July 20, 1965 C. W. HATCHER 3,195,957

PAVEMENT LEVELING MACHINE WITH MEANS FOR REDUCING EFFECTS OF BUMPS

Filed Nov. 3, 1961 3 Sheets-Sheet 1

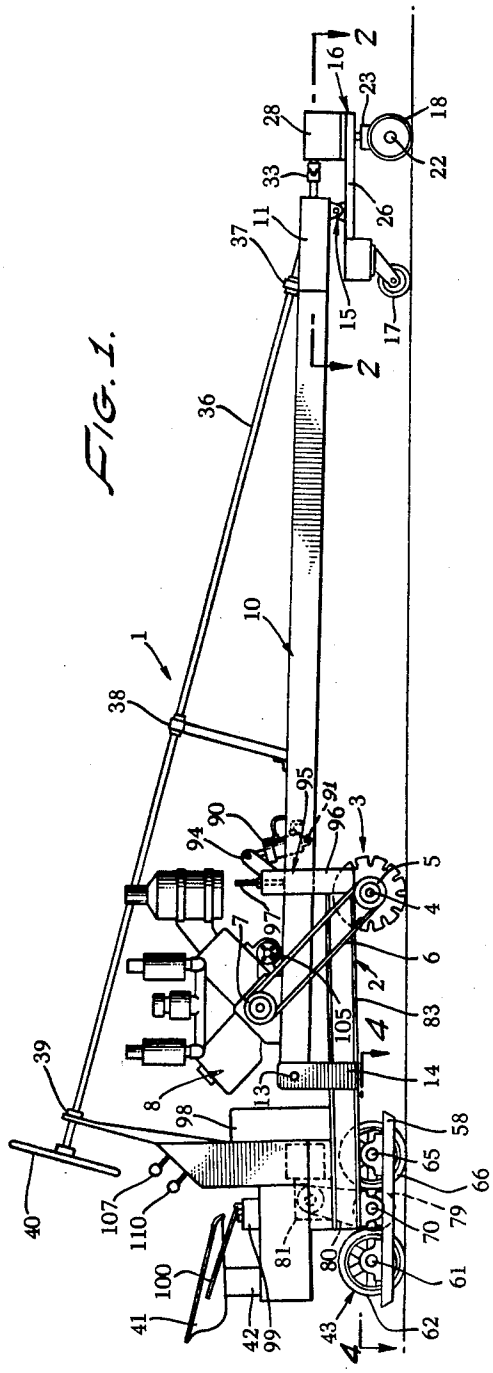


FIG. 1.

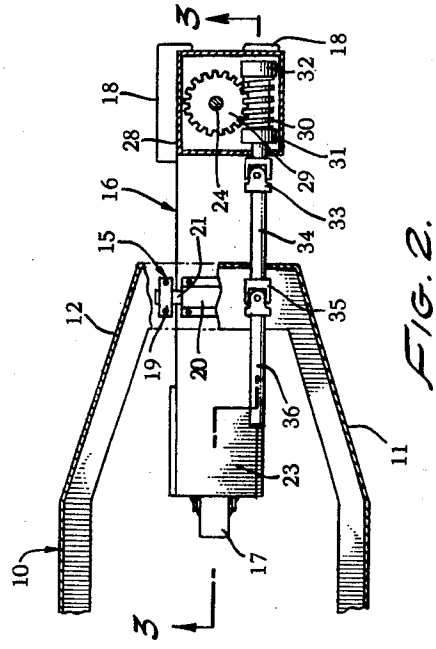


FIG. 2.

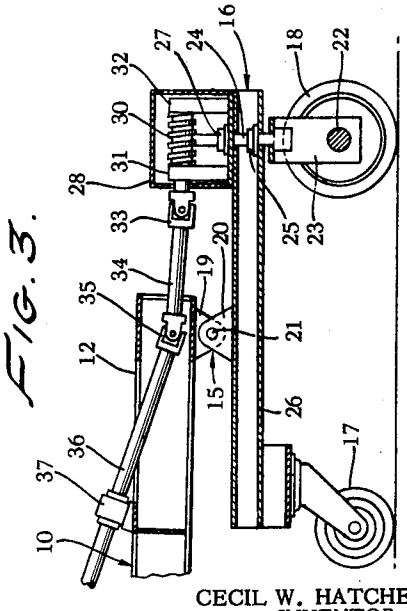


FIG. 3.

