United States Patent

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[54] **APPARATUS FOR CONTROLLING INITIAL ENGAGEMENT OF CUTTERS WITH CONCRETE PAVEMENT SURFACES**
24 Claims, 5 Drawing Figs.

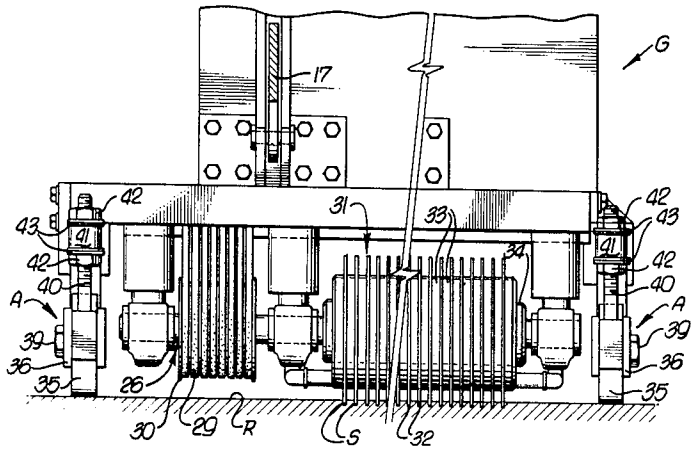
[52] **U.S. Cl.** **299/39,** 51/176
[51] **Int. Cl.** **E01c 23/09**
[50] **Field of Search** 299/39, 40, 41; 51/176

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ABSTRACT: A tractor or wheel loader carries a grooving unit, including a gang of rotating saw blades, for cutting parallel grooves in a concrete pavement. A shock absorber device prevents the saw blades from being lowered rapidly to impact against the pavement and thereby possibly damage the blades. The shock absorber device is initially lower than the blades and contacts the pavement first, gradually retracting to permit gradual lowering and engagement of the saw blades with the pavement.



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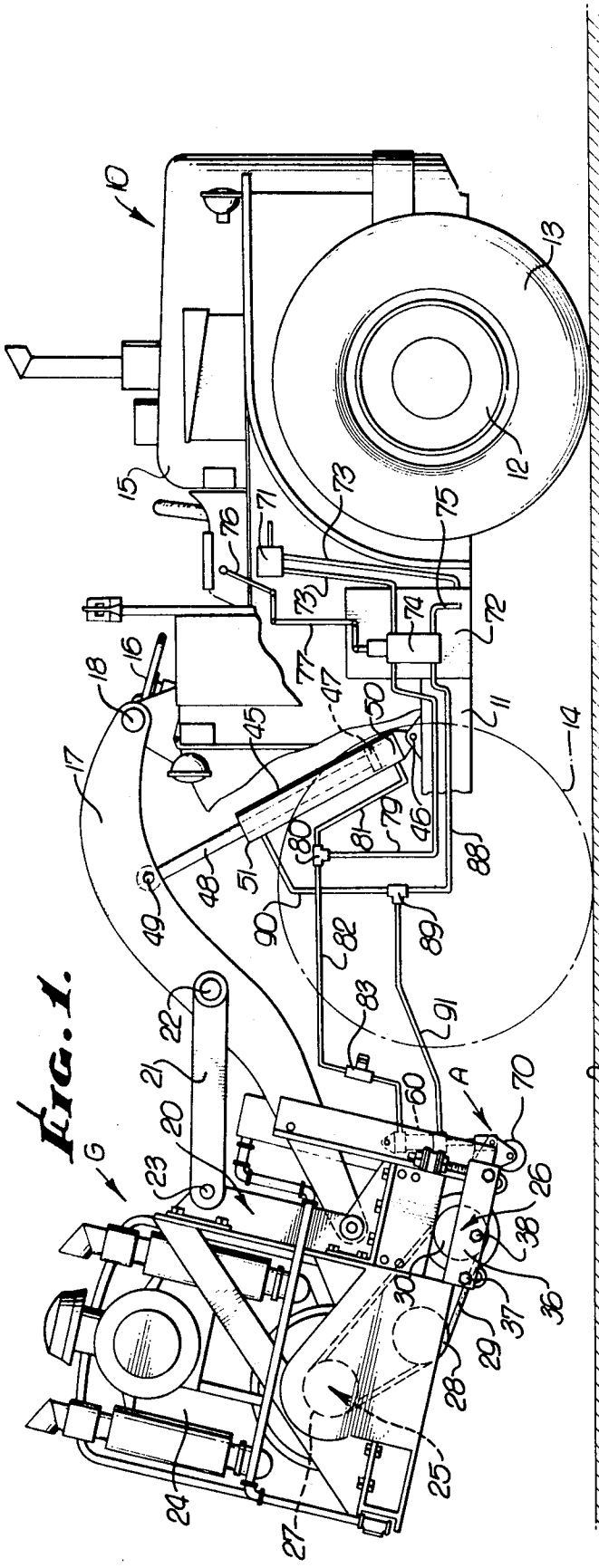


FIG. 1.

