United States Patent

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[54] **TRANSVERSE PAVEMENT TEXTURING APPARATUS**
32 Claims, 16 Drawing Figs.

[52] U.S. Cl. 299/39, 51/176
[51] Int. Cl. E01c 23/09
[50] Field of Search 299/39, 40, 41; 51/176

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ABSTRACT: A horizontal frame carried by a hydraulic cylinder and piston mechanism under a vehicle truck chassis. Hydraulic motors rotate a cutter assembly while other hydraulic motors rotate pinions engaging racks fixed to the underside of the frame to propel the cutter assembly transversely across a pavement traffic lane to cut transverse grooves therein of a combined overall width corresponding to the cutter assembly length. The hydraulic mechanism elevates the frame and cutter assembly from the pavement to allow the truck to move along the traffic lane, or lowers the frame and cutter assembly to impose a portion of the truck weight on the cutter assembly. The end portions of the frame are foldable upwardly to reduce the width of the apparatus to within the legal limit for highway travel, and for storage.

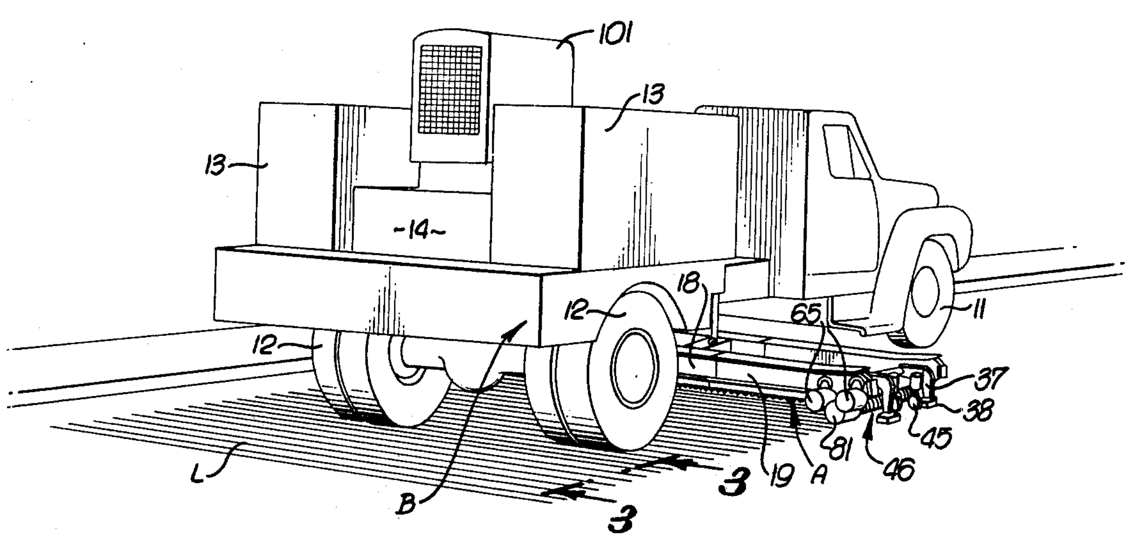


FIG. 1.

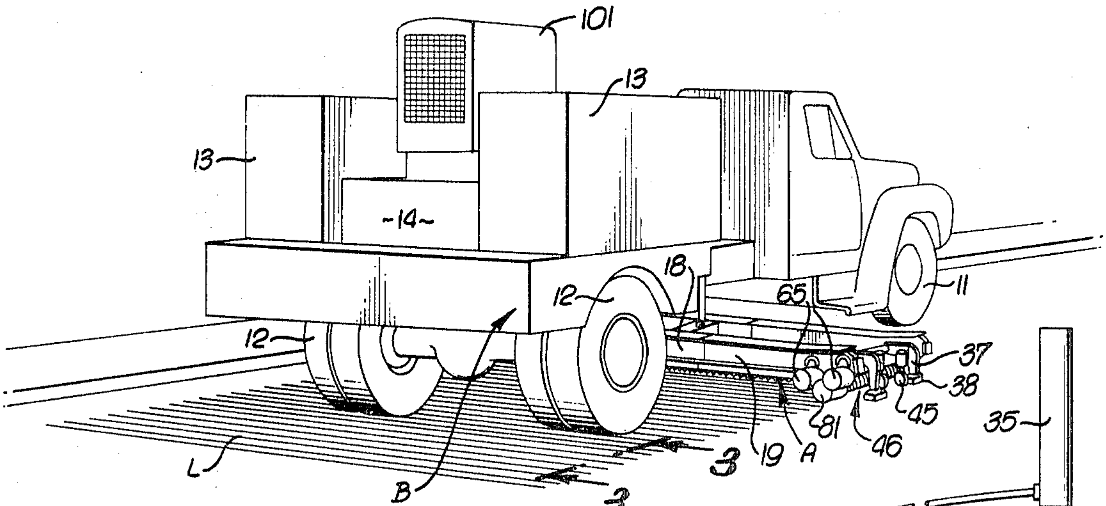


FIG. 2.

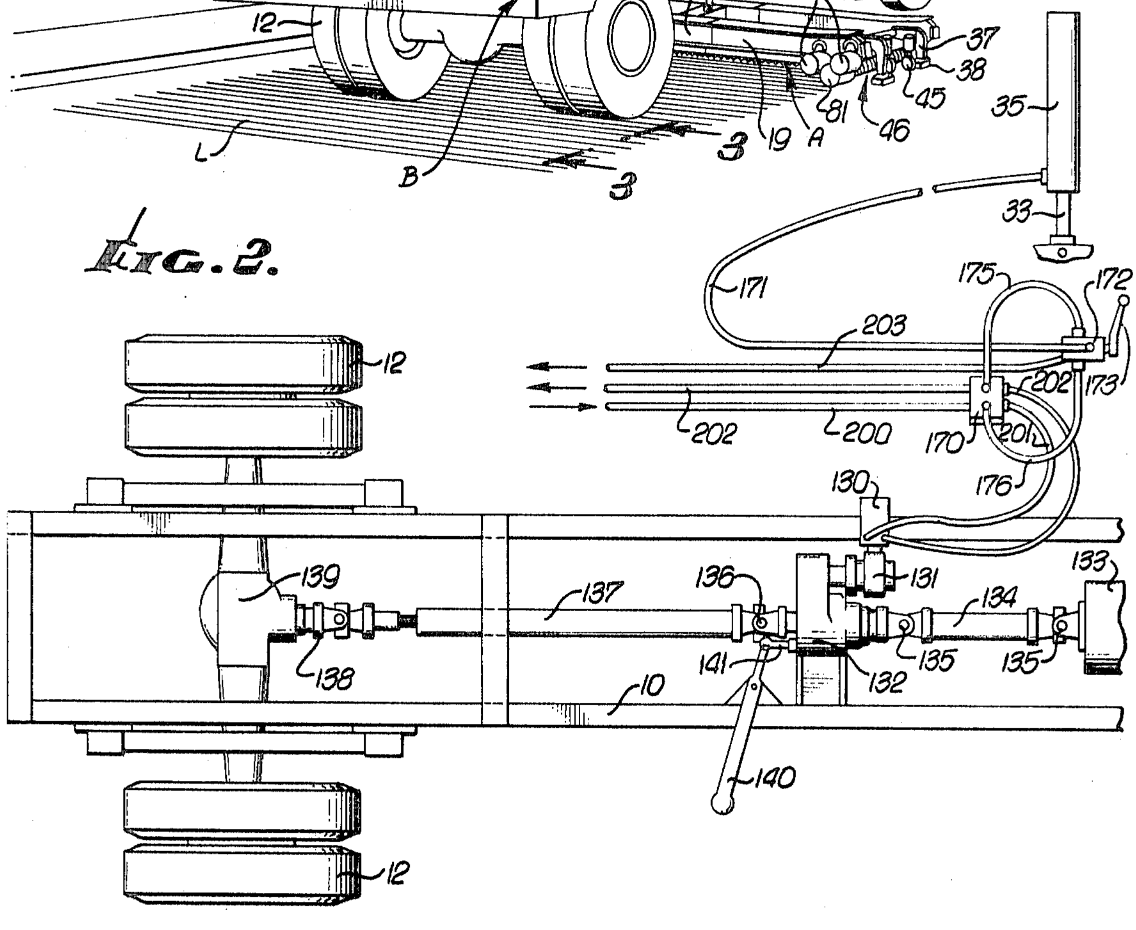
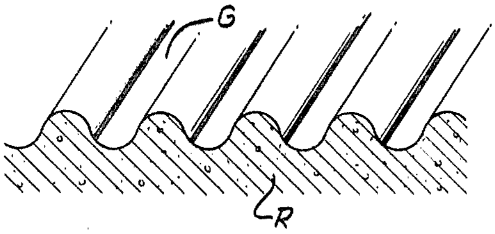


FIG. 3.