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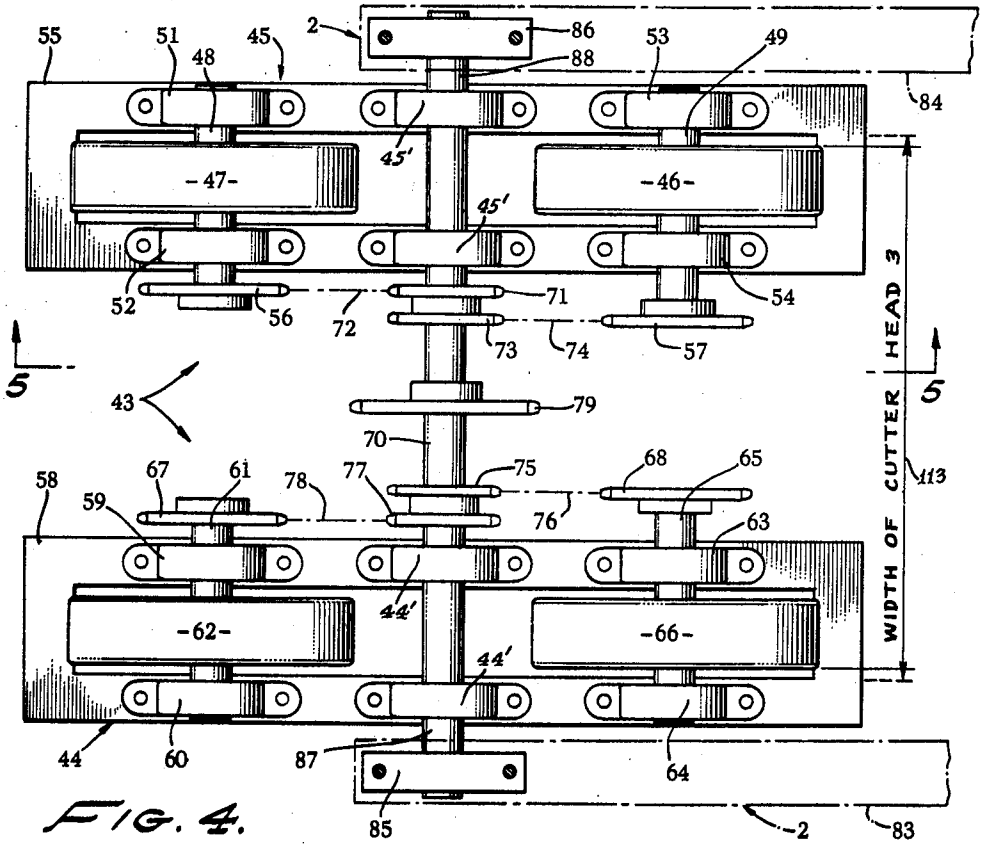


FIG. 4.

