **67** and has eccentric weights **68** keyed thereto. Other eccentric weights **69** are secured to a gear **70** journaled on the shaft **66** by bearings **71**. A stub shaft **72** fixed in the housing **65** has a pinion **73** journaled thereon which meshes with a gear **74** keyed to the shaft **66**. A shaft **75** journaled in the housing **65** on bearings **76** has a gear **77** thereon meshing with the pinion **73**. The shaft **75** also has a gear **78** thereon meshing with the gear **70**. By this construction rotation of the shaft **66** causes the weights **68** to rotate in one direction and the weights **69** to rotate in the other direction at the same speed. By properly determining the phase of the two sets of weights relative to each other, it is possible to impart transverse or longitudinal oscillations in a horizontal plane to the cutting member, or a combination of both. Covers **79** close the ends of the housing **65**. An impeller **80** on the lower end of the shaft **75** is provided for circulating lubricant contained within the housing **65**. The impeller delivers lubricant through a bore **81** in the shaft **66** to various levels in the vibrator by radial bores communicating therewith. Lubricant returns to the impeller through the lower bearings **67** and a passage **82**, or through ports **82***a*.

The shafts **66** of the several oscillators **64** are driven by the engine **32**. By means of a belt drive, the engine operates a cross shaft **83** made up of a plurality of sections connected by couplings and extending through bevel gear units **84** secured to cross members **4** and **5**. Telescoping

vertical shafts **84***a* extend downwardly from the units **84** to the vibrator shafts and are provided with universal couplings adjacent both the bevel gear units and the vibrators. It will be apparent that in the arrangement shown the shaft **83** is driven continuously but a suitable clutch may be provided to disconnect it from the engine when desired. In any event, when the shaft **83** is driven, the eccentric weights of the oscillators are rotated to cause oscillation of the cutting members. The eccentric weights of all the oscillators, of course, will be positioned so that the cutting members vibrate in unison. A relatively small amplitude of oscillation, say ¼ inch, is sufficient and a frequency of about 2000 oscillations per minute is satisfactory. It will be understood that when the weights **68** and **69** are at opposed positions, their centrifugal forces balance and there is no resulting force exerted on the cutting member. As the weights approach positions in which they are in overlying relation, an increasing horizontal force is applied to the cutting member. A similar force in the opposite direction is applied when the weights have executed another half revolution.

The points at which the weights are in overlying relation may be disposed on a line parallel to the edge of the cutting member or normal thereto merely by removing the pinion **73** and making the necessary adjustment of the phase relation of the two sets of weights. It is thus possible to cause the cutting member to oscillate in the direction of its cutting edge, giving a sawing action or at right angles thereto resulting in a chiseling action. Either action is highly effective in aiding the cutting member to penetrate the soil between the road rails. It will be obvious that sufficient clearance must be provided between the latter and the outer cutting members to permit the desired oscillation, if it takes place in a direction parallel to the edge of the cutting member.

Conveyor and pusher plate

Spaced series of plates **85** and **86** extend transversely of the car, each plate of the two series being secured to one of the subframes **49** and depending therefrom generally in vertical alinement with the cross members **3** and **4**. Horizontal plates **87** secured to the latter provide bottom guide tracks for the upper run of a chain conveyor **88**. The conveyor includes a pair of chains **89** having flights **90** in the form of flat plates secured thereto at intervals and extending between the chains. As shown more clearly in Figure 5, the conveyor flights **90** extend forwardly of the cutting edge of **57** as well as above it. Top guide tracks **91** in the form of narrow plates with upwardly curved ends are secured to the cross members **3** and **4** to confine the upper run of the conveyor chains. The plates **85** and **86** have flanges **92** providing bottom guide tracks for the lower run of the conveyor chains. Angles **93** secured to the plates above the flanges confine the bottom run of the conveyor chains. The chains are trained over sprockets **94** on a tailshaft **95**. The shaft **95** is journaled in one of a series of bearings **96** formed adjacent the ends of the cross members **3** and **4**. The several mountings for the tailshaft thus afforded permit the effective width of the conveyor to be adjusted in accordance with the setting of the side frames **9** for various road widths. The sides **13** of the boxes **12** have holes **95***a* therethrough to accom-

modate the shaft 95. The outer subframes and plates 85 and 86 are replaced when the setting of the side frames is altered, and the length of the chains 89 correspondingly changed.

As shown in Figure 3, the conveyor guide tracks are sectional, extending in one piece only the width of a single subframe, like the plates 85, and are adjusted by means of the eyebolts 52 and 53 to the same extent as the cutting members 55. Thus the conveyor flights 90 are always the same distance above the forward edge of the cutting member. The outermost plates 85 and 86 are pivoted at 97 to the sides of the boxes 12. While these pivot points at the sides of the machine are fixed vertically, the intermediate portions of the conveyor tracks are adjustable for various contours along with the cutting members 55.