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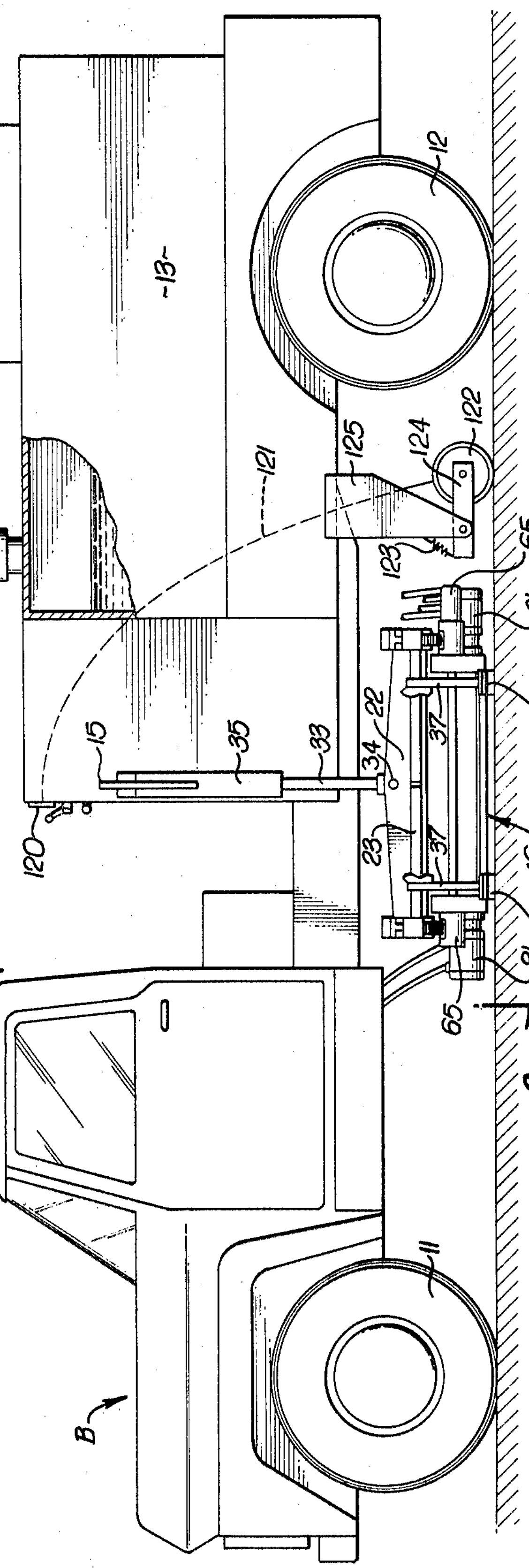

FIG. 4.

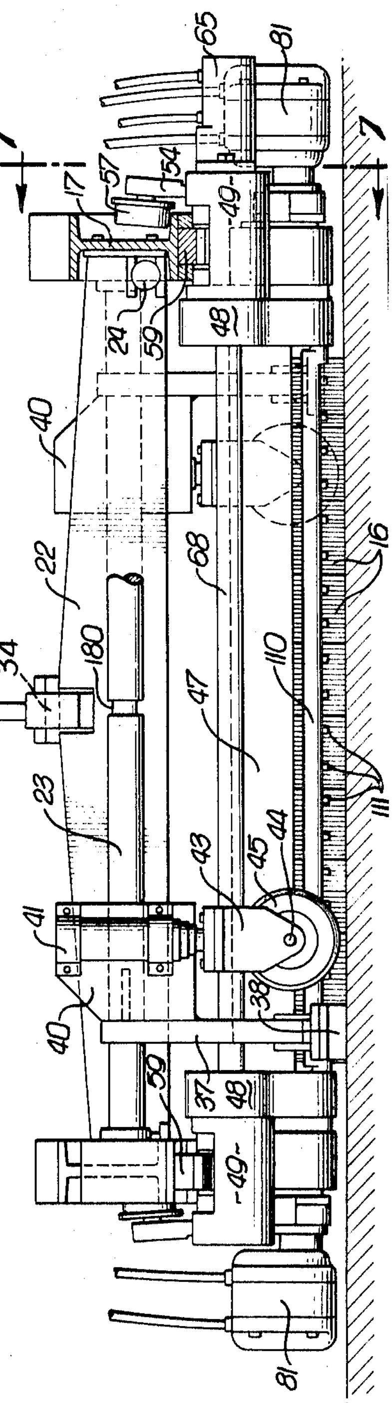

FIG. 5.

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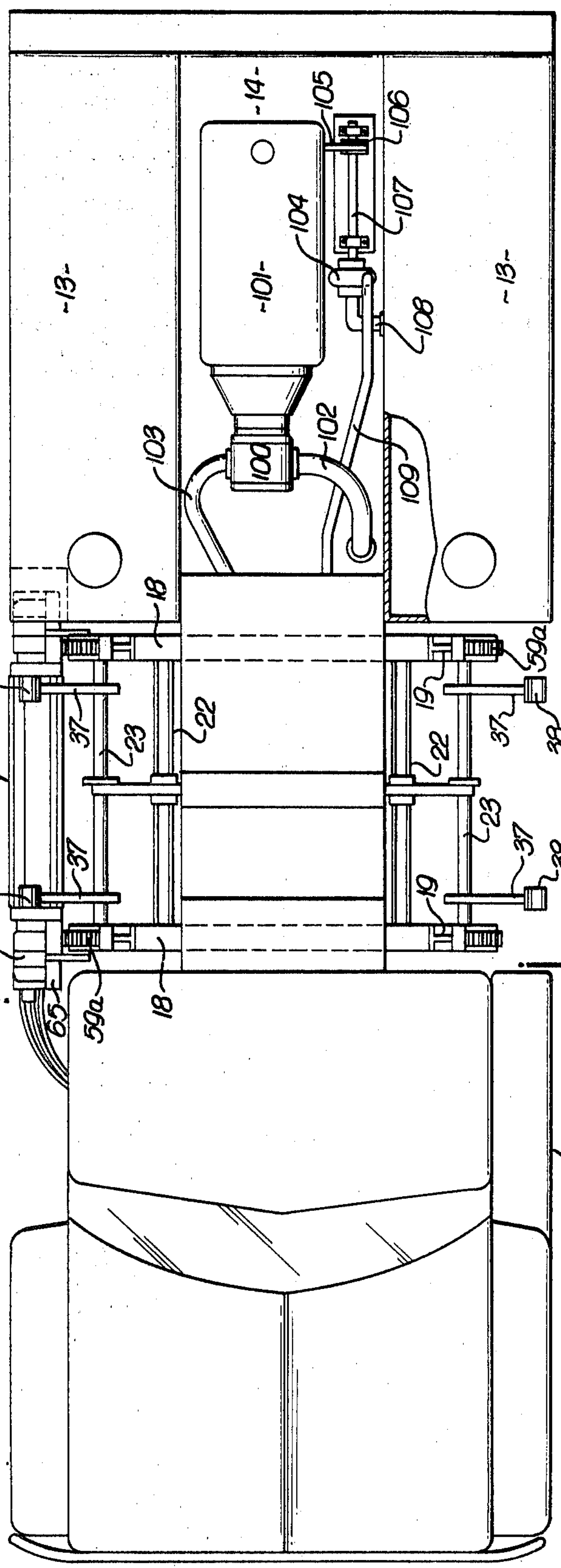

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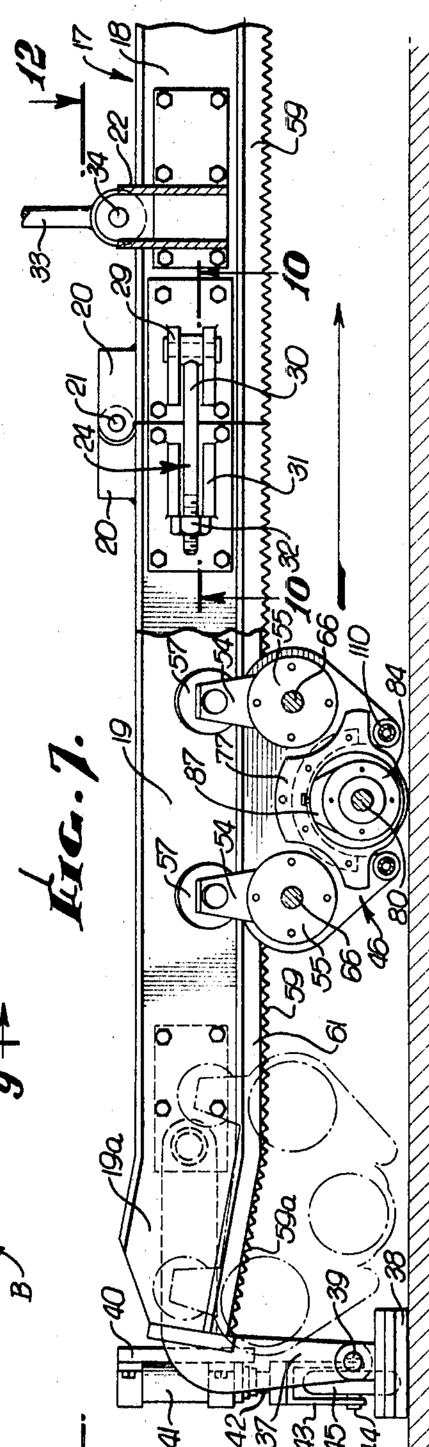

FIG. 7.