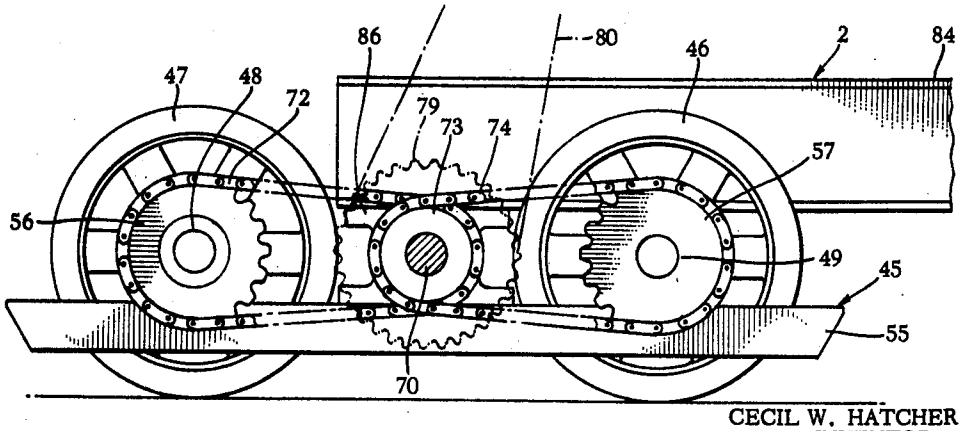


FIG. 5.

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PAVEMENT LEVELING MACHINE WITH MEANS FOR REDUCING EFFECTS OF BUMPS

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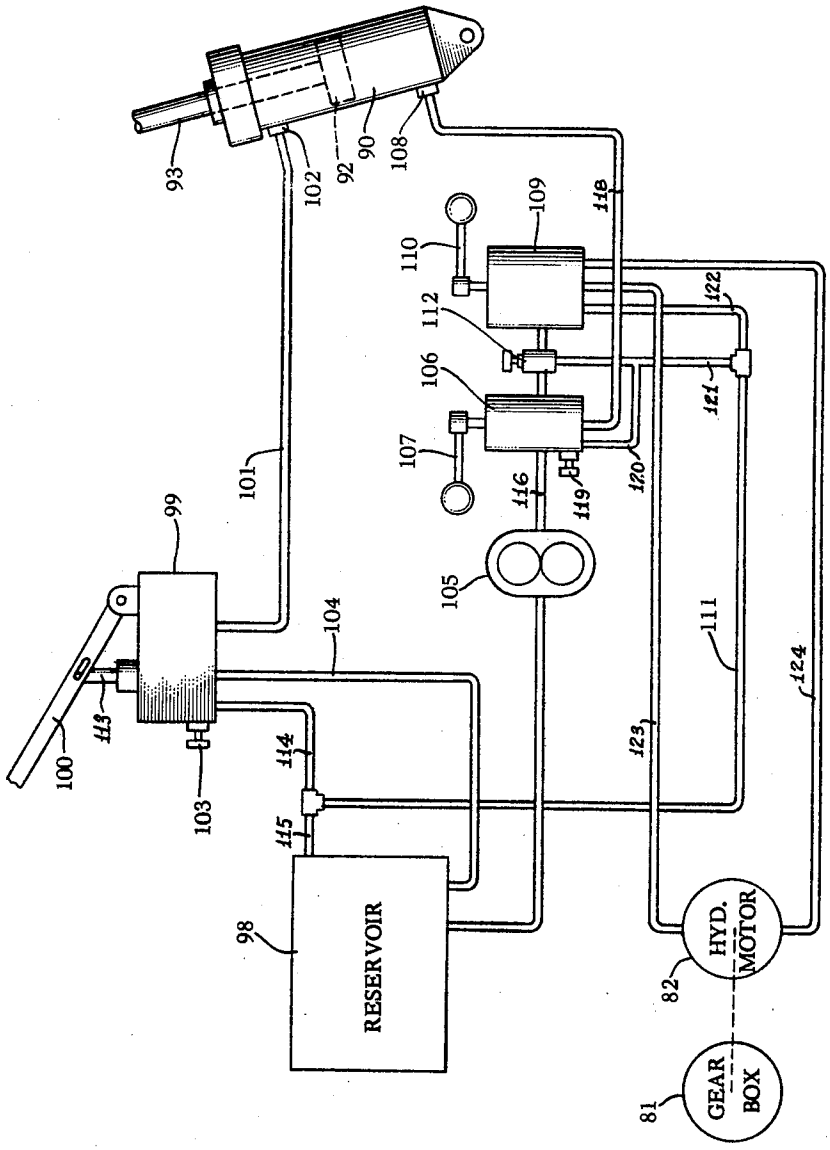


FIG. 6.