As shown in Figures 3 and 4, the sides 13 and bottoms 16 of boxes 12 form the lower end of a chute cooperating with the conveyor 88. An extension chute 98 of troughlike section is pivoted to one of the boxes 12 at 99. The angular position of the chute 98 is fixed by braces 100 extending from the box 12. A shaft 101 is journaled in adjustable bearings 102 mounted on the chute 98 adjacent the upper end thereof. The shaft 101 is the head shaft of the conveyor, having sprockets 103 thereon around which the conveyor chains are trained. The shaft 101 is driven by shaft 46 through a chain-and-sprocket drive 104. Chain idler sheaves 105 are mounted on a shaft 106 journaled in the sides 13 of the box 12 adjacent their inner end.

The bottom of the chute 98 is a continuation of the bottom 16 of the box 12. The conveyor 88 operates in the manner of a drag-scraper conveyor to move soil across the cutting members 55 and upwardly along the bottom 16 of the box 12 and the bottom of the chute 98. The latter terminates a short distance below the extreme upper end of the chute and discharges soil loosened by the cutting members into a pile 107 at one side of the right-of-way. Because of its pivotal mounting at 99 the chute 98 may be swung up to the position shown in dotted lines in Figure 3, after uncoupling the braces 100, to clear roadside obstructions or to facilitate traveling of the machine when not actually operating on the subgrade.

It will be observed that provision of duplicate boxes 12 at opposite sides of the machine permits the discharge of soil to either side of the road since the conveyor 88 may be mounted on the left-hand side of the machine as well as on the right-hand side on which it is illustrated in Figure 3.

Pusher plates 108 are secured to the flanges 92 of the plates 86 and extend downwardly toward the cutting members 55. At their lower edges, the plates 108 have flexible wiper strips 109 in contact with the upper surfaces of the cutting members. The pusher plates prevent the soil loosened by the cutting members from flowing over the latter as the machine advances and confine the loosened soil above the cutting members so that it accumulates temporarily in the path of the conveyor flights 90. The latter operate as above described to sweep the accumulated soil progressively across the width of the machine and into the chute 98. Each pusher plate extends the width of a single subframe and thus does not interfere with the adjustment of the cutting members and conveyor tracks to a curved contour.

Modifications

Figure 10 illustrates certain parts only of a modified form of subgrader. In this construction, a car frame includes cross members 110 and 111 and longitudinal members 112. A cutting member 113 is pivotally supported below the frame on links 114 and is provided with an oscillator 115 shown in greater detail in Figures 11 and 12. The horizontal reaction on the cutting member resulting from the advance of the car is sustained by struts 116 of spring steel pivoted to the cutting member at 117 and supported on plates 118 depending from the frame members 112. The oscillator 115 is driven by a motor 119 on the car frame through a chain-and-sprocket drive 120 and a bevel-gear drive 121. From the latter, a telescoping shaft 122 with universal joints at each end extends to the oscillator 115. While the motor 119 is shown as an electric motor, it will be evident that an internal-combustion engine may be used where convenience requires it.

The oscillator 115 comprises a housing 123 in which parallel shafts 124 and 125 are journaled on suitable bearings. Opposite ends of the shafts project from the housing 123 and have eccentric weights 126 secured thereto. Meshing gears 127 on the shafts cause them to rotate in opposite directions at the same speed. The shaft 124 is adapted to be coupled to the shaft 122 and, when driven thereby, the rotation of the eccentric weights in opposite directions produces a reciprocating force in the same manner as described in connection with the oscillators 64. The oscillator 115 when mounted as shown in Figure 10 causes reciprocation of the cutting member 113 in a horizontal plane in the direction parallel to its forward edge. Reciprocation of the cutting member in the direction normal to its forward edge would be produced if the oscillator were positioned at right angles to its illustrated position. A pusher plate 123 performs for the cutting member 113 the function of the pusher plate 108 described above.

It will be apparent from the foregoing description and explanation that the subgrader of my invention has important advantages over subgraders known heretofore. In the first place, the machine of my invention finishes the subgrade to a sufficient degree of smoothness for pouring without re-rolling. This results principally from the fact that the cutting member oscillates at relatively high frequency in a horizontal plane as it is being advanced in cutting through the soil. The ability of the machine to finish the subgrade smoothly is further aided by the fact that the conveyor sweeps over the length of the cutting member while the pusher plate prevents loosened soil from passing to the rear of the cutting member. The machine is positively driven by winches and cables and since there is thus no need for extra weight, it need be made only sufficiently strong and heavy to withstand the forces to which it is subjected in use.