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FIG. 8.

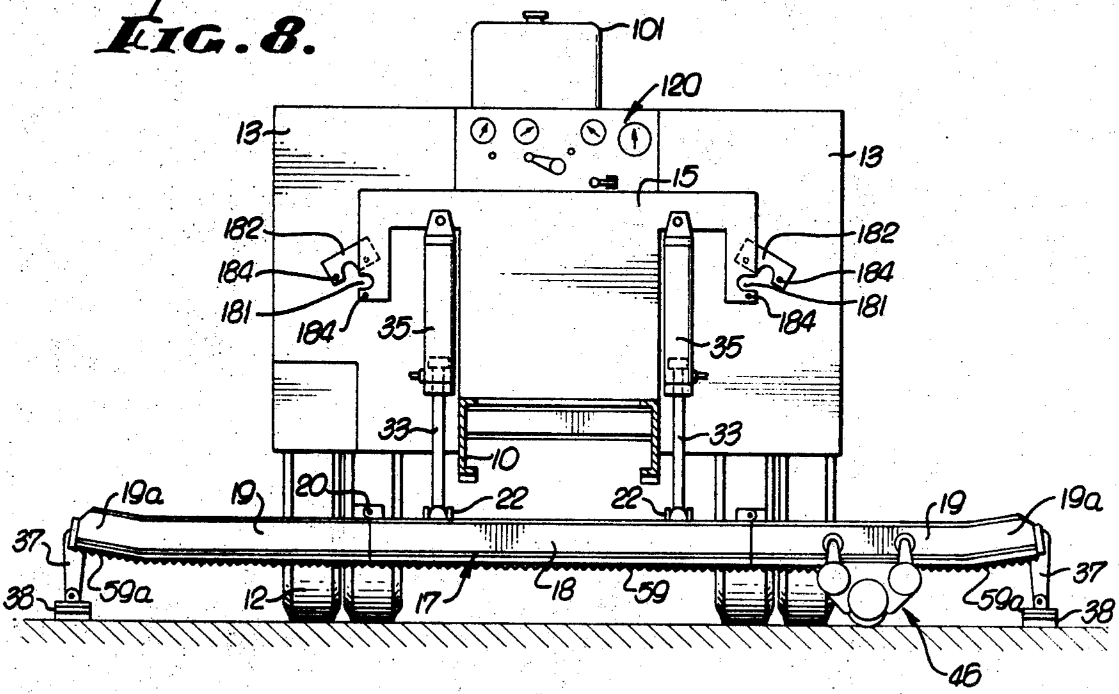


FIG. 10.

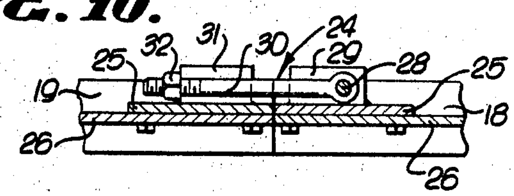


FIG. 9.

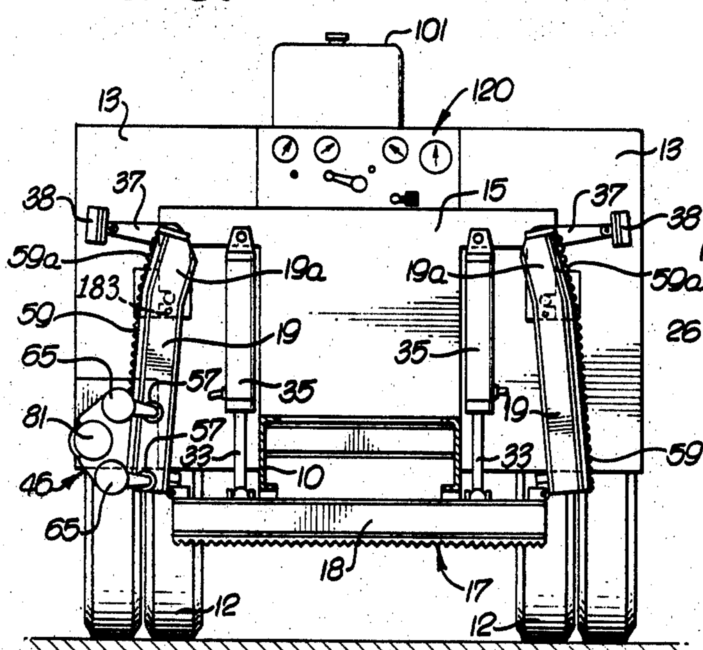
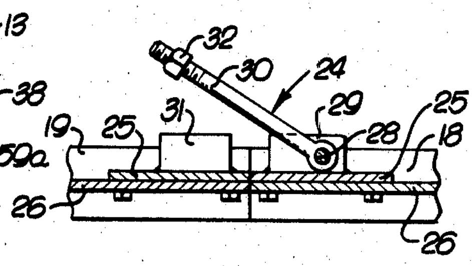


FIG. 11.



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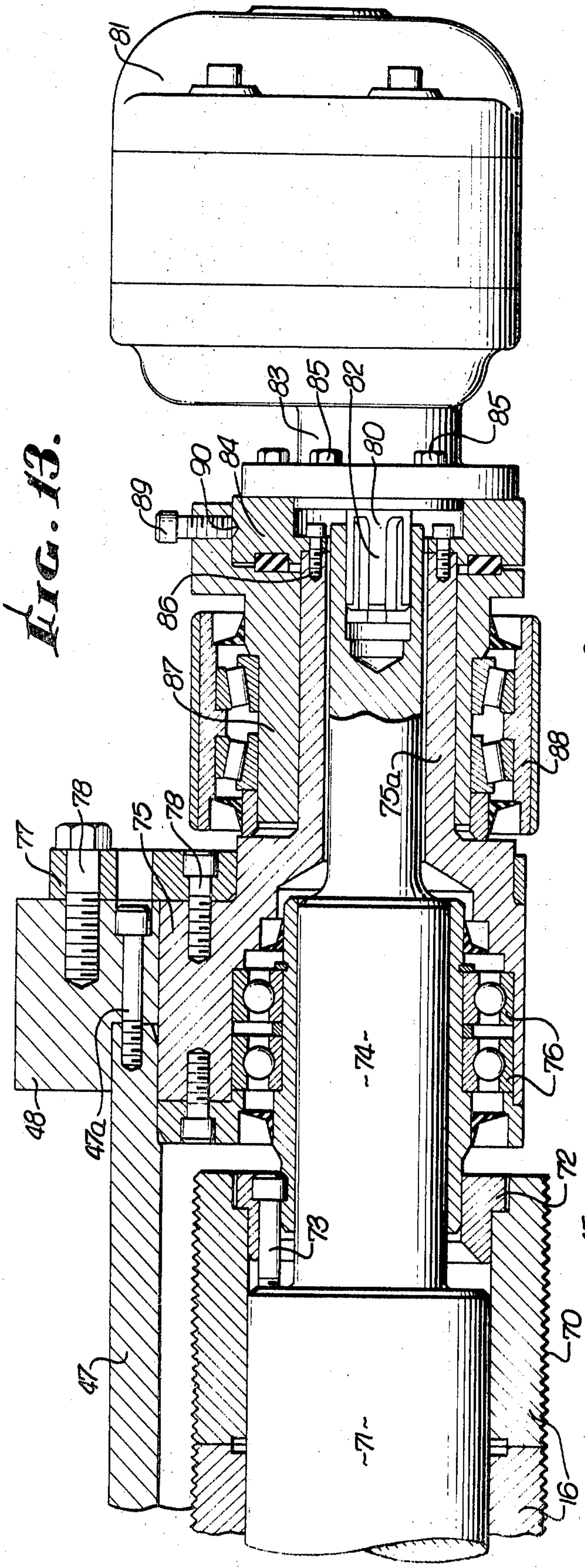

FIG. 13.