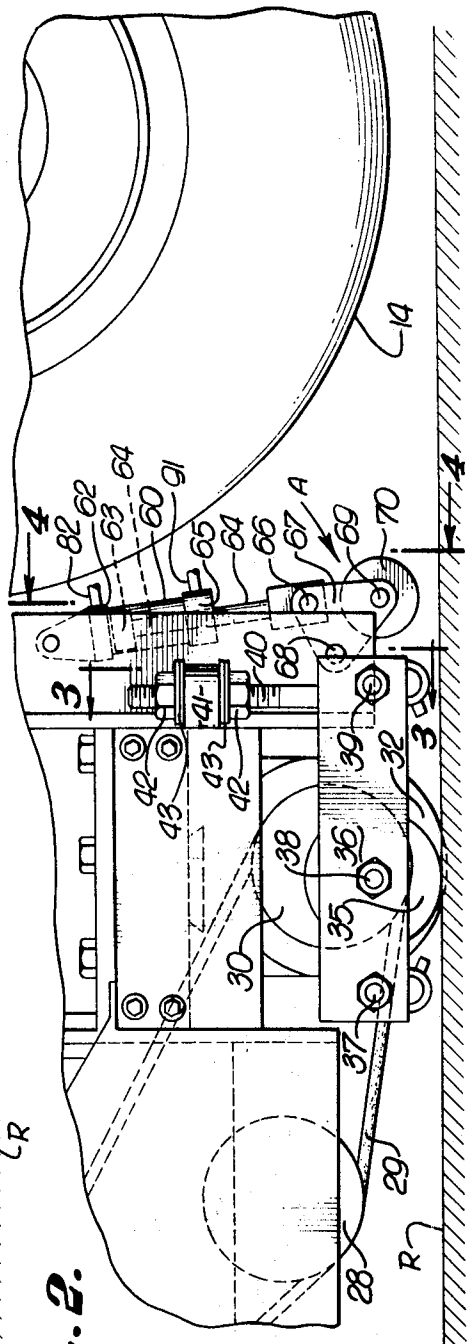


FIG. 2.

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FIG. 3.

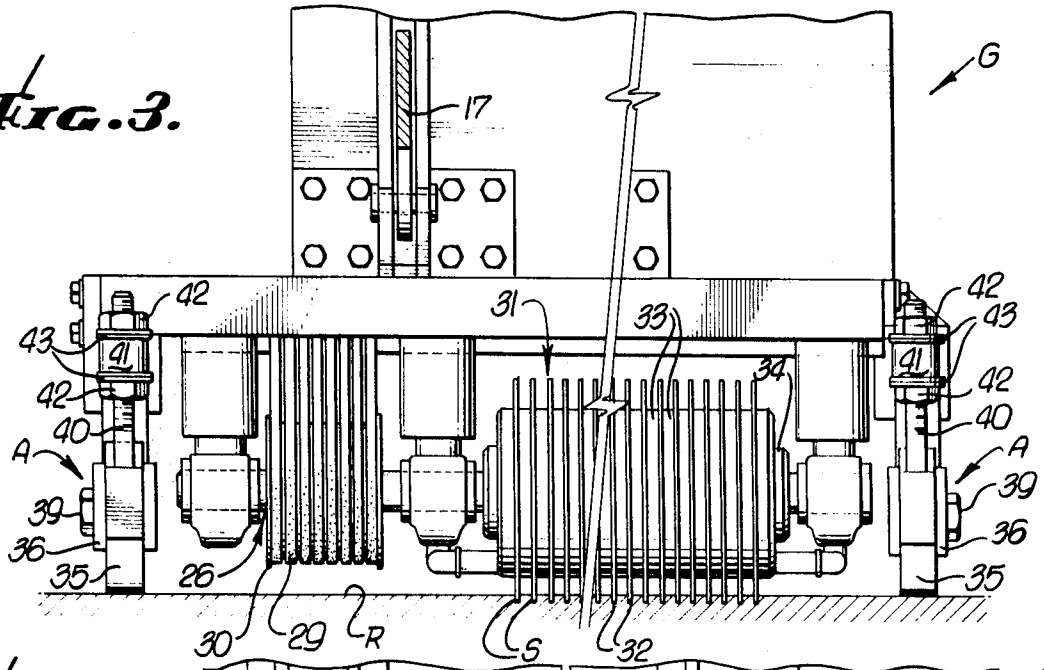


FIG. 4.

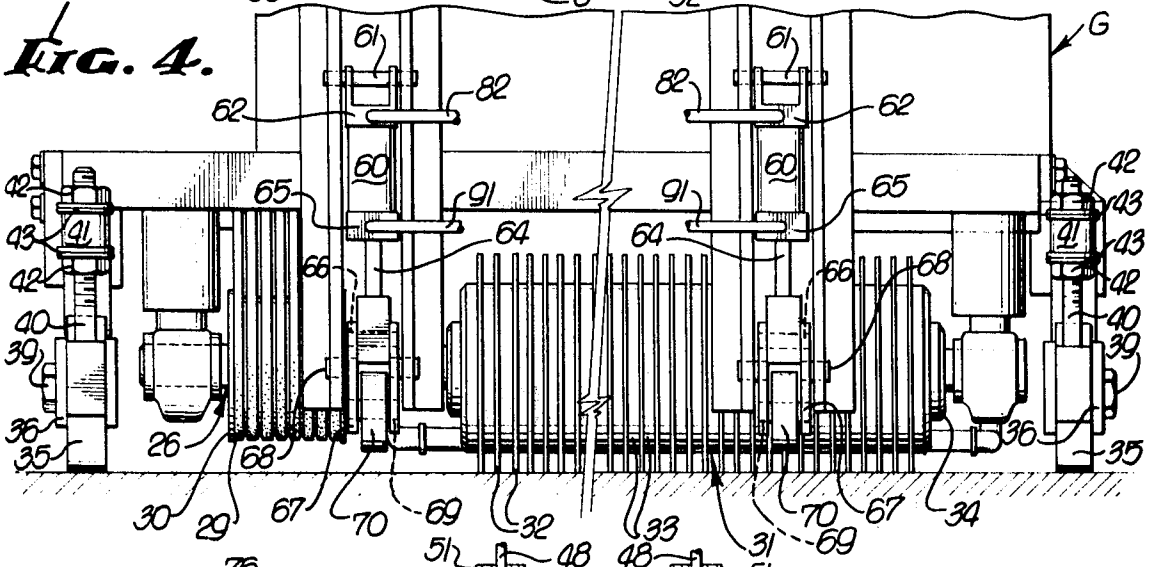
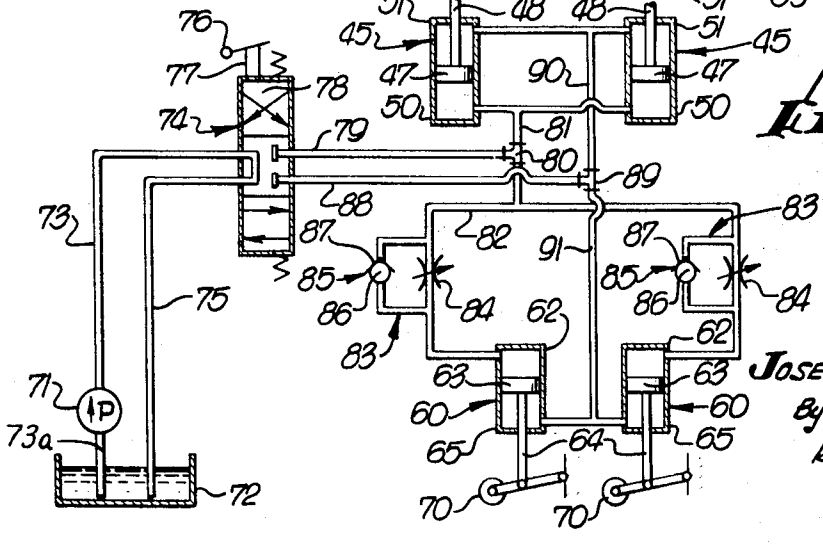