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United States Patent Office 3,195,957 Patented July 20, 1965

3,195,957

PAVEMENT LEVELING MACHINE WITH MEANS FOR REDUCING EFFECTS OF BUMPS

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Filed Nov. 3, 1961, Ser. No. 150,039
6 Claims. (Cl. 299—39)

The invention relates to a bump cutter with means for reducing effect of bumps and more particularly it relates to a self-propelled vehicle having rotatable abrasive wheels for removing bumps from concrete paving such as aircraft landing fields, floors and the like.

The invention is an improvement on the bump cutter disclosed and claimed in the following co-pending applications, S.N. 615,937 filed October 15, 1956, for Concrete Bump Cutter, referred to hereafter as Case A now Patent No. 3,007,687, November 7, 1961; S.N. 706,138 filed December 30, 1957, for Concrete Bump Cutter, referred to hereafter as Case B now Patent No. 3,037,755, June 5, 1962; S.N. 132,183 filed August 17, 1961, for Steering Control for Self-Powered Cutting Machine, division of Case B which is a continuation of Case A, referred to hereafter as Case C, now Patent No. 3,087,712, April 30, 1963.

In Case A the sensitivity of the machine is reduced to relatively minor irregularities of the surface of the paving by supporting the cutter, for height adjustment, on an elongated frame having a wheel support at a longer distance from the cutter than its vehicle support, whereby the variation in the height of the cutter is only a fraction of the variation in the height of the outer end of such elongated frame as its front wheel rides over the paving.

In Case B the invention is directed to an arrangement where in the rear of the vehicle frame is pivotally connected to a truck having front and rear wheels which in fact are driving wheels, the truck thus acting as a rear extension frame somewhat of the same general nature as the front extension frame, to reduce the vertical motion at the rear of the vehicle frame in proportion to the lever arms between the front and rear wheels of the truck and the truck pivot.

In Case C the invention is directed to an improved remote steering control for the self-powered cutting machine.

For reasons explained in connection with Cases B and C, it is important to reduce the error in the height of the cutter following the action of the front wheels, noting that while the front wheels reduce the error, they do not eliminate it, for the reason that such error is reflected into the action of the rear wheels to cause a further error in the height of the cutter. In other words, the accuracy with which the height of the cutter is maintained depends on the combined action of both the front and rear wheel supports. It has been found that the accuracy also depends upon the presence or absence of chattering of the cutter.

The present invention has for an object to further improve the accuracy with which the level of the cutter is maintained. This is accomplished by providing an improved bump reducing support for the front wheel suspension for the extension frame, by providing an improved rear wheel suspension wherein a bump at one side of the machine is not reflected into the undesired movement of the other side of the machine, the width of the cutter head being preferably greater than the width of the rear wheels, and the provision of a hydraulic cylinder and control for snubbing or holding down the cutter to its work, or for raising the cutter head from its work. An important object is to provide

such an improved rear wheel suspension comprising laterally spaced rear wheel frames having tandem rear wheels driven by a transverse drive shaft on which the rear wheel frames are pivotally mounted independently of each other. Preferably the motor for operating the cutter shaft is mounted on the rear of the extension frame, the hydraulic cylinder and piston being connected at their opposite ends to the vehicle frame and the extension frame, with means for supplying fluid pressure to the opposite ends of the cylinder, the pressure when supplied to one end of the cylinder acting to raise the cutter head from its work, and when supplied to the other end of the cylinder, assisting the weight of the motor which drives the cutter shaft to snub the cutter and hold it down to its work. Preferably the hydraulic cylinder has a separate control for the alternative operation of lifting the cutter from its work, with coarse and fine controls for the snubber inlet and for the "raise out" inlet.

For further details of the invention, reference may be made to the drawings wherein FIG. 1 is a view in side elevation of a bump cutter according to the present invention.

FIG. 2 is an enlarged sectional view on line 2—2 of FIG. 1.

FIG. 3 is a sectional view on line 3—3 of FIG. 2.