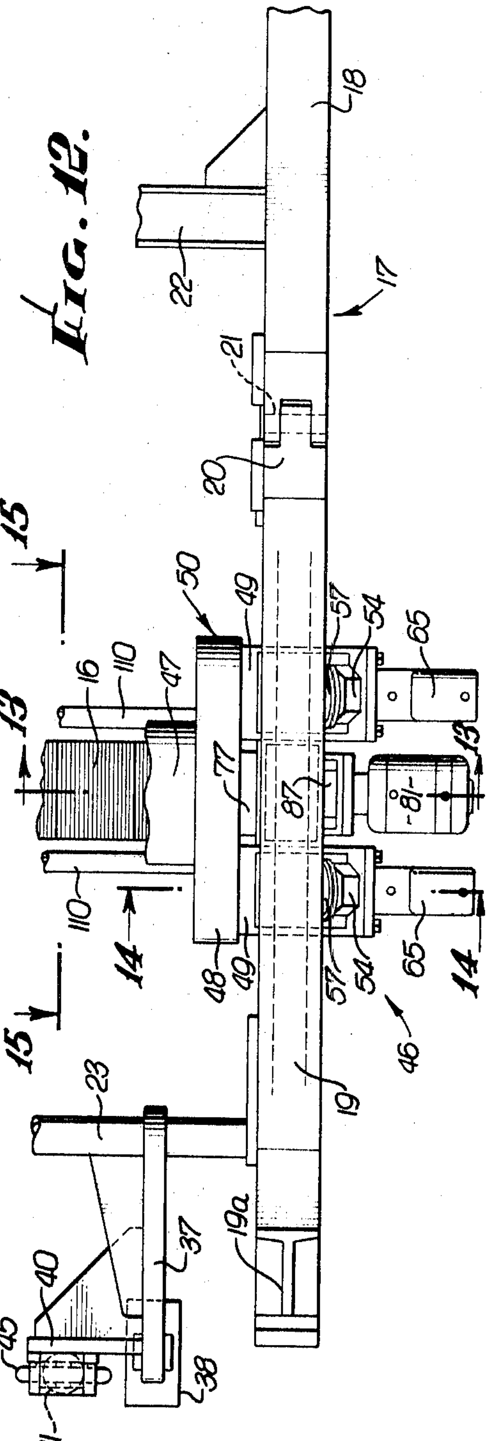

FIG. 12.

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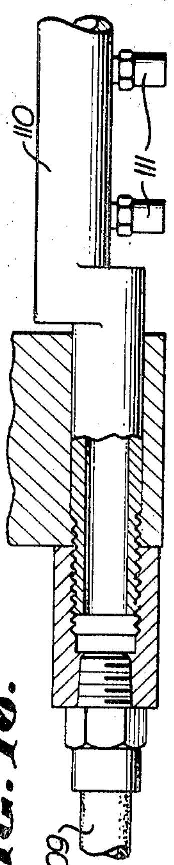

FIG. 16.

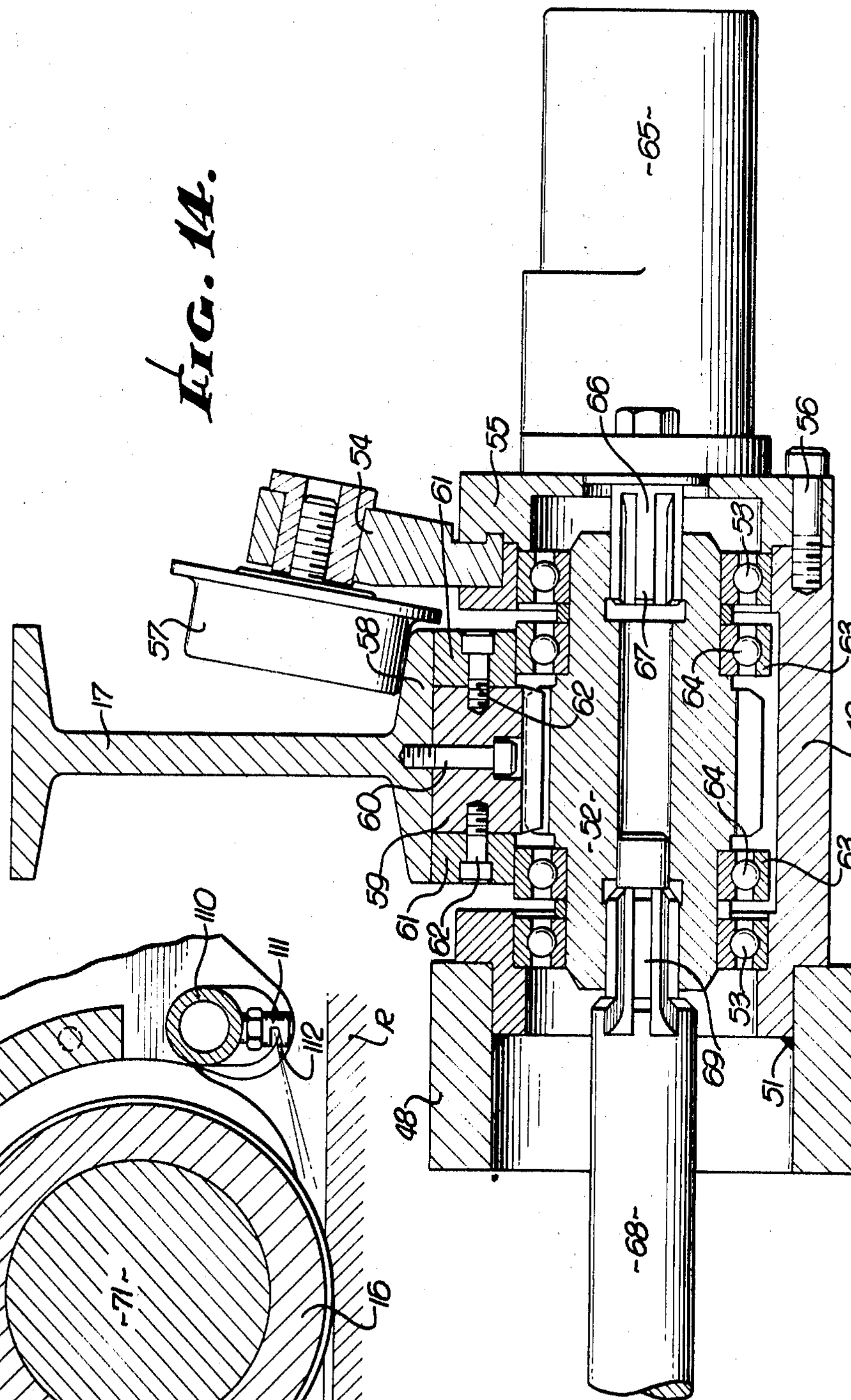

FIG. 14.

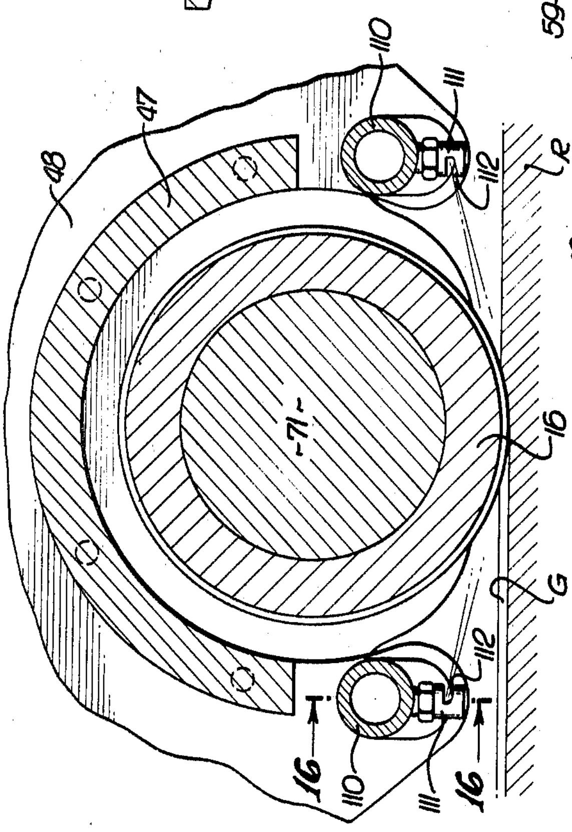

FIG. 15.

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TRANSVERSE PAVEMENT TEXTURING APPARATUS

The present invention relates to apparatus for producing textured surfaces in concrete and similar pavements, and more particularly to apparatus for simultaneously cutting a multiplicity of parallel grooves in pavements transversely across a traffic lane of a highway.