FIG. 5.



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APPARATUS FOR CONTROLLING INITIAL ENGAGEMENT OF CUTTERS WITH CONCRETE PAVEMENT SURFACES

The present invention relates to apparatus for cutting grooves in concrete and similar roadway surfaces, such as in highway and airport runways surfaces.

Apparatus has been provided for cutting grooves in concrete roadway surfaces. One such apparatus includes a gang of closely spaced rotating saw blades or discs that are moved along the roadway to cut shallow parallel grooves therein, to improve traction of vehicle and aircraft wheels thereagainst particularly during inclement weather. The particular four-wheel vehicle with a grooving cutter mechanism mounted thereon forms the subject matter of the application of Frank L. Christensen and Takeshi Mori, Ser. No. 851,193 filed Aug. 19, 1969 for "Machines for Cutting Grooves in Concrete and Similar Roadway Surfaces." In such machine, the gang of saw blades is shiftable from a position elevated above the roadway surface into engagement therewith. It is, however, important to prevent the saw blades from being dropped accidentally or moving rapidly upon the pavement surface, since the impact could damage the saw blades. A gang of saw blades, with a matrix at their peripheral cutting portions containing diamonds, is expensive, a gang capable of grooving an overall pavement width of above 5 feet costing in the neighborhood of $10,000.00

The present invention prevents accidental or too rapid lowering of the cutters of the grooving unit onto the pavement, controlling the vertical down feet of the cutters into the cutting position in the pavement or roadway. A shock absorber means is provided which first contacts the roadway and prevents engagement of the saw blades, or other cutters, therewith, retaining them a short distance above the roadway. After the shock absorber unit engages the roadway, it effects gradual lowering of the cutters into the cutting position, the shock absorber unit then being ineffective. Upon elevating of the cutter members from the roadway, the shock absorber unit automatically repositions itself to extend before the lowermost portion of the cutters, so that subsequent lowering of the grooving unit toward the pavement will again first contact the shock absorber unit therewith, followed by gradual lowering of the cutters the short distance necessary to bring them into appropriate cutting position with respect to the pavement.

More specifically, the shock absorber mechanism is operatively associated with the mechanism for raising and lowering the cutters into and from engagement with the pavement, such that elevating of the cutters from the pavement automatically extends the shock absorber mechanism so that it engages the pavement surface and prevents the cutters from bearing there against, after which the shock absorber, as noted above, automatically retracts to permit the gradual lowering of the cutters into their cutting position with respect to the pavement. If the lowering mechanism were to suddenly drop the grooving unit toward the pavement surface, the cutter blades could not contact the latter since the shock absorbers would first engage the surface, preventing the blades from contacting the latter. The cutting action then occurs without interference from the shock absorber mechanism. When the cutters are elevated from the pavement, the shock absorber is again automatically brought into its operative position in response to elevation of the cutter or grooving unit from the pavement.

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.

Referring to the drawings: FIG. 1 is a partially diagrammatic side elevational view of a machine embodying the invention, with its grooving unit elevated from a roadway surface and its shock absorber unit in extended position;

FIG. 2 is an enlarged side elevational view of a portion of the grooving unit, located in engagement with the roadway surface, with the shock absorber unit retracted, and a vehicle wheel raised from the roadway surface;

FIG. 3 is an enlarged cross section, taken along the line 3—3 on FIG. 2;

FIG. 4 is an enlarged cross section, taken along the line 4—4 on FIG. 2; and

FIG. 5 is a diagrammatic view of the hydraulic system of the machine.