FIG. 4 is an enlarged sectional view on line 4—4 of FIG. 1.

FIG. 5 is a sectional view on line 5—5 of FIG. 4.

FIG. 6 is a flow diagram of the hydraulic control mechanism employed in connection with the invention.

Referring in detail to the drawings, the vehicle 1 has a vehicle frame 2 at the front end of which is rotatably mounted a cutter head 3 on a cutter shaft 4 having a pulley 5 connected by belt 6 to the pulley 7 on the engine 8. Cutter head 3 is disclosed and claimed in Cases A and B and comprises a series of abrasive discs on the cutter shaft with separators for leaving a series of ridges in the pavement, or the abrasive discs may be spaced close enough to make a substantially smooth cut. The engine 8 as shown at 9 is mounted on the rear end of an extension frame 10. Extension frame 10 as shown in FIG. 2 has opposite arms 11 and 12, being somewhat U shaped. The rear end of the extension frame 10 has a hinge connection on a horizontal axis, as shown at 13, with an upright post 14 at each side of the vehicle frame 2, one of these posts being shown in FIG. 1 at 14.

The front end of extension frame 10 has a hinge connection 15 on a horizontal axis with the front truck 16 which has a rear caster wheel 17 and a front wheel 18 for steering. The hinge connection 15 includes suitable bearings 19 on the frame 10, the bearing 20 on the truck 16 and a hinge pin or shaft 21.

The front wheel 18 has an axle 22, see FIG. 3, carried by a bracket 23 fixed to a vertical shaft 24 having a bearing 25 on the body 26 of the truck and a further bearing 27 in a housing 28 fixed to the body 26. The distance from cutter head 3 to the front wheel means or truck 16 is greater than the distance from cutter head 3 to the rear wheel means or rear truck 43.

The shaft 24 at its upper end has a worm wheel 29 meshing with a worm 30 rotatably supported on a horizontal axis by bearings 31 and 32 carried by the casing 28. The worm 30 is connected by a universal coupling 33 to a short steering rod section 34, the latter having a connection through the universal coupling 35 with the front end of the inclined steering rod 36. Steering rod 36 has bearing supports on the extension frame 10 as indicated at 37, 38 and 39. Bearing 39 is a self aligning bearing having a swivel mount to permit steering rod 36 to pivot about hinge 13 while the steering rod is supported from

vehicle frame 2 by bearing 39. The rear end of extension rod 36 has a handle or steering wheel 40 accessible to an operator for whom a seat 41 is provided, this seat being mounted as shown at 42 on the vehicle frame 2.

As the front of the extension frame 10, which determines the height of the cutter head 3 as described later, is mounted by the hinge connection 15 at an intermediate point on the front truck 16, any bump encountered by the forward travel of the front wheel 18 will be reduced in its effect on the extension frame 10 in proportion to the relative distances involved between the hinge connection 15 and the wheels 17 and 18.

The effect of bumps at the rear of the machine during its forward travel, is reduced as follows:

The rear of the vehicle frame 2 is supported by a rear truck 43 which is composed of two truck members 44 and 45 arranged side by side, see FIG. 4.

Truck member 45 has front and rear driven wheels 46 and 47 having axles 48 and 49 having bearing supports 51, 52 and 53, 54 on the truck frame 55. Axle 48 has a sprocket 56 and axle 49 has a sprocket 57. Similarly, the other truck member 44 has a truck frame 58 having bearings 59 and 60 for axle 61 of rear driven wheel 62. Also, truck frame 58 has bearings 63, 64 for the axle 65 of front driven wheel 66. Axle 61 has a sprocket 67 and axle 65 has a sprocket 68.

A drive shaft 70 extends across the middle of both of the truck members 44 and 45 having a sprocket 71 connected by chain 72 to sprocket 56, also having a sprocket 73 connected by chain 74 to sprocket 57, also having a sprocket 75 connected by a chain 76 to sprocket 68, a sprocket 77 connected by chain 78 to sprocket 67, and a central sprocket 79 connected by chain 80, see FIGS. 1 and 4, to a gear box 81, see FIGS. 1 and 6, which is driven by the hydraulic motor 82.