Apparatus is known for cutting grooves in concrete pavement for the purpose of increasing the grip of the vehicle tires on the pavement to prevent skidding, particularly in wet weather. It is desirable to cut closely spaced transverse grooves in the concrete surface to not only increase the grip of the vehicle tires on the pavement, but to allow water to drain transversely from the highway surface and thereby prevent planing of the tires and skidding in wet weather.

Prior apparatus is of an excessive length and can only be used for cutting transverse grooves in a highway surface by blocking substantially all lanes of the highway, which is highly undesirable, particularly on freeways and other highways having a high traffic density.

By virtue of the present invention, a cutter go grooving apparatus is provided, which can cut transverse grooves in a highway lane without necessitating the closing of all lanes of a multiple lane highway. The cutter assembly is mounted on a vehicle truck of a legal width, the cutter assembly being engaged with the highway surface and moved transversely across the traffic lane to cut the grooves therein, whereupon the cutter assembly is elevated from the cutter surface to permit the vehicle to move forward a distance equal to the overall effective cutting length of the cutter assembly, whereupon the foregoing transverse grooving of the traffic lane is repeated. While in use, the cutter apparatus extends beyond the sides of the vehicle, but the end portions of the track upon which the cutter portion traverses transversely of the vehicle and traffic lane are foldable upwardly to permit the travel of the truck along the highway within the legal limit of the maximum width of a vehicle travelling along the highway, also permitting storage of the truck with the cutter apparatus mounted thereon within the space required for the truck itself.

The necessary cutting weight of the cutters against the pavement surface is obtained by imposing a desired portion of the truck weight thereon, to insure he the securing of the proper and uniform depth of cut of the cutters into the pavement is predetermined and is controlled in a simple manner. A safety device is also provided which prevents movement of the truck lengthwise of the highway lane, unless the cutters are elevated from the pavement surface. The apparatus is capable of completing a transverse cutting cycle in a rapid manner, there being alternate transverse movements of the cutter assembly across the highway surface and longitudinal shifting of the truck vehicle to position the cutters for a return traverse pass across the pavement surface to produce parallel grooves therein equal to the overall length of the cutter assembly.

This invention possesses many other advantages, and has other purposes which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIG. 1 is an isometric view of a transverse pavement grooving apparatus applied to a truck and positioned for transversely grooving a traffic lane;

FIG. 2 is a plan view of a portion of the drive mechanism for the truck;

FIG. 3 is an isometric view and section taken along the line 3–3 on FIG. 1 of a portion of textured or grooved pavement produced by the apparatus;

FIG. 4 is a side elevational view of the truck and transverse pavement texturing apparatus;

FIG. 5 is an enlarged side elevational view, with parts broken away, of the pavement texturing apparatus illustrated at the lower central portion of FIG. 4;

FIG. 6 is a top plan view of the truck with the end portions of the supporting rails and rack in a generally vertical, folded condition;

FIG. 7 is a section taken along the line 7–7 on FIG. 5;

FIG. 8 is a section taken along the line 8–8 on FIG. 4;

FIG. 9 is a section taken along the line 9–9 on FIG. 6;

FIG. 10 is a section taken along the line 10–10 on FIG. 7, showing the end portions of the track locked in extended position;

FIG. 11 is a view similar to FIG. 10 illustrating an end portion of the track unlocked for upward folding with respect to the central portion of the track;

FIG. 12 is a top plan view taken along the line 12–12 on FIG. 7;

FIG. 13 is an enlarged section taken along the line 13–13 on FIG. 12;

FIG. 14 is an enlarged section taken along the line 14–14 on FIG. 12;

FIG. 15 is an enlarged section taken along the line 15–15 on FIG. 12;

FIG. 16 is a section taken along the line 16–16 on FIG. 15.

The apparatus illustrated in the drawings is particularly designed for cutting adjacent parallel transverse grooves G in a lane of a concrete roadway R (FIG. 3). In general, it includes a cutter apparatus A carried by a truck or other highway vehicle B, which can proceed lengthwise along a traffic lane L of the roadway. As specifically disclosed, the truck has the usual chassis or main frame **10**, steerable front wheels **11** and rear wheels **12**. It also carries tanks **13** for water used for cleaning the cutters and for flushing the cuttings from the region in which the cutting operation is occurring, as well as a reservoir **14** for a power oil used in operating the cutter apparatus, as described hereinbelow.

The cutter apparatus is supported from a frame **15** suitably secured to the chassis **10** of the truck and is capable of being elevated and lowered with respect to the frame and chassis, to bring the cutters **16** into and out of contact with the roadway surface. As specifically disclosed, the cutter apparatus includes spaced parallel tracks **17** extending transversely of the truck chassis **10**, each track including a center section **18** and swingable end sections **19** at each end of the center track section and pivotally secured thereto at their inner portions to permit the end sections to be swung upwardly to positions nesting within the confines of the truck body. Interweaved hinge brackets **20** (FIG. 7) are welded or otherwise suitably secured to an end of each center track section **18** and the adjacent end of the swingable end section **19**, there being a hinge pin **21** passing through the interweaved portions of the brackets.

Spaced crossmembers **22** extend between and are secured to the spaced-apart center track sections **18**, and a torsion bar **23** extends between and is secured to each pair of spaced end sections **19** near their outer ends. When the end sections **19** have been swung downwardly, to lie horizontally of the center track sections **18** in aligned transverse continuations thereof, they are rigidly secured to the center track sections by clamp bolts **24** (FIGS. 5, 10, 11). There is a bracket **25** welded or otherwise secured to the inner side of the vertical web **26** of each I-beam rail or track section **18**, **19** adjacent to its end, and a bolt **24** associated with each pair of brackets. Each bolt **24** has an eye **27** mounted on a hinge pin **28** extending across the vertically spaced arms **29** of the center track section bracket **25**, the shank **30** of the bolt being swingable to a position between the arms **31** of the adjacent bracket on the swingable end section **19**. When the bolt shank is disposed fully within both pair of arms **29**, **31**, a nut **32** threaded on the shank can be tightened to firmly secure the swingable end section **19** to the center track section **18**. When the four bolts **24** have been tightened with respect to the four sets of brackets **25**, the spaced-apart sets of track sections **18**, **19** form a rigid structure with one another provided by the interconnecting crossmembers 22 and torsion bars 23 attached thereto (FIG. 8).

The tracks 17 extend horizontally and transversely of the truck chassis 10 when the apparatus is in use, and, as stated above, may be raised and lowered with respect to the roadway surface. Such action is provided by a cylinder and piston mechanism, consisting of vertical piston rods 33 on opposite sides of the truck chassis 10, the lower ends of which are secured to the crossmembers 22 by pins 34, the upper ends of which extend into vertical cylinders 35, the upper end of each of which is connected by a pin 36 to the cross frame 15. When hydraulic fluid under pressure enters the lower or rod ends of the cylinders 35, the piston rods 33 are elevated to elevate the track assembly. When hydraulic fluid center enters the head ends of the cylinders 35, the piston rods and tracks 17 are lowered.

Attached to each torsion rod 23 interconnecting the swingable end sections 19 are longitudinally spaced arms 37, which will be disposed substantially vertically when the swingable end track sections 19 are in the horizontal position locked to the center track sections 18, the lower end of each arm having a roadway surface engaging pad 38 secured thereto, as by means of a hinge pin 39 (FIG. 7). Also secured to each arm 37 by means of a bracket 40 is a cylinder 41 containing a piston and piston rod 42, the lower end of the piston rod being secured to a bifurcated wheel support 43 having an axle 44 mounting a roadway engaging wheel 45, the axis of the wheel being substantially parallel to the axes of the truck wheels 11, 12, to support the cutter assembly when it is moved a short distance longitudinally of the concrete roadway lane L, as described hereinbelow. Thus, there are two roadway-engaging pads 38 at each side of the frame structure and also two roadway-engaging pad-elevating wheels 45 at each side of the frame structure.

The grooving mechanism is suspended from the tracks 17, being movable therealong to move a cutter assembly 46 transversely across the roadway lane, in order to make the desired grooving cut in its surface. This apparatus includes a suitable frame structure 50, comprising an elongate curved member 47 extending transversely of the tracks 17 and secured at its opposite ends, as by screws 47*a*, to spaced supporting members 48. Each supporting member extends laterally of and beyond the curved frame member, each frame member 48 having openings therein in which end supports 49 are piloted, being secured thereto by welding material 51, or the like (FIG. 14). A pinion 52 is rotatably mounted in each end support 49 by suitable bearings 53, an upwardly extending bracket 54 being fixed to each end support 49 by a retainer plate 55 attached to the support by screws 56, this bracket carrying a rotatable flanged trolley wheel 57 adapted to engage the upper surface of the lower outer flange 58 of a rail or trackway 17, as disclosed most clearly in FIG. 14. The pinion 52 meshes with gear teeth on the bottom of a rack 59 fixed to the underside of each rail or track by screws 60, there also being rails 61 on opposite sides of each rack attached thereto by screws 62. The undersides of the rails are engaged by rollers 63 on opposite sides of each pinion 52 mounted on the pinion 52 through the agency of ball bearings 64. The engagement of the rollers 63 with the undersides of the rails 61 insures the proper mesh of the gear teeth on each pinion 52 with the teeth of the rack 59.