With the exception of the shock absorber mechanism and the hydraulic system illustrated in the drawings, the machine for cutting grooves S in concrete and similar roadway surfaces R is illustrated in the above-identified U.S. patent application. In view of such illustration and description only those portions of the apparatus will be described for the purpose of setting forth the present invention, since a complete description is unnecessary to its understanding. The machine includes a four-wheel vehicle **10** which may be of a conventional tractor or wheel loader type manufactured by the Caterpillar Tractor Company. It has a main frame or chassis **11** with one set or a pair of steerable wheels **12** including pneumatic tires **13**, which for steerable wheels **12** including pneumatic tires **13**, which, for convenience, may be referred to as steerable front wheels, and another set or pair of wheels **14** including pneumatic rubber tires which, set or pair of wheels **14** for convenience, may be referred to as r ear wheels. The unit has the usual internal combustion engine **15**, such as a diesel engine, that drives through a torque converter or other variable ratio transmission (not shown) to both the front and rear wheels to effect a four-wheel drive. The steerable wheels **12** are steered through a known mechanism by appropriate turning of a steering wheel **16** manipulated by the driver. A pair of spaced swing ro lift arms **17** are pivotally connected at their forward end portions to the upper part of the frame or chassis by hinge pins **18**, the rear or lower ends of these arms being connected by pins **19** to the movable frame **20** of the grooving unit G of the machine. A pair of laterally spaced upper arms **21** are also connected by forward connector pins **22** to the swing arms **17** and by rear connector pins **23** to the movable frame **20** of the highway grooving unit.

The movable frame **20**, which is disposed behind the rear wheels **14** of the machine, carries an internal combustion engine **24**, such as a diesel engine, the crankshaft **25** of which rotates a shaft structure **26** through a suitable transmission, such as a belt and pulley transmission **27**, **28**, **29**, **30**, rotatably supported in bearings fixed to the fame. The drive shaft structure **26** is suitably fixed to a saw blade assembly **31**, comprising a plurality of saw discs or cutters **32** separated by spacers **33** and clamped to a mandrel **34** suitably attached to the drive shaft structure. The rim portion of each saw blade **32** may comprise a matrix of diamonds and other material for effectively cutting the concrete roadway surface. The saw blade or cutter assembly **31** may assume any required form, one such assembly being illustrated and described in the patent application of Warren J. Hughes and Donald H. Mabey, Ser. No. 788,838,, filed Jan. 3, 1969, for "Rotary Cutter Assembly."

As illustrated, the depths of penetration of the saw blades into the roadway surface, that is to say, the depth of cut of the parallel saw blades in producing the grooves S in the roadway surface, is determined by a pair of depth-of-cut rollers **35** located at opposite sides of the movable frame. Thus, a support arm **36** is pivotally mounted on the frame at each of its sides by a pivot pin **37**, each arm having an axle **38** rotatably mounting a depth-of-cut roller **35** engageable with the roadway or airport runway surface R. The end of the support arm **36** opposite the pivot pin **37** is connected by means of a pin **39** to a generally vertically adjustable rod or shaft **40** having an upper threaded portion passing through a boss **41** fixed to the movable frame **20**. Threadedly mounted on the threaded shaft portion and above and below the boss are nuts **42** bearing against washers **43** engaging the upper and lower surfaces of the boss. Appropriate turning of the nuts at each side of the

frame will effect vertical adjustment of the shaft **40** to move the forward ends of the support arms up or down and shift the axes of the depth-of-cut rollers **35** with respect to the axis of the cutter shaft **26**. The rollers **35** are located a desired distance above the lower periphery of the saw blades **32**, thereby determining the depth of penetration of the saw bladed or cutters into the roadway surface R, which determines the depth of the grooves S cut into such surface. Following adjustment of the depth-of-cut rollers, the nut **42** are retightened against the washers **43** and the washers against the upper and lower sides of the bosses **41** to retain the depth-of-cut rollers in the position to which they have been adjusted.

The movable frame **20** and saw blade assembly **31** and depth-of-cut rollers **35** carried thereby are shiftable as a unit in a vertical direction to bring the saw discs and rollers into and out of engagement with the pavement surface. The shifting or actuating mechanism includes a pair of laterally spaced cylinders **45** having lower ends connected hinge pins **46** to the frame or chasses **11** of the wheel loader vehicle. Each cylinder has a piston **47** slidable therein and secured to a piston rod **48** extending from the upper end of the cylinder and connected by a pin **49** to a swingable arm **17**. The introduction of fluid under pressure into the head or lower ends **50** of the cylinders will shift the pistons **47** and piston rods **48** upwardly to swing the arms **17** and the entire movable frame **20** upwardly with respect to the roadway or pavement surface. On the other hand, the bleeding of fluid under pressure from the head ends of the cylinders and the introduction of such fluid under pressure into the upper or rod ends **51** of the cylinders will effect retraction of the piston rods **48** into the cylinders and downward movement of the swing arms **17** and the movable frame **20** to bring the depth-of-cut rollers **35** and the saw blades **32** downwardly. Prior to lowering of the grooving unit G, rotation of the saw blade assembly **31** by the internal combustion engine **24** on the frame is initiated, operating through the transmission **27–30**. The continued application of fluid under pressure into the rod ends **51** of the cylinders, after the shock absorber portion A of the grooving unit, described hereinbelow, has contacted the pavement, will effect elevation of the rear of the frame or chassis **11** and of the rear wheels **14** from the pavement surface. Thereafter, as set forth hereinbelow, the shock absorber unit A gradually retracts to slowly lower the rotating saw blades **32** and depth-of-cut **35** into contact with the pavement surface R. The weight of the wheel loader type of mechanism **10**, to which the movable frame **20**, saw blade assembly **31**, and depth-of-cut roller mechanism has been secured, is quite large, and more than adequate for insuring penetration of the cutters **32** into the roadway surface to the desired depth, with the depth-of-cut rollers **35** engaging the roadway surface to limit the extent of penetration of the saw blades into the pavement.