In FIG. 4, the line 113' shows that the width of the cutter head 3 in an axial direction is greater, viz., 24 inches, then the width to the outside edges of the wheels of truck 43, viz., 23 inches. The wheels of the truck 43 thus ride on the path cut by the cutter head 3.

The vehicle frame 2 as shown in Cases A to C has laterally spaced side arms 83 and 84, see FIG. 4, the rear ends of which are supported by bearings 85 and 86 on the opposite ends 87 and 88 of the drive shaft 70 which thus serves as a hinge connection for the rear end of the vehicle frame 2, at a horizontal axis intermediate the front end and rear wheels of the truck members 44 and 45. The truck member or wheel frame 44 is hingedly connected to the drive shaft 70 by means of bearings 44', and the truck member or wheel frame 45 is similarly hingedly connected to the drive shaft 70 by means of bearings 45'. Both the hinge connection just described for the rear end of vehicle frame 2 and the use of individual truck members 44 and 45 contribute to reducing the effect on the cutter head 3 of bumps encountered by the rear truck 43 as the vehicle moves in a forward direction.

As shown in FIG. 1, a hydraulic cylinder 90, see also FIG. 6, has a hinge connection 91 with the extension frame 10, and having a piston 92 and plunger 93 having a hinge connection 94 with a U shaped bracket 95, which as shown in Cases A to C has opposite vertical arms connected to the front end of the arms 83 and 84 of the vehicle frame 2, one of these arms 96 which arises from the front arm 83 which appears in FIG. 1. Also, as described in Cases A to C, the bracket 95 has an adjustable stop 97 to limit the downward movement of, and determine the height of the cutter head 3. As described in connection with FIG. 6, means are provided for supplying hydraulic pressure to the opposite ends of cylinder 90, to either raise the cutter head 3, or to use the hydraulic pressure and the weight of engine 8 to snub the cutter head 3 and hold it to its work.

Turning to FIG. 6 of the drawings, diagrammatically illustrated therein is a hydraulic system which, considered generally, includes a reservoir 98, a hand pump 99 for delivering fluid to one end of the cylinder 90 to snub the cutter head 3 down in engagement with the pavement, a gear pump 105 having its inlet connected to the reservoir, a two-way valve 106 for delivering fluid from the pump 105 to the other end of the cylinder 90 through conduit 118 to lift the cutter head clear of the pavement, a three-way valve 109 for delivering fluid from the pump 105 to the hydraulic motor 82 through conduits 123 or 124, selectively, to drive the motor in one direction or the other to cause it to drive the vehicle 1 forwardly or rearwardly, and an adjustable relief valve 112 for controlling the fluid pressure of fluid to the hydraulic motor 82 irrespective of the direction in which it is driven. Fluid dumped by relief valve 112 flows through the conduit extending downwardly therefrom to conduit 121 and back to reservoir 98. The hand pump 99 and the valves 106, 109 and 112 are so located that they are readily accessible from the operator's seat 41.

Considering the hydraulic system in more detail, the hand pump 99 is of the reciprocating type and includes a plunger 113 reciprocable by a pivoted handle 100, the cylinder, not shown, in which the plunger 113 is reciprocable being provided with an inlet check valve, not shown which communicates with the reservoir 98 through a line 104, and being equipped with an outlet check valve, not shown, which communicates through a line 101 with a snubber port 102 adjacent the upper end of the cylinder 90. Manual operation of the pump 99 delivers fluid from the reservoir 98 to the cylinder 90 above the piston 92 through the lines 104 and 101 to snub the cutter head 3 downwardly against the pavement. The outlet check valve associated with the plunger 113 locks the cutter head 3 in its snubbed condition. As will be apparent, snubbing the cutter head 3 in this manner locks the vehicle and extension frames 2 and 10 together, and makes them in effect a single rigid frame, to apply the maximum possible weight to the cutter head 3 to maintain it in engagement with the pavement without chattering.