A reversible hydraulic motor 65 is attached to the retainer plate 55, its shaft 66 being connected to an associated pinion 52 by a spline connection 67. An elongate shaft 68 is connected to the opposite end of each pinion by a spline connection 69, this shaft extending to the other of the parallel tracks 17, where it is connected to another pinion 52 meshing with its rack 59, this pinion also mounting rollers 63 engageable with rails 61 secured to opposite sides of the other rack, not shown in detail since the pinion, rollers, and flanged trolley wheel arrangement 52, 63, 57 is identical to the one specifically disclosed in FIG. 14, except, of course, that the trolley wheel bracket 54 and the flanged trolley wheel 57 are arranged opposite to the structure specifically disclosed in FIG. 14, the trolley wheel engaging the upper side of the lower outer flange 58 of the other parallel track 17.

It will be noted from the drawings, and particularly FIG. 7, that there are two trolley wheels 57, pinions 52, rollers 63, and reversible hydraulic motors 65 spaced from one another along the length of the track 17 at one side of the frame structure, and that the shafts 68 interconnect the pinions 52 on one side of the cutter apparatus with the rack-engaging pinions 52 on the other side of the apparatus.

The aligned cutters 16 are disposed within the curved central portion 47 of the frame, which also functions as a water guard, and extends between the frame members 48 on opposite side thereof. As disclosed, the cutters can assume any desired form for texturing or grooving the surface of the roadway. It is preferably of the type embodying parallel circumferential ridges 70 normal to the axis of the cutter assembly and having diamonds (not shown) therein for effecting the cutting or grooving action in the roadway surface. As an example, the cutters may be of the type disclosed in U.S. Pat. No. 3,306,669. The cutters 16 of the desired length, which, by way of example, may have an overall length of 3 feet, are mounted on and suitably keyed or otherwise secured to a drive shaft 71, being clamped thereagainst by a clamp ring 72 engaging an end cutter and forced thereagainst by clamp screws 73 threaded into the drive shaft. The end cutter at the opposite end of the shaft engages a flange (not shown) on the shaft which serves as an abutment therefor. Each end portion 74 of the drive shaft is of reduced diameter and is carried in a frame member 75 through suitable bearings 76 disposed substantially midway of the end frame members 48, this frame being secured to the latter by means of a plate 77 fastened to members 48, 75 by screws 78. The bearing and frame supporting assembly 48, 75—78 is identical at each end of the cutter drive shaft 71, each end of the shaft being secured to the shaft 80 of a reversible hydraulic motor 81 by a spline connection 82. The motor frame 83 is attached to an adapter 84 by screws 85, the adapter, in turn, being secured to the end frame 75 by screws 86.

An eccentric 87 is rotatably mounted on a each end frame 75, this eccentric carrying a depth of cut roller 88 adapted to engage the roadway surface. By turning each eccentric 87 on the cylindrical portion 75*a* of the frame 75, the periphery of the depth of cut roller 88 can be adjusted vertically so as to determine the extent of penetration of the cutters 16 in the roadway surface. Of course, the cutters 16 will extend a short distance lower than the depth of cut rollers 88, which, for example, may be one-sixteenth of an inch or one-eighth of an inch, such dimension approximating the depth of the grooves G cut in the roadway surface. The eccentric 87 is secured in position of adjustment by a lock screw 89 threaded thereinto and adapted to be received in one of a number of radial depressions 90 in the periphery of the adapter 84.

It will be apparent that the cutters 16 are rotated by the reversible hydraulic motors 81 connected at each end to the drive shaft 71. During rotation of the cutters, they are moved transversely across the roadway lane L by the hydraulic feed motors 65 driving the pinions 52 engaging the racks 59, the entire cutter apparatus 46 being shiftable from one end of the tracks 17 to the opposite end of the tracks. It will be noted that the end portions 59*a*, 19*a* of the racks and rails are inclined upwardly, automatically elevating the cutters 16 from the roadway surface when the end of the run of the cutter apparatus along the tracks is reached. This also enables rotation of the cutters 16 to commence before another traverse along the tracks occurs, the cutters rotating at the appropriate speed before engaging the roadway surface.

Hydraulic fluid under pressure is supplied by a hydraulic pump 100 driven by a suitable power plant 101, such as in an internal combustion engine, mounted on the truck (FIG. 6). The hydraulic oil or other fluid is drawn from the oil reservoir 14 through an intake line 102 into the pump, and delivered through a discharge line 103 to the several hydraulic motors

65, 81, and also to the various cylinders 35, 41 through suitable tubular lines controlled by appropriate valves (not shown). A water pump 104 is also driven by a power takeoff from the engine 101, as, for example, by means of a belt 105 passing over a pulley 106 attached to a shaft 107 connected to the pump rotor, the water being drawn from one of the water tanks 13 through an intake line 108 and discharged through the discharge line 109 to water headers 110 suitably carried by the frame of the cutter apparatus and extending on opposite sides of and along the lower portions of the rotatable cutter members 16, as disclosed in FIGS. 15 and 16. A plurality of nozzles 111 is connected to each water header, having openings 112 directed toward the roadway surface and the bottom portions of the cutters to clean the roadway surface and the cutters of cuttings, insuring appropriate penetration of the cutters into the roadway surface to obtain the desired grooves G extending transversely of the roadway lane. The frame 47 is curved and will provide a water guard confining the water to the cutters and their work region on the lane L.

To obtain a cutting action of the cutters, they must be forced or pressed against the roadway surface during the time they are rotating and traversed transversely across the traffic lane. In the present case, the downward force is provided by imposing a portion of the weight of the truck B and the load carried thereby on the cutters. This is obtained by directing the hydraulic fluid under pressure into the head ends of the cylinders 35, which will force cause the piston and piston rods 33 therein to exert a downward force on the parallel tracks 17, this force being transmitted through the rails 61 to the rollers 63, bearings 53, 64 and pinions 52 to the frame 50 of the cutter mechanism, and then from the frame to the shaft 71 and the cutters themselves, the cutters penetrating into the roadway surface to the extent determined by engagement of the depth of cut rollers 88 with the roadway surface at opposite ends of the cutter assembly.

After the cutter assembly has moved transversely across the traffic lane and has cut the parallel grooves G in the roadway surface, which, for example, may be of the pattern illustrated in FIG. 3, and which may be of an overall width of 3 feet, for example, assuming that the overall length of the cutters is 3 feet, the cutter assembly automatically is elevated slightly by the inclined track portions 19*a*. This assembly and the entire track and frame structure are then elevated with respect to the roadway. Such elevation occurs by exhausting the fluid pressure from the head ends of the main cylinders 35 back to the reservoir 14 and by directing fluid under pressure into the rod ends of the cylinders 35 and into the head ends of the four cylinders 41 at opposite ends of the cutter assembly. The pistons in the latter cylinders are moved downwardly to move the pad elevating wheels 45 into engagement with the roadway surface and raise the entire track structure and the cutters 16 with respect to the roadway surface. At the same time, the fluid under pressure in the rod ends of the main cylinders 35 assists in the elevating action by lifting upwardly on the piston rods 33 to raise the track structure and the cutter carriage supported thereby.

The vehicle B can now move forwardly a distance corresponding to the length of the cutters 16, which, in the above example, is 3 feet, the distance travelled being indicated to the operator on an indicating dial 120 (FIG. 4) connected by a flexible cable 121 to an indicating wheel 122 engaging the roadway surface, and retained in such engagement by a tension spring 123 connected to one end of a lever arm 124 pivotally mounted on a bracket 125 fixed to the vehicle frame 10, and on which the indicating wheel 122 is rotatably mounted. For convenience, and assuming that the distance to be traversed lengthwise along the highway lane is 3 feet, the circumference of the indicating wheel 122 will be 3 feet, and it will rotate the pointer of the indicating dial 360°, or one revolution, to correspond to one revolution of the indicating wheel.