Two shock absorber devices A are used being laterally spaced from one another. Each unit is carried by the movable frame **20**. As shown, each unit includes a cylinder **60** mounted on the movable frame by a pin **61** passing through the upper end **62** of the cylinder and pivotally securing it to the frame **20** (FIG. **4**). The cylinder has a piston **63** slidable therein secured to a piston rod **64** extending from the rod end **65** of the cylinder and connected by a pivot pin **66** to a support **67** pivoted upon the movable frame **20** by a hinge pin **68**. The support carries an axle **69** rotatably mounting a pavement engaging wheel **70**. When fluid under pressure is introduced into the upper or head ends **62** of the cylinders, the pistons **63** therein are moved downwardly to move the piston rods **64** downwardly and swing the supports **67** about their hinge pins **68** and thereby lower the wheels or rollers **70**. When in their lower position, such rollers **70** will contact the pavement R, when the movable frame **20** is shifted downwardly, before the saw blades **32** can contact the pavement, the latter being prevented from engaging the pavement. When fluid under pressure is introduced into the rod ends **65** of the cylinders **60**, the pistons **63** are elevated therein, which swing the supports **67** upwardly and bring the rollers **70** upwardly to permit engagement of the saw blades **32** and depth-of-cut rollers **35** with the pavement. As described hereinbelow, such elevation or retraction of the supports **67**, rollers **70**, piston rods **64** and pistons **63** occurs gradually so that the rotating saw blades **32** are brought in a gradual manner into contact with the pavement R and into grooving relation to the pavement.

As illustrated, the vehicle or wheel loader **10** has a pump **71** driven constantly by the vehicle engine **15** when it is rotating, which draws a fluid or liquid, such as oil, from a supply tank **72** through a suction line **73***a* and delivers such fluid under high pressure to a discharge line **73** running to a three-position valve **74** mounted on the vehicle. A return line **75** extends from this valve to the supply tank **72** to return hydraulic fluid thereto. The three-position valve **74** is actuated by the operator through a control lever **76** and suitable linkage **77** running to the movable spool **78** of the three-position valve. A fluid pressure line **79** extends from one end of the three-position valve to a junction **80**, another line **81** extending from this junction to the lower or head end **50** of each hydraulic lift cylinder **45**. Another line **82** extends from this junction to the head end **62** of each of the shock absorber cylinders **60**, each of these latter lines having a flow control valve **83** therein including a metering orifice **84** and a check valve **85** having a seat **87** and a ball **86** engageable therewith to permit free flow of fluid through the line **82** toward the cylinder **60**, but which seats to preclude flow of fluid from the cylinder back towards the junction **80**. Another line **88** extends from the three-position valve **74** to another junction **89**, a fluid line **90** running from this junction to the rod end **51** of each cylinder **45**, and a fluid line **91** from the junction **89** to the rod end **65** of each of the shock absorbing cylinders **60**.

The hydraulic system is illustrated diagrammatically in FIG. **5**. As disclosed therein, the three-position valve **74** can occupy a neutral position, in which fluid under pressure from the pump **71** flows through the pump discharge line **73** into the valve and then returns therefrom through the return line **75** to the supply tank **72**. When in this position, fluid cannot flow through either of the other lines **79**, **88** to either the head or rod ends of the lift cylinders **45** or to either the head or rod ends of the shock absorber cylinders **60**. Actuation of the control liver **76** by the operator in on e direction, as upwardly as disclosed in FIG. **5**, will place the high pressure pump discharge line **73** in communication with the fluid lines **79**, **80**, **81**, **82** running to the head ends **50** of the lift cylinders **45** and to the head ends **62** of the shock absorber cylinders **50**, elevating the pistons **47** in the lift cylinders to elevate the entire grooving mechanism G from the pavement R, and at the same time shifting the pistons **63** in the shock absorber cylinders downwardly to lower the shock absorber wheels or rollers **70**. Fluid in the rod ends **51** of the lift cylinders **45** and in the rod ends **65** of the shock absorber cylinders **60** can then return through the return line **90**, **91**, **89**, **88**, **75**, to the supply tank **72**.

To effect engagement of the shock absorber A and saw blades **32** with the pavement, the control lever **76** is moved in the opposite direction, to lower the spool **78** of the three-position valve to it slower position as seen in FIG. **5**, which will place place the high pressure pump discharge line **73** in communication with the fluid lines **88**, **89**, **90**, **91** running to the rod ends **51** of the lift cylinders **45** and to the rod ends **65** of the shock absorber cylinders **60**. At the same time, the head ends **50** of the lift cylinders **45** and the head ends **62** of the shock absorber cylinders **60** are placed in communication with the return line **75** running to the supply tank **72**. The pistons **47** in the lift cylinders are then lowered therewithin to shift the movable frame **20** downwardly, together with the shock absorber mechanism A, depth-of-cut rollers **35** and saw blades **32** carried thereby, the fluid pressure in the rod ends **65** of the shock absorber cylinders **60** tending to elevate the pistons **63** therein. However, the fluid in the head ends **62** of these cylinders can only flow outwardly therefrom at a relatively slow rate, since all of such fluid must pass through the choke orifices or metering devices **84** before flowing through the lines **82**, **80**, **79**, **75**, back to the supply tank **72**.