The oscillations of the cutting member are transmitted to the car frame to a very limited extent only. The cutting member, being suspended on spring steel hangers, is relatively free for movement and the spring cushions between the cutting member and the thrust arms which absorb the reaction of the member, prevent vibrations being induced in the frame at the car. As already indicated, the rapid oscillation of the cutting member enables it to cut soil harder than could be penetrated by a fixed cutting member.

The oscillators may be easily adjusted to cause vibration of the cutting member parallel to its forward edge or normal thereto. The conveyor may be driven from either side of the machine and may be caused to discharge toward either side. The vertically adjustability of the cutting members permits the subgrade to be finished to a curved contour as well as flat. The machine is relatively simple in construction so that it can be manufactured and maintained at moderate cost.

It is to be noted that, in order to simplify the drawings, various control mechanisms have been omitted including gear-shifting and clutch-engaging levers and push-pull rods connecting the levers to the elements to be actuated, as well as the hydraulic system for actuating the lifts **29**.

Although I have illustrated and described but a preferred embodiment of the invention with certain modifications, it will be recognized that changes in the construction and arrangement of the parts may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, means mounting said member on said frame for bodily oscillatory movement in a horizontal plane relative thereto, means for causing such movement of said member, and a substantially vertical pusher plate secured to said frame in a plane spaced rearwardly of the forward edge of the member, effective to prevent soil loosened thereby from flowing past said member.

2. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, means mounting said member on said frame for bodily oscillatory movement in a horizontal plane relative thereto, means for causing such movement of said member, a pusher plate secured to said frame in a plane spaced rearwardly of the forward edge of the member, effective to prevent soil loosened thereby from flowing over said member, and a flexible wiper strip secured to the lower edge of said plate and engaging said member.

3. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a plurality of subframes suspended below said frame across the width thereof, a generally horizontal cutting member suspended below said frame and directly supported by said subframes jointly, and means for vertically adjusting said subframes to vary the contour of said member.

4. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a plurality of subframes suspended below said frame across the width thereof, a generally horizontal cutting member suspended below said frame and directly supported by said subframes jointly, means for vertically adjusting said subframes to vary the contour of said member, a conveyor traveling across said frame, and guides for the lower run of said conveyor mounted on said subframes whereby they are adjusted to conform to said member.

5. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, flexible means mounting said member at a predetermined elevation on said frame for bodily oscillatory movement in a horizontal plane relative thereto, said means being adapted to limit the vibration transmitted to said frame, an eccentric weight mounted on said member for rotation, means on the frame for driving said weight to oscillate said member, and means including vibration-absorbing means for positioning said member relative to the machine.

6. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, flexible means mounting said member at a predetermined elevation on said frame for bodily oscillatory movement in a horizontal plane relative thereto, said means being adapted to limit the vibration transmitted to said frame, a plurality of systems of eccentric weights spaced along said member and mounted for rotation thereon, common drive means on the frame for all said systems, and means including vibration-absorbing means for positioning said member relative to the machine.

7. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, means mounting said member on said frame for bodily oscillatory movement in a horizontal plane relative thereto, means for causing such movement of said member, and a substantially vertical pusher plate above and adjacent to said member depending from the frame in a plane spaced rearwardly from the forward edge of said member, said plate serving to prevent soil from flowing past said member.

8. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, and means resiliently mounting said member on said frame for bodily movement in a horizontal plane relative thereto, including flexible hanger means for suspending the member and means including cushioning means tending to maintain a mean position of the member relative to the frame in the direction of travel, but permitting a cutting action of the member by reason of its deceleration on engaging the soil.

9. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, flexible hangers suspending the member from the frame and means yieldably tending to maintain a mean position of said member relative to said frame in the direction of travel but permitting

bodily movement relative thereto in a horizontal plane, thereby causing a cutting action of the member as a result of its retardation on engaging the soil.

10. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, flexible hangers mounting said member on the frame for bodily oscillatory movement back-and-forth along the line of travel of the car, means for effecting such movement of the member to cause it to exert a chopping action resulting from its retardation on engaging the soil and yieldable means tending to maintain said member in a mean position between the limits of its oscillation.

11. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, flexible hangers mounting said member on said frame for bodily oscillatory movement transversely of the frame, means for causing such movement of the member, whereby it exerts a sawing action on the soil, and cushioning means tending to maintain said member in a mean position in the direction of travel of the frame but permitting oscillation in that direction.

12. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a generally horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, subframes below said frame having hangers secured to said member, and means for vertically adjusting the several subframes to change said depth and contour.

13. A subgrading machine comprising a wheeled frame adapted to travel on spaced supports, a horizontal cutting member suspended below said frame and extending across the roadway between said supports adapted to cut a subgrade of predetermined depth and contour, subframes below said frame having means suspending said member at a fixed elevation, and independently adjustable means supporting the subframes from the frame whereby the shape of the member may be altered.

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