When it is desired to release the snubbing action, a relief valve 103 is opened to connect the line 101 to lines 114 and 115 leading to the reservoir 98.

The valve 106 is operated by a handle 107. When it is in one position, other than neutral, it delivers fluid to a line 118 leading to a cutter head lifting port 108. When it is desired to lower the cutter head 3, relief valve 119 is opened and fluid is returned to the reservoir 98 by way of lines 118, 120, 121, 111 and 115. When the valve 106 is in its neutral position, it permits fluid from the pump 105 to flow to the valve 112 and to the valve 109.

The valve 109 is a three-way valve operable by a handle 110. When the valve 109 is in a neutral position, it receives fluid from the pump 105 through the line 116, and returns it to the reservoir 98 through a line 122 and the lines 111 and 115. Under such conditions, the hydraulic motor 82 is inoperative and the vehicle 1 is stationary.

To drive the vehicle 1 in the forward direction, the valve 109 is placed in an operating position such that fluid under pressure from the pump 105 is delivered to one side of the hydraulic motor 82 through a line 123, the spent fluid being returned to the reservoir through a line 124 and the lines 122, 111 and 115. Conversely, when it is desired to propel the vehicle 1 in the reverse direction, the valve 109 is set in a position to deliver fluid under pressure from the pump 105 to the opposite side of the hydraulic motor 82 through the line 124. Under such conditions, spent fluid is returned to the reservoir through the lines 123, 122, 111 and 115.

I claim:

1. In a vehicle-type, pavement leveling machine, the combination of:

(a) frame means having longitudinally spaced front and rear ends;

(b) front wheel means connected to and supporting said frame means adjacent said front end thereof;

(c) a rear wheel assembly connected to and supporting said frame means adjacent said rear end thereof;

(d) rotary cutter means mounted on said frame means intermediate said front wheel means and said rear wheel assembly, and rotatable about a horizontal axis extending transversely of said frame means, for cutting a relatively wide and level path in pavement over which the machine runs;

(e) said rotary cutter means being spaced forwardly from said rear wheel assembly a first longitudinal distance, and said front wheel means being spaced forwardly from said rotary cutter means a second longitudinal distance which is large as compared to said first longitudinal distance so that any tendency of bumps encountered by said front wheel means to move said rotary cutter means vertically is reduced in proportion to the ratio of said first longitudinal distance to said second longitudinal distance;

(f) said rear wheel assembly being behind and in line with said rotary cutter means and the transverse width of said rotary cutter means exceeding that of said rear wheel assembly so that said rear wheel assembly runs on the relatively wide and level path cut by said rotary cutter means to minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically;

(g) said rear wheel assembly including two transversely spaced rear wheel frames each having two rear wheels rotatably mounted thereon in tandem; and

(h) means mounting said rear wheel frames on said frame means for independent pivotal movement of said rear wheel frames about a transverse horizontal axis intermediate said tandem rear wheels on said rear wheel frames to further minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically.

2. In a self-propelled, vehicle-type, pavement leveling machine, the combination of:

(a) frame means having longitudinally spaced front and rear ends;

(b) front wheel means connected to and supporting said frame means adjacent said front end thereof;

(c) a rear wheel assembly connected to and supporting said frame means adjacent said rear end thereof;

(d) rotary cutter means mounted on said frame means intermediate said front wheel means and said rear wheel assembly, and rotatable about a horizontal axis extending transversely of said frame means, for cutting a relatively wide and level path in pavement over which the machine runs;

(e) said rotary cutter means being spaced forwardly from said rear wheel assembly a first longitudinal distance, and said front wheel means being spaced forwardly from said rotary cutter means a second longitudinal distance which is large as compared to said first longitudinal distance so that any tendency of bumps encountered by said front wheel means to move said rotary cutter means vertically is reduced in proportion to the ratio of said first longitudinal distance to said second longitudinal distance;

(f) said rear wheel assembly being behind and in line with said rotary cutter means and the transversed width of said rotary cutter means exceeding that of said rear wheel assembly so that said rear wheel assembly runs on the relatively wide and level path cut by said rotary cutter means to minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically;

(g) said rear wheel assembly including two transversely spaced rear wheel frames each having two rear wheels rotatably mounted thereon in tandem;

(h) means mounting said rear wheel frames on said frame means for independent pivotal movement of said rear wheel frames about a transverse horizontal axis intermediate said tandem rear wheels on said rear wheel frames to further minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically; and

(i) means on said frame means and connected to said rotary cutter means and said rear wheels for driving said rotary cutter means and at least one of said rear wheels on each of said rear wheel frames.

3. A self-propelled, vehicle-type, pavement leveling machine as set forth in claim **2** wherein said front wheel means includes a front wheel frame having tandem front wheels rotatably mounted thereon, said front wheel frame being pivotally connected to said frame means for pivotal movement relative thereto about a transverse horizontal axis intermediate said tandem front wheels, thereby further reducing any tendency of bumps encountered by said front wheel means to move said rotary cutter means vertically.

4. A self-propelled, vehicle-type, pavement leveling machine as set forth in claim **2**, including:

(a) rear main and front extension frames together constituting said frame means and each having front and rear ends;

(b) said main frame having said rotary cutter means and said rear wheel assembly mounted thereon adjacent its said front and rear ends, respectively;

(c) said extension frame having said front wheel means mounted thereon adjacent its said front end;

(d) means pivotally connecting said rear end of said extension frame to said main frame, intermediate said front and rear ends of said main frame, for relative pivotal movement about a transverse horizontal axis; and

(e) abutting stop means on said front end of said main frame and on said extension frame for supporting said front end of said main frame on said extension frame.

5. A self-propelled, vehicle-type, pavement leveling machine as set forth in claim **4** including means interconnecting said extension frame and said front end of said main frame for raising and lowering said front end of said main frame to raise and lower said rotary cutter means out of and into engagement with the pavement.

6. In a self-propelled, vehicle-type, pavement leveling machine, the combination of:

(a) frame means having longitudinally spaced front and rear ends;

(b) front wheel means connected to and supporting said frame means adjacent said front end thereof;

(c) a rear wheel assembly connected to and supporting said frame means adjacent said rear end thereof;

(d) rotary cutter means mounted on said frame means intermediate said front wheel means and said rear wheel assembly, and rotatable about a horizontal axis extending transversely of said frame means, for cutting a relatively wide and level path in pavement over which the machine runs;

(e) said rotary cutter means being spaced forwardly from said rear wheel assembly a first longitudinal distance, and said front wheel means being spaced forwardly from said rotary cutter means a second longitudinal distance which is large as compared to said first longitudinal distance so that any tendency of bumps encountered by said front wheel means to move said rotary cutter means vertically is reduced in proportion to the ratio of said first longitudinal distance to said second longitudinal distance;

(f) said rear wheel assembly being behind and in line with said rotary cutter means and the transverse width of said rotary cutter means exceeding that of said rear wheel assembly so that said rear wheel assembly runs on the relatively wide and level path cut by said rotary cutter means to minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically;

(g) said rear wheel assembly including two transversely spaced rear wheel frames each having two rear wheels rotatably mounted thereon in tandem;

(h) said rear wheel assembly further including a transverse horizontal drive shaft rotatably mounted on said frame means;

(i) said rear wheel frames being independently pivotally mounted on said drive shaft, intermediate the tandem rear wheels on said rear wheel frames, so as to further minimize any tendency of bumps in the pavement to cause said rear wheel assembly to move said rotary cutter means vertically;

(j) said rear wheel assembly additionally including driving connections between said drive shaft and at least one of said tandem rear wheels on each of said rear wheel frames; and

(k) means on said frame means and connected to said rotary cutter means and said drive shaft for driving said rotary cutter means and said drive shaft.

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