Fluid under pressure is permitted to flow into the rod ends **51** of the lift cylinders **45** until the shock absorber rollers **70** engage the pavement R, the lift cylinders then moving upwardly to raise the rear end of the chassis **11** and the rear wheels **14** from the pavement surface, so that a large portion of the weight of the vehicle **10** and of the grooving unit G is then being borne by the wheels or rollers **70** of the shock absorber unit. When the rear wheels **14** are elevated from the pavement, which for example, may be a distance of about 2 inches thereabove, the control lever **76** may be manipulated to place the three-position valve **74** in the neutral position, thereby trapping fluid in the rod ends **51** of the lift cylinders and in the rods ends **65** of the shock absorber cylinders. However the weight of the rear portion of the vehicle is being imposed on the hydraulic fluid in the rod portions of the lift cylinders **45**, which thereby maintains a high unit pressure of fluid in such cylinders **45**, which thereby maintains a high unit pressure of fluid in such cylinders, this pressure being transmitted through the fluid lines **90, 91** running to the rod ends of the shock absorber cylinders **60**. Thus, there is fluid pressure in the shock absorber cylinders elevating the pistons **63** therein, the rate of elevation being determined by the rate at which the liquid in the head ends **62** of these cylinders can flow through the choke orifices **84** into the lines **82, 81** running to the head ends **50** of the lift cylinders **45**. As fluid is forced out of the head ends **62** of the shock absorber cylinders, the rollers **70** and the supports **67** carrying them move upwardly about their pivot pins **68** to permit descent of the movable frame **20** and engagement of the rotative saw blades **32** against the pavement, the saw blades rotating to cut grooves S therein to a depth determined by contact of the depth-of-cut rollers **35** with the pavement surface.

When the grooving unit is to be raised by the operator, the valve **74** is shifted to the upper position (Fig. **5**), so that fluid under pressure flows into the head ends **50** of the lift cylinders **45** and also the head ends **62** of the shock absorber cylinders **60**. The lift pistons **47** are thereby elevated to swing the arms **17** upwardly and lift the entire grooving unit G from the pavement, beginning the cutters **32** and depth-of-cut rollers **35** out of engagement therewith, as well as raising the shock absorber wheels **70**, the fluid under pressure also being imposed through the lines **82** and past the check valve **85** into the head ends **62** of the shock absorber cylinders **60**, to shift the pistons **63** and rods **64** downwardly and relocate the rollers **70** in their lower position with respect to the movable frame **20**. The pistons and piston rods in the shock absorber cylinders are extended quite rapidly, since fluid under pressure can flow relatively freely past the check valves **85** and into the head ends of the cylinders, as distinguished from the relatively slow rate of flow of the fluid from the head ends **62** of the cylinders **60** through the choke orifices **84** when the pistons **63**, rods **64** and the rollers **70** are to be elevated. During elevation of the lift pistons **47** and lowering of the shock absorber pistons **63**, the oil from the rod sides of their companion cylinders flows through the lines **90, 91, 88** and through the control valve **74** into the return line **75** that carries it back to the supply tank **72**.

Following full elevation of the cutters of the grooving unit G, which will be first accompanied by reengagement of the rear wheels **14** with the pavement R, the valve **74** can be shifted to its neutral position, thereby trapping oil in the head ends **50** of the lift cylinders **45** and in the head ends **62** of the shock absorber cylinders **60**, which will retain the grooving unit G in the elevated ed position, as well as the shock absorber rollers **70** in their maximum depending position with respect to the saw blades **32** and the depth-of-cut rollers **35**. The weight of the grooving unit G and the swing arms **17** is large and is being imposed through the piston rods **48** and the pistons **47** on the liquid in the head ends **50** of the lift cylinders, such liquid under pressure also behind imposed through the fluid in the lines **81, 82** on the liquid in the head ends **62** of the shock absorber cylinders **60**, thereby insuring a large pressure holding the shock absorber rollers **70** in their lowermost position and capable of resisting upward movement relative to the movable frame **20** of the grooving unit G.

When the control valve **74** is manipulated to lower the grooving unit G into its working position, oil can flow from the head ends of the lift and shock absorber cylinders to the tank **72**. However, the weight of the parts is still being imposed through the lift pistons **47** on the oil in the head ends **50** of the lift cylinders **45** and in the lines **81, 82** connected thereto, the pressure of this oil also being present in the head ends **62** of the shock absorber cylinders to retain the pistons **63** and rollers **70** in their lowermost or extended position, the oil in the lines **81, 82** being at a relatively high pressure. The introduction of fluid under pressure into the rod ends **51** of the lift cylinders and into the rod ends **65** of the shock absorber cylinders will occur and will first contact the shock absorber rollers **70** with the pavement, the oil under pressure in the head ends **62** of the cylinders **60** still being at a high value and preventing retraction of the shock absorber pistons **63** upwardly in such cylinders until the rear wheels **14** are elevated from the pavement, the entire weight of the rear portion of the unit at first being borne by the shock absorber rollers **70**. However, the saw blades **32** and depth-of-cut rollers **35** are still out of contact with the pavement. As an example, when the shock absorber wheels **14** first contact the pavement, the saw blades **32** may be located approximately 1½ inches above the pavement R. Following contact of the wheels **70** with the pavement the fluid pressure in the rod ends **51, 65** of the lift cylinders **45** and shock absorber cylinders **60** increases due to flow of oil from the pump **71** through the valve **74**, such pressure increase also being imposed on the fluid in the rod ends of the shock absorber cylinders The fluid in the head ends **62** of the shock absorber cylinders is then forced by the upward movement of the pistons **63** out through the choke orifices **84** and back through the valve **74** and the return line **75** to the tank **72**, such outward flow permitting upward retraction of the pistons **63** and rods **64** in the cylinders **60** and elevation of the shock rollers **70** to permit the gradual descent of the cutters **32** against and into the pavement to cut the grooves S therewithin, as limited by engagement of the depth-of-cut rollers **35** with the pavement. The upward retraction of the shock absorber rollers **72** and the descent of the cutters **32** and depth-of-cut rollers **35** occurs relatively slowly and at a uniform controlled velocity, giving the cutters an opportunity to cut into the concrete pavement to the desired depth, which, for example, may be one-sixteenth to one-eighteenth of an inch. The vehicle is then moved along the pavement by the power being transmitted from the engine **15** through the vehicle transmission to the front wheels **12**, the rear wheels **14** merely rotating freely since they are elevated from contact with the pavement.