Longitudinal movement of the vehicle to convey the entire cutting apparatus 46 the distance of 3 feet, or to the position of the next grooving cut, is effected by a hydraulic motor 130 connected to a speed-reducing transmission 131, which, in turn, is connected to a selective transmission 132 (FIG. 2). The normal drive to this selective transmission 132 for moving the vehicle B along the highway stems from the usual truck engine through the truck transmission 133 connected by a drive shaft 134 and universal joints 135 to the selective transmission. The output end of the selective transmission is connected through a universal joint 136 to a shaft 137 connected through another universal joint 138 to the usual truck differential 139 for rotating the rear wheels 12 of the vehicle. A shift lever 140 is pivotally mounted on the truck chassis, the inner end of which is connected to a shift rod 141 that will either place the selective transmission in the condition in which the drive from the truck engine through the transmission 133 and drive shafts 134, 137 proceeds to the truck differential 139, at which time the hydraulic motor 130 and speed reducing transmission 131 are uncoupled from the output shaft 137, or one in which the shaft lever is shifted to disconnect the normal drive and to connect the hydraulic motor and speed reducing transmission to the output shaft 137.

The hydraulic motor 130 is used whenever the truck is to be advanced along the roadway lane L a short distance to effect another cut. Accordingly, the shift lever 140 is appropriately manipulated to disconnect the truck engine and transmission 133 from the differential 139 and to connect the hydraulic motor 130 and its transmission 131 thereto. Hydraulic fluid from the pump 100 is directed to the hydraulic motor 130 to effect its rotation and drive the rear wheels 12, the advance of the truck proceeding until the operator notes that the indicating dial has turned a distance corresponding to the overall length of the cutters 16, at which time the application of fluid pressure to the hydraulic motor 130 will be discontinued. Fluid pressure can then be directed to the rod ends of the wheel cylinders 41 to elevate the wheels 45 from the ground, to exhaust the rod ends of the main frame lifting cylinders 35, and to impose the pressure once again on the head ends of the main cylinders, the pads 38 again engaging the roadway. Operation of the cutters 16 and rack and pinion mechanism is again effected to bring the cutter assembly down the incline 19*a* to engage the rotating cutters 16 with the roadway surface, the fluid under pressure in the cylinders 35 imposing a portion of the truck weight on the entire track structure and the cutters, the penetration of the cutters into the roadway being limited by engagement of the depth of cut rollers 88 with the roadway surface.

The entire track frame structure is rigid, and despite the fact that the pads 38 are engaging the roadway surface, the penetration of the cutters into the roadway surface is effected by the action of the fluid under pressure in the head ends of the hydraulic cylinders 35, since the pad arms 37 are connected to the torsion bars 23 and such bars can twist the slight degree necessary to penetrate the cutters into the roadway surface, as limited by the depth of cut rollers 88, and effect the cut as the carriage and cutters are moved along the tracks 17, until the carriage and cutters have reached the opposite ends of the tracks and ride up the inclines 19*a*, at which time the cutters will be out of engagement from the roadway surface. The pressure to the hydraulic motor 130 can be reestablished, following elevation of the pads 38 from the roadway surface, as a result of introducing fluid pressure into the head ends of the wheel cylinders 41 and into the rod ends of the main cylinders 35, for the purpose of advancing the cutter assembly 46 the distance equal to the overall length of the cutters, after which the foregoing cycle can be repeated to cause the reengagement of the pads 38 with the roadway surface, the imposition of the weight on the track assembly, and the bringing of the cutters 16 down the incline regions 19*a* of the tracks into contact with the roadway surface, the cutters proceeding along to the opposite end of the tracks 17. During the cutting operation, the water pump 104 is delivering cleaning fluid liquid to the headers 110 and nozzles 111, to flush the cuttings from the region of work and to keep the cutters 16 in a clean and cool condition. Both the hydraulic motors 81, 65 for rotating the cutters 16 and for rotating the pinions 52 engageable with the racks 59 are reversible to insure the proper direction of rotation of the cutters and the proper direction of feed of the carriage assembly along the tracks 17 from one track end to the opposite track end.

To prevent movement of the vehicle B along the roadway surface with the cutter assembly and pads 38 in engagement therewith, fluid pressure cannot be directed to the reversible hydraulic motor 130 for moving the vehicle forwardly or backward, depending on the direction of desired travel along the roadway, unless fluid pressure is present in the head ends of the wheel cylinders 41 and in the rod ends of the main cylinders 35, which will insure that the entire track frame assembly, cutters, and pads have been raised out of engagement with the roadway surface. Fluid under pressure to the hydraulic motor 130 is directed from the pump 100 to a known four-way directional control valve 170, which is shifted to a position allowing fluid pressure from the pump to travel through the lines 200 and 201 or 202 to the hydraulic motor when pressure is present in a hydraulic line 171 connected to the rod ends of the main cylinders 35 and to the head ends of the wheel cylinders 41. Fluid exhausts from the motor through the lines 202 or 201 and 203 to the tank 14. This four-way valve is shifted to an operative or inoperative position as respects the hydraulic motor 130 by a pilot valve 172 connected through the line 171 to the rod ends of the main cylinders 35 and the head ends of the wheel cylinders 41. When the operator moves the pilot valve lever 173 in one direction from a neutral position to a position to operate the hydraulic motor 130 in a selected direction, fluid pressure in the hydraulic line 171 is required to shift the piston operated, four-way directional control valve 170 to an effective position, the pressure to the valve 170 passing from the pilot valve through either a line 175 or 176. Otherwise, valve 170 cannot be shifted and it remains in an ineffective position, the pressure from the pump being unable to pass to the hydraulic motor 130. When the drive of the hydraulic motor 130 is to cease, the pilot valve lever 173 is shifted to neutral, which will cause the four-way control valve to shut off the flow of fluid from the pump. The four-way directional control valve is of a known construction and is effective to produce rotation of the hydraulic motor in a forward or a reverse direction, under the control of the operator, depending upon the manner in which the pilot valve lever 173 is shifted, or left in a neutral position, in which the hydraulic motor is not operated at all.

When the cutter apparatus is no longer required, or the cutting operation is to cease, the mechanism is elevated to elevate the pads 38 and cutter assembly 46 from the roadway surface, and the cutter assembly is shifted to one end of the tracks 17. The track bolts 24 are released to permit the end sections 19 to swing upwardly about their hinge pins 21 until a circumferential groove portion 180 on each torsion rod 23 enters a socket 181 in the frame 15 (FIGS. 8, 9), whereupon a pivoted closure 182 can be swung down into the circumferential groove 180 and a pin 183 placed through aligned holes 184 in the pivoted closure and the frame to lock the swingable end sections 19 at each side of the track center sections 18 in a substantially vertical position, as disclosed in FIG. 9. When in this position, the entire cutter apparatus 46 is in its elevated condition, as disclosed, and lies substantially entirely within the confines of the truck body. Most states have width limitations for highway travel of 8 feet, the apparatus thus being in the position to permit normal conveyance of the truck B along the highway as a result of shifting the transmission lever 140 to disengage the hydraulic motor 130 from the output shaft 137 and differential 139, and to engage the normal drive mechanism of the truck with the differential so that the truck engine can propel the vehicle over the highway in a normal manner.

It is thus apparent that an apparatus has been provided that can produce a transverse pattern across a highway lane without completely stopping traffic on a multiple lane highway. When the end sections 19 are extended, as disclosed in FIGS. 1 and 10, travel of traffic along two lanes of traffic is prevented, and, in fact, only part of the lane adjacent to the one on which the apparatus is working has traffic flow interrupted. The transverse grooves G are formed in the highway surface along a desired length, which will prevent skidding of vehicles, not only because of the increased grip of the vehicle tires thereon, but by allowing water to drain away transversely of the pavement surface and thereby eliminate planing of vehicle tires on the wet surface. The necessary cutting weight on the cutters 16 is imposed by taking advantage of the weight of the truck and its load itself. Assurance is had that the vehicle can move forwardly a distance equal to one cutter length when the cutter assembly and pads are elevated from the surface. The track structure and the cutter mechanism itself are foldable to within the legal limits of the maximum width of a vehicle traversing a highway, and is readily unfolded to place the complete track structure in a horizontal condition, with its end portions 19 extending beyond the width of the truck, so that the grooving cut can be taken across the full width of a highway lane L. The depth of cut of the cutters is provided in a very simple manner and is adjustable. An entire cycle of cutting transversely across the highway lane is accomplished in a relatively rapid manner. As an example, a full cycle of operation of the apparatus, from completion of a previous cut, through movement of the vehicle a distance equal to the overall length of the cutter, to the completion of the next cut, takes about 3 minutes.

I claim:

1. In apparatus for texturing roadway surfaces: a vehicle having a chassis and roadway-engaging wheels for moving said vehicle longitudinally along the roadway; elongate cutter means; means for supporting said cutter means from said chassis for movement of said cutter means transversely of said chassis and the direction of longitudinal movement of said vehicle along the roadway to produce a cutting action by said cutter means on the roadway surface; said supporting means including means for selectively raising or lowering said cutter means with respect to said chassis and roadway surface to selectively disengage or engage said cutter means with the roadway surface, said raising or lowering means elevating said chassis with respect to the roadway surface after engagement of said cutter means with the roadway surface to impose a portion of the weight of said chassis upon said cutter means.

2. In apparatus as defined in claim 1; and means for elevating said cutter means from the roadway at the end of its transverse movement to permit longitudinal movement of said vehicle along the roadway.

3. In apparatus as defined in claim 1; means for automatically elevating said cutter means from the roadway at the end of its transverse movement to permit longitudinal movement of said vehicle along the roadway; and means preventing movement of said vehicle along the roadway when the cutter means is in engagement with the roadway.

4. In apparatus as defined in claim 1; means for elevating said cutter means from the roadway at the end of its transverse movement to permit movement of said vehicle along the roadway; means for moving said vehicle longitudinally along the roadway after elevation of said cutter means from the roadway; and means for preventing operation of said vehicle moving means unless said cutter means has been elevated from the roadway.

5. In apparatus as defined in claim 1; and means for elevating said cutter means from the roadway to permit movement of said vehicle along the roadway.

6. In apparatus as defined in claim 1; and depth of cut control means engageable with the roadway surface for limiting the depth of penetration of said cutter means in the roadway.

7. In apparatus as defined in claim 1; depth of cut control means engageable with the roadway surface for limiting the depth of penetration of said cutter means in the roadway; and means for adjusting said depth of cut control means to vary the depth of penetration of said cutter means in the roadway.

8. In apparatus as defined in claim 1; and roller means on said cutter means engageable with the roadway surface for limiting the depth of penetration of said cutter means of in the roadway.

9. In apparatus as defined in claim 1; roller means on said cutter means engageable with the roadway surface for limiting the depth of penetration of said cutter means in the roadway; and means for adjusting the axis of said roller means relative to the axis of said cutter means to change the depth of penetration of said cutter means in the roadway.

10. In apparatus for forming grooves and the like in roadway surfaces: a vehicle having a chassis and roadway-engaging wheels for moving said vehicle longitudinally along the roadway; track means carried by and extending transversely of said chassis; cutter means movably mounted on said track means for movement therealong transversely of said chassis and the direction of longitudinal movement of said vehicle along the roadway to cut adjacent grooves in the roadway surface; means for selectively raising or lowering said track means and cutter means with respect to said chassis and roadway surface to selectively disengage or engage said cutter means with the roadway surface, said raising or lowering means elevating said chassis with respect to said track means and cutter means after engagement of said cutter means with the roadway surface to impose a portion of the weight of said vehicle upon said cutter means.

11. In apparatus as defined in claim 10; and means secured to the end portions of said track means and engageable with the roadway surface to support said track means on the roadway surface independently of said vehicle.

12. In apparatus as defined in claim 10; said track means comprising a central section carried by said chassis, and end sections releasably secured thereto for movement inwardly of the vehicle to reduce the overall width of the apparatus for transportation along the roadway.

13. In apparatus as defined in claim 10; said track means comprising a central section carried by said chassis, and end sections pivotally connected to said central section for upward swinging and disposition inwardly of the vehicle to reduce the overall width of the apparatus for transportation along the roadway.

14. In apparatus as defined in claim 10; means for preventing movement of said vehicle along the roadway when said cutter means is in engagement with the roadway.

15. In apparatus as defined in claim 10; means for moving said vehicle along the roadway after elevation of said cutter means from the roadway; and means for preventing operation of said vehicle moving means unless said cutter means has been elevated from the roadway.

16. In apparatus as defined in claim 10; said track means including an upwardly inclined portion at the end thereof, whereby said cutter means rides upwardly of said inclined portion and out of engagement from the roadway.

17. In apparatus for forming grooves and the like in roadway surfaces: a vehicle having a chassis and roadway engaging wheels for moving said vehicle longitudinally along the roadway; a supporting structure carried by said chassis comprising spaced parallel tracks extending transversely of said chassis and the direction of longitudinal movement of said vehicle along the roadway; cutter means movable along said tracks in engagement with the roadway surface to cut adjacent transverse grooves therein; means connected to said supporting structure and chassis for selectively raising or lowering said tracks and cutter means with respect to said chassis and roadway surface to selectively disengage or engage said cutter means with the roadway surface, said raising or lowering means elevating said chassis with respect to said tracks and cutter means after engagement of said cutter means with the roadway surface to impose a portion of the weight of said vehicle on said cutter means.

18. In apparatus as defined in claim 17; racks secured to said tracks; said cutter means comprising pinions meshing with said racks, and means for rotating said pinions to propel said cutter means along said tracks transversely of said vehicle; said cutter means further including an elongate rotatable cutter device, and means for rotating said cutter device during its travel along said tracks.

19. In apparatus as defined in claim 17; racks secured to said tracks; said cutter means comprising pinions meshing with said racks, and means for rotating said pinions to propel said cutter means along said tracks transversely of said vehicle; said cutter means further including an elongate rotatable cutter device, and means for rotating said cutter device during its travel along said tracks; and means engageable with the roadway surface for determining the depth of penetration of said cutter device into the roadway surface.

20. In apparatus as defined in claim 17 racks secured to said tracks; said cutter means including pinions meshing with said racks, and means for rotating said pinions to propel said cutter means along said tracks transversely of said vehicle; said cutter means further including an elongate rotatable cutter device, and means for rotating said cutter device during its travel along said tracks; said raising and lowering means including cylinder and piston means connected to said supporting structure and chassis for selectively raising or lowering said supporting structure and cutter means with respect to said chassis and roadway surface.

21. In apparatus as defined in claim 20, supporting means secured to the end portions of said supporting structure and engageable with the roadway surface to support said supporting structure on the roadway surface.

22. In apparatus as defined in claim 20, said cylinder and piston means comprising means for imposing the portion of the weight of said vehicle of on said cutter device.

23. In apparatus as defined in claim 20, means preventing movement of said vehicle along the roadway when the cutter device is in engagement with the roadway.

24. In apparatus as defined in claim 20, means for moving said vehicle along the roadway after elevation of said cutter device from the roadway; and means for preventing operation of said vehicle moving means unless said cutter device has been elevated from the roadway.

25. In apparatus for forming grooves and the like in roadway surfaces: a vehicle movable along the roadway; a supporting structure carried by the vehicle comprising spaced parallel tracks extending transversely of the vehicle; and cutter means supported by and movable along said tracks transversely of the vehicle and in engagement with the roadway surface to cut adjacent transverse grooves therein; racks secured to said tracks; said cutter means including pinions meshing with said racks, and means for rotating said pinions to propel said cutter means along said tracks transversely of said vehicle; said cutter means further including an elongate rotatable cutter device, and means for rotating said cutter device during its travel along said tracks; and cylinder and piston means connected to said supporting structure and vehicle for selectively raising or lowering said supporting structure and cutter means with respect to the vehicle and roadway surface; additional cylinder and piston means connected to the end portions of said supporting structure; roadway-engaging wheels connected to said additional cylinder and piston means to elevate said supporting structure and cutter means in response to fluid under pressure in said additional cylinder and piston means.

26. In apparatus as defined in claim 25, supporting means secured to the end portions of said supporting structure and engageable with the roadway surface to support said supporting structure on the roadway surface.

27. In apparatus as defined in claim 26, said supporting structure comprising a central section, and end sections pivotally connected to said central section for upward swinging and disposition inwardly of the vehicle to reduce the overall width of the apparatus for transportation along the roadway.

28. In apparatus as defined in claim 26, means for moving said vehicle along the roadway after elevation of said cutter device from the roadway; and ma means for preventing opera-

tion of said vehicle moving means unless said cutter device has been elevated from the roadway.

29. In apparatus for forming grooves and the like in roadway surfaces: a vehicle movable along the roadway; a supporting structure carried by and movable with respect to the vehicle comprising spaced parallel tracks extending transversely of the vehicle; cutter means supported by and movable along said tracks transversely of the vehicle and in engagement with the roadway surface to cut adjacent transverse grooves therein; cylinder and piston means connected to the end portions of said supporting structure; and roadway-engaging wheels connected to said cylinder and piston means to elevate said supporting structure and cutter means in response to fluid under pressure in said cylinder and piston means.

30. In apparatus as defined in claim 29, supporting means

secured to the end portions of said supporting structure and engageable with the roadway surface to support said supporting structure on the roadway surface.

31. In apparatus as defined in claim 30, said supporting structure comprising a central section, and end sections pivotally connected to said central section for upward swinging and disposition inwardly of the vehicle to reduce the overall width of the apparatus for transportation along the roadway.

32. In apparatus as defined in claim 30, means for moving said vehicle along the roadway after elevation of said cutter means from the roadway; and means for preventing operation of said vehicle moving means unless said cutter means has been elevated from the roadway.