In the event that descent of the movable frame **20**, as a result of introducing fluid under pressure into the rod ends **51** of the lift cylinders **45**, occurred rapidly, the cutters **32** would be prevented from contacting or impacting against the pavement, since the shock absorber rollers **70** will first contact the latter. Even if the movable frame **20** were to drop for some reason, the shock absorber rollers **70** would first contact the pavement R and prevent the impacting of the cutters **32** against the pavement. As a result of elevation of the grooving unit G from the pavement, the fluid pressure automatically extends the shock absorber pistons **63** and rods **64** and their associated wheels **70**, whereby they are in a position to initially reengage the pavement once more.

I claim:

1. In a machine for performing a cutting action on a roadway: a support movable generally vertically toward and from the roadway; cutter means carried by the support for cutting the roadway; means for moving said support and cutter means towards and from the roadway; and shock absorber means mounted on and carried by said support and movably vertically with respect thereto and engageable with the roadway prior to engagement of said cutter means with the roadway, said shock absorber means embodying means for retarding descent of said support toward the roadway and of said cutter means into engagement with the roadway after engagement of said shock absorber means with the roadway.

2. In a machine as defined in claim 1; and means responsive to operation of said moving means in elevating said support and cutter means for lowering said shock absorber means relative to said support and cutter means.

3. In a machine as defined in claim 1; and means responsive to operation of said moving means in lowering said support and cutter means for elevating said shock absorber means relative to said cutter means and support after engagement of said shock absorber means with the roadway.

4. In a machine as defined in claim 1; and instrumentalities responsive to operation of said moving means in elevating said support and cutter means for lowering said shock absorber means relative to said support and cutter means, said instrumentalities being responsive to operation of said moving means in lowering said support and cutter means for elevating said shock absorber means relative to said cutter means and support after an engagement of said shock absorber means with the roadway.

5. In a machine as defined in claim 1; said cutter means comprising a gang of retractable parallel saw blades for cutting a plurality of parallel grooves simultaneously in the roadway.

6. In a machine for performing a cutting action on a roadway: a support movable generally vertically toward and from the roadway; cutter means carried by said support for cutting the roadway; fluid operated means for moving said support and cutter means toward and from the roadway; fluid operated shock absorber means carried by said support and engageable with the roadway prior to engagement of said cutter means with the roadway for retarding descent of said cutter means into engagement with the roadway.

7. In a machine as defined in claim 6; and means for directing fluid under pressure simultaneously to said fluid operated means and fluid operated shock absorber means for elevating said support and cutter means and for lowering said shock absorber means relative to said cutter means.

8. In a machine as defined in claim 6; and means for directing fluid under pressure simultaneously to said fluid operated means fluid operated shock absorber means for lowering said support and cutter means and for elevating said shock absorber means relative to said cutter means after engagement of said shock absorber means with the roadway.

10. In a machine as defined in claim 6; and means for directing fluid under pressure simultaneously to said fluid operated means and fluid operated shock absorber means for elevating said support and cutter means and for lowering said shock absorber means relative to said cutter means; and means for directing fluid under pressure simultaneously to said fluid operated means and fluid operated shock absorber means for lowering said support and cutter means and for elevating said shock absorber means relative to said cutter means after engagement of said shock absorber means with the roadway.

10. In a machine as defined in claim 6; and means for directing fluid under pressure simultaneously to said fluid operated means and fluid operated shock absorber means for lowering said support and cutter means and for elevating said shock absorber means relative to said cutter means after engagement of said shock absorber means with the roadway; and flow restricting means in said fluid directing means for retarding elevation of said shock absorber means shock absorber means with the roadway.

11. In a machine as defined in claim 6; said cutter means comprising a gang of rotatable parallel saw blades for cutting a plurality of parallel grooves simultaneously in the roadway.

12. In a machine for performing a cutting action on a roadway: a vehicle adapted to traverse the roadway and having a first frame; a second frame movable generally vertically toward and from the roadway cutter means carried by said second frame for cutting the roadway; first cylinder means connected to one of said frames; first piston means slidable in said cylinder means and connected to the other of said frames; fluid operated shock absorber means carried by said second frame and comprising a roadway contacting member second cylinder means; one of said second cylinder means and second piston means being connected to said second frame, the other of said second cylinder means and second piston means being connected to said roadway contacting member; said second cylinder means having fluid therein acting upon said second cylinder means and second piston means whereby said roadway contacting member engages the roadway prior to engagement of said cutter means with the roadway for retarding descent of said cutter means into engagement with the roadway.

13. In a machine as defined in claim 12; and means for directing fluid under pressure to one portion of said first cylinder means and to one portion of said second cylinder means for elevating said second frame and cutter means and for lowering said roadway contacting member relative to said cutter means.

14. In a machine as defined in claim 12; and means for directing fluid under pressure simultaneously to one portion of said first cylinder means and to one portion of said second cylinder means for lowering said second frame and cutter means and for elevating said roadway contacting member contacting relative to said cutter means after engagement of said roadway contacting member with the roadway.

15. In a machine as defined in claim 12; and means for directing fluid under pressure to one portion of said first cylinder means and to one portion of said second cylinder means for elevating said second frame and cutter means and for elevating said second frame and cutter means and for lowering said roadway contacting member relative to said cutter means; and means for directing fluid under pressure simultaneously to another portion of said first cylinder means and to another portion of said second cylinder means for lowering said frame and cutter means and for elevating said roadway contacting member relative to said cutter means after engagement of said roadway contacting member with the roadway.

16. In a machine as defined in claim 12; and means for directing fluid under pressure simultaneously to one portion of said first cylinder means and to one portion of said second cylinder means for lowering said second frame and cutter means and for elevating said roadway contacting member relative to said cutter means after engagement of said roadway contacting member with the roadway; and flow restricting means in said fluid directing means for retarding elevation of said roadway contacting member relative to said cutter means after engagement of said roadway contacting member with the roadway.

17. In a machine as defined in claim 12, said cutter means comprising a gang of rotatable parallel saw blades for cutting a plurality of parallel grooves simultaneously in the roadway.

18. In a machine for cutting grooves in a set surface traversed by vehicles: a vehicle having a roadway engaging set of forward wheels and a roadway engaging set of rear wheels and including drive means for at least one of said sets of wheels; a frame connected to said vehicle and moving vertically with respect thereto; cutter means rotatably mounted on said frame; means for rotating said cutter means to cut grooves in the roadway surface; means operatively connected between said vehicle and frame for moving said frame vertically to selectively elevate said cutter means from the roadway surface or to shift said cutter means into engagement with the roadway surface and elevate a set of wheels from engagement with the roadway surface, whereby the weight of the frame and a portion of the weight of the vehicle are applied to said cutter means; said vehicle, frame and cutter means being moved along the roadway surface by said drive means rotating the set of wheels remaining in engagement with the roadway surface; and shock absorber means carried by said support and engageable with the roadway surface prior to engagement of said cutter means with the roadway surface for retarding descent of said cutter means into engagement with the roadway surface.

19. In a machine as defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slideable in said first cylinder and connected to said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and a second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface.

20. In a machine as defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slidable in said first cylinder and connected to said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and a second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface; and means for directing fluid under pressure simultaneously to one portion of said first cylinder and to one portion of said second cylinder for elevating said frame and cutter means and for lowering said roadway surface engaging member relative to said cutter means.

21. In a machine as defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slidable in said first cylinder and connected to said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and a second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface; and means for directing fluid cylinder and to one portion of said second cylinder for lowering said frame and cutter means and for elevating said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway.

22. In a machine as defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slidable in said first cylinder and connected to said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and a second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface; and means for directing fluid under pressure simultaneously to one portion of said first cylinder and to one portion of said second cylinder for elevating said frame and cutter means and for lowering said roadway surface engaging member relative to said cutter means; and means for directing fluid under pressure simultaneously to an other portion of said first cylinder and to another portion of said second cylinder for lowering said frame and cutter means and for elevating said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway surface.

23. In a machine ad defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slidable in said first cylinder and connected to said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and a second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface; and means for directing fluid under pressure simultaneously to one portion of said first cylinder and to one portion of said second cylinder for elevating said frame and cutter means and for lowering said roadway surface engaging member relative to said cutter means; and means for directing fluid under pressure simultaneously to another portion of said first cylinder and to another portion of said second cylinder for lowering said frame and cutter means and for elevating said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway surface; and flow restricting means in said first-mentioned fluid directing means for retarding elevation of said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway surface.

24. In a machine as defined in claim 18; said means for moving said frame comprising a first cylinder connected to said vehicle, a first piston slidable in said first cylinder and connected to said frame; said shock absorber beans being mounted on said frame; said shock absorber means being mounted on said frame and including a roadway surface engaging member, a second cylinder connected to said frame, and s second piston slidable in said second cylinder and connected to said roadway surface engaging member; said second cylinder having fluid therein exerting pressure between said second cylinder and second piston to retard descent of said cutter means into engagement with the roadway surface; and means for directing fluid under pressure simultaneously to one portion of said first cylinder and to one portion of said second cylinder for elevating said frame and cutter means and for lowering said roadway surface engaging member relative to said cutter means; and means for directing fluid under pressure simultaneously to another portion of said first cylinder and to another portion of said second cylinder for lowering said frame and cutter means and for elevating said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway surface; and flow restricting means in said first-mentioned fluid directing means for retarding elevation of said roadway surface engaging member relative to said cutter means after engagement of said roadway surface engaging member with the roadway surface; said cutter means comprising a gang of rotatable parallel saw blades for cutting a plurality of parallel grooves simultaneously in the roadway surface.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,608,969 Dated September 28, 1971

Inventor(s) JOSEPH B. FOWKES

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 67 (claim 1, line 16), "movably" should be --movable--.

Column 7, line 20, cancel "retractable" and substitute --rotatable--; line 39 (claim 8, line 3), before "fluid" insert --and--; line 43, the number of the claim designated "10" should be --9--; line 60 (claim 10, line 8), after "means"(first occurrence) insert --relative to said cutter means after engagement of said--; line 68 (claim 12, line 4), after "roadway" insert a --;--; line 73 (claim 12, line 9), before "second" insert a --,--.

Column 8, line 1, after "means" (first occurrence) insert --, and second piston means slidable in said second cylinder means--; lines 21 and 22 (claim 14, lines 5 and 6), cancel "contacting"; lines 27 and 28 (claim 15, lines 4 and 5), cancel "and for elevating said second frame and cutter means"; line 51 (claim 18, line 1), "set" should be --roadway--.

Column 9, line 39 (claim 21, line 12), after "fluid" insert --under pressure simultaneously to one position of said first--; line 60 (claim 22, line 17), "an other" should be --another--.

Column 10, lines 35 and 36, cancel "said shock absorber beans being mounted on said frame;"; line 39, "s" should be --a--.

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents