

[54] CONCRETE CUTTING MACHINE

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[51] Int. Cl. E01c 23/09

[58] Field of Search 299/39

[56] References Cited
UNITED STATES PATENTS

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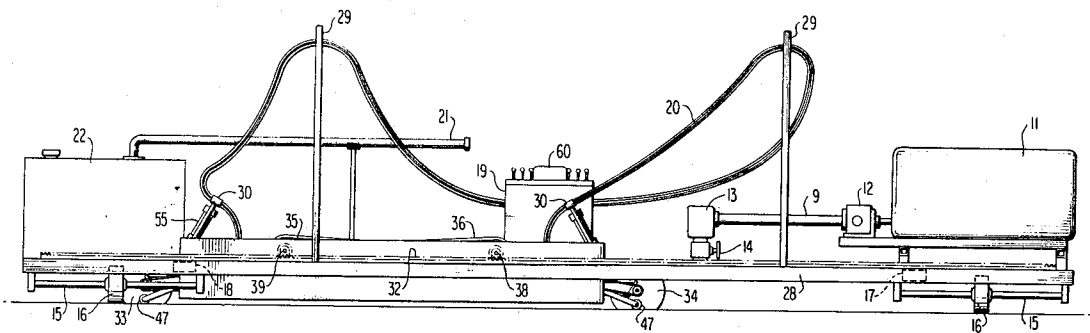
3,318,637	5/1967	Warner	299/39
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[57] ABSTRACT

A machine for cutting transverse contraction joints in concrete highways has independently hydraulically controlled saws which may be hydraulically raised or lowered. The saws will always cut to the same depth with respect to the surface of the road and this depth may be controlled. The machine is itself hydraulically driven and has only one gasoline engine and hydraulic storage tank.

8 Claims, 7 Drawing Figures



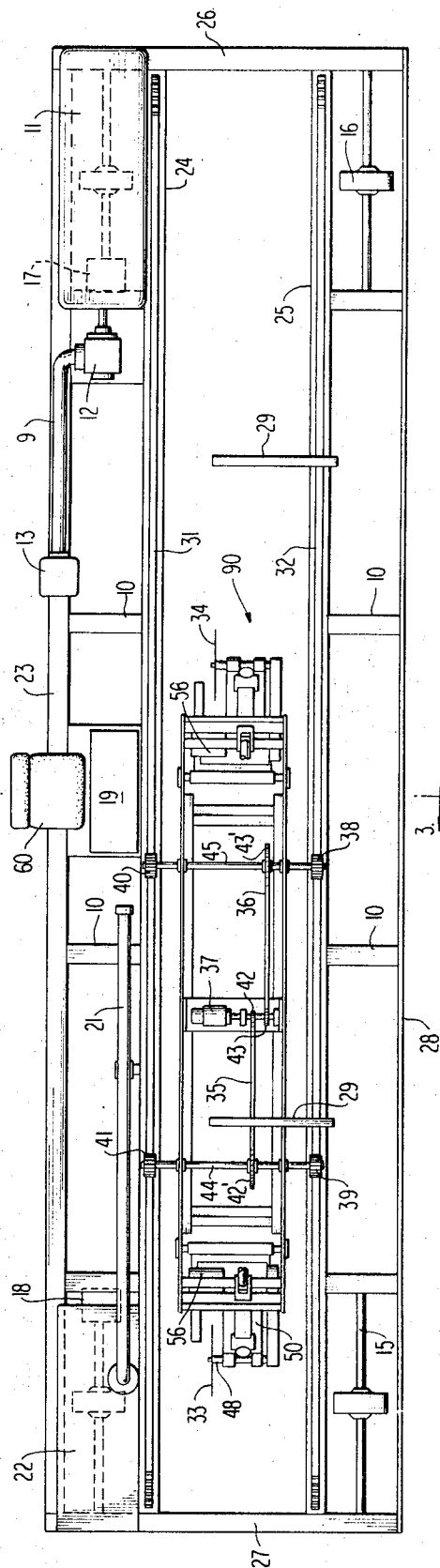
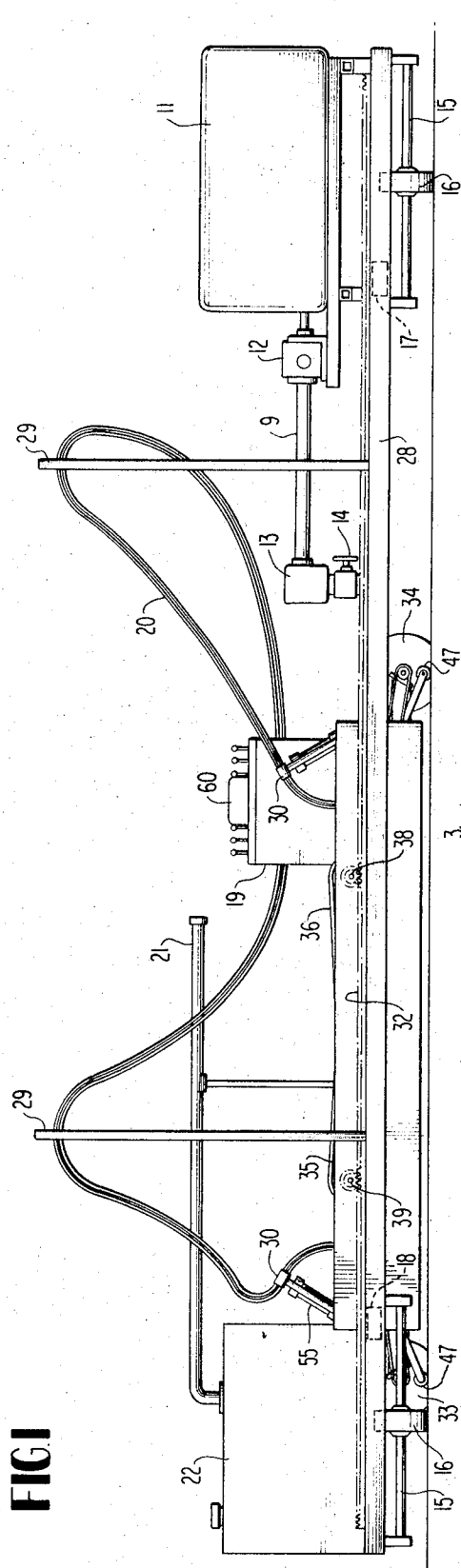


FIG 3

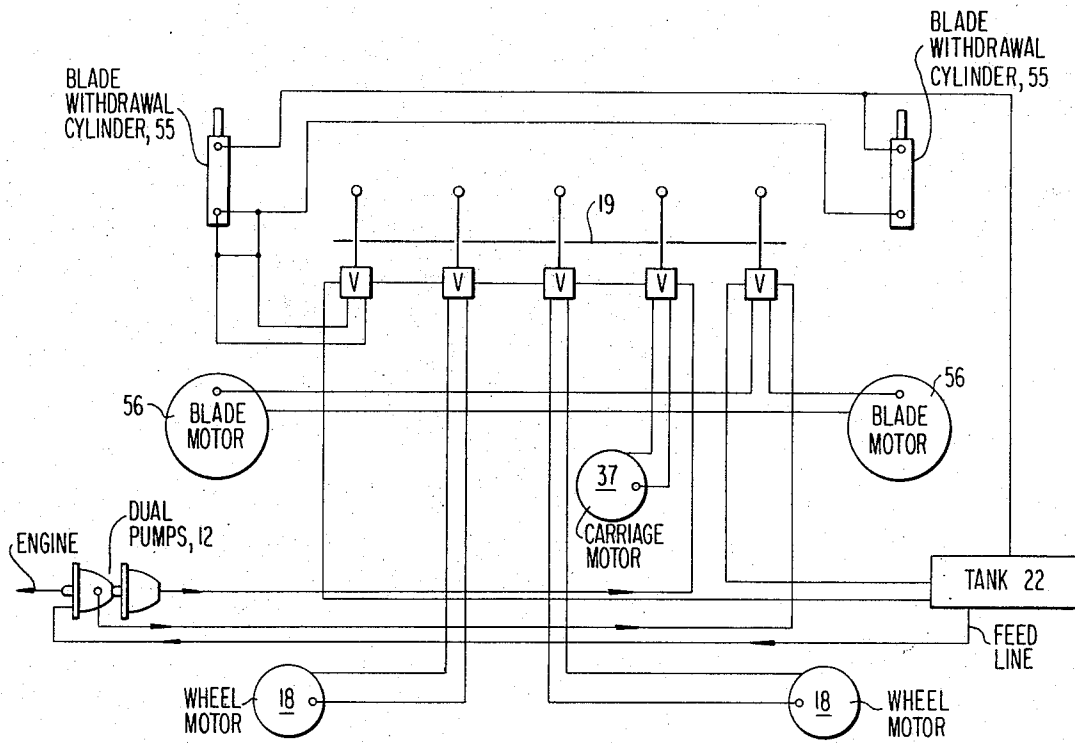
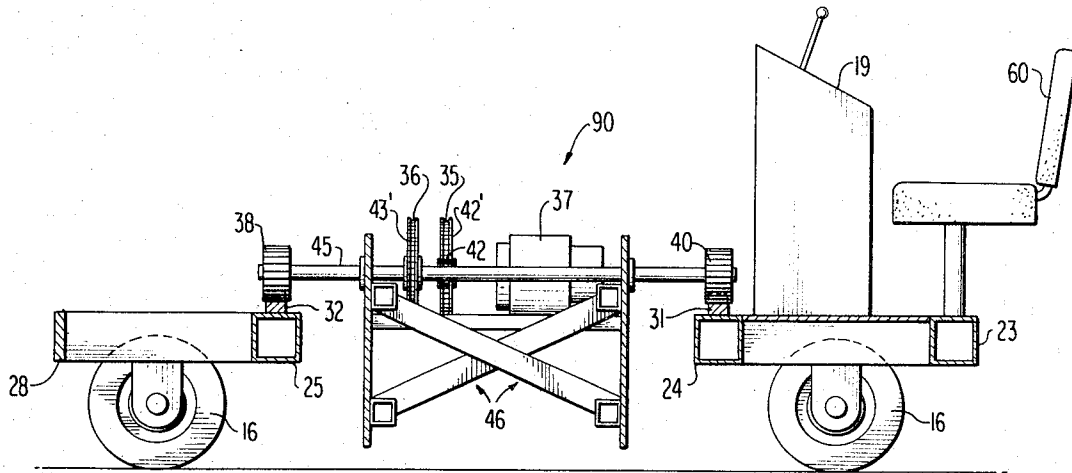


FIG 7

FIG4

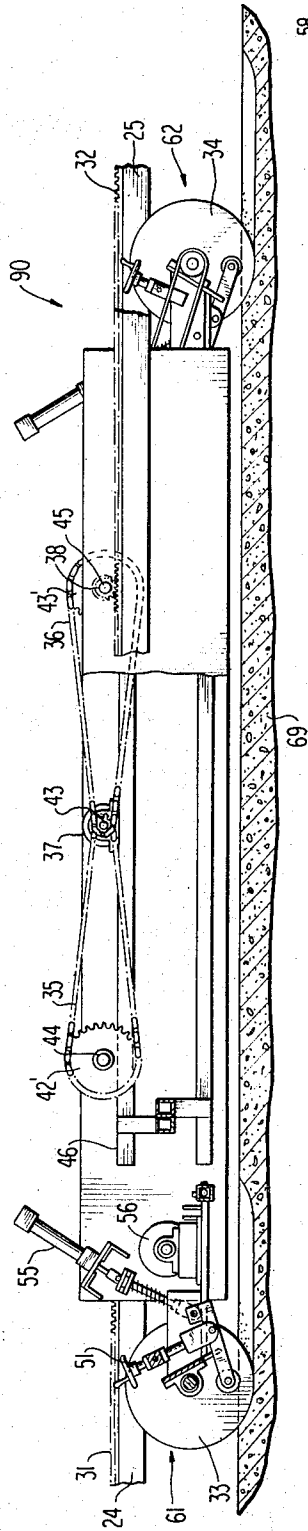


FIG5

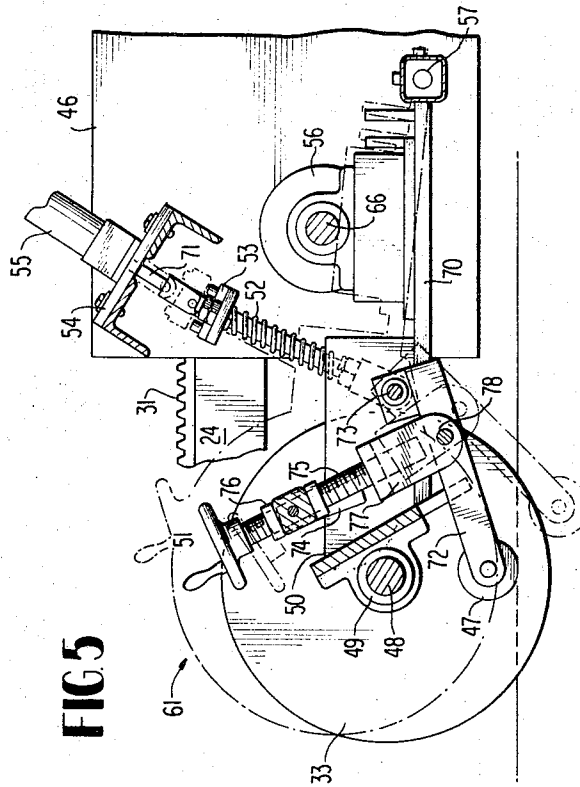
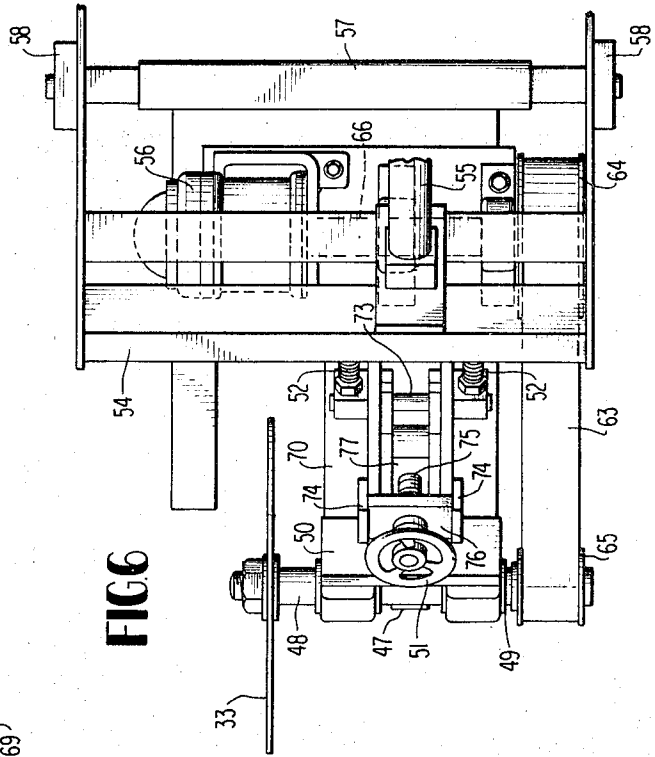


FIG6



CONCRETE CUTTING MACHINE

FIELD OF THE INVENTION

The invention relates to a concrete cutting machine and more particularly to a machine for sawing a contraction joint in a concrete pavement or highway.

BACKGROUND OF THE INVENTION

In making a concrete highway, the concrete is usually poured to form a continuous strip of paving which may be of great length, such as a mile or more. Due to expansion and contraction, caused by temperature changes of the weather, an elongated strip of concrete roadway is subject to cracks. These cracks are usually jagged or irregular and increase the maintenance of the pavement. To overcome this problem, it is customary to saw a slot across the concrete at spaced intervals to control the cracking of the pavement. It is, of course, very important that these slots be perfectly straight over the entire width of the highway. It is also desirable for the depth of these slots to be accurately controlled.

Several machines for sawing such slots in highways are known in the prior art. These machines all have various disadvantages. Several of these machines require a number of workers plus a driver in order to operate. The cost and upkeep of these machines is often very high due to the fact that they are operated off of gasoline motors. Furthermore, the blade carriage of these prior art machines are often chain driven resulting in breakdowns and often resulting in inaccurate cutting.

In the Hatcher U.S. Pat. No. 3,273,939 there are two blade carriages each of which saws one half of the width of the roadway and whose slots are supposed to meet in the center. The blade carriages are driven by a chain pull system. The blade carriages rest on wheels which ride on two rails and which are guided by a third parallel rail. In order to account for the crown of the highway, the rails on which the blade carriages travel are hinged at the center in order to attempt to align the blades at a proper angle and achieve a uniform depth.

However, due to the length of the guide rail, it has been found that the center hinge of the Hatcher machine, as well as the chain pull carriage drive mechanism, often under the stress of cutting, cause an arc effect or bowing in the cut slot rather than a straight line. This same process throws the alignment out slightly and as a result produces unacceptable work as far as several states are concerned. Furthermore, the Hatcher machine is very heavy and, accordingly, the concrete of the highway must be very solid before the machine can move onto the surface; on the other hand, it is important that concrete be cut as quickly as possible or as wet as possible in that it gives a much better cut.

The gasoline powered drive shaft of the saws in the Hatcher machine cannot reverse the rotation of the saws nor can the speed of the blades be altered. Variable speed control permits better blade life because each piece of pavement has an optimum speed at which the blade performs better than another. The rotational change has the advantage of allowing a better quality of cut on one pavement versus another depending upon the age of the concrete and the type of aggregate used. In some cases the upcut is better and in others the downcut is more desirable.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention

to obviate the problems of the prior art, such as those mentioned above.

It is an object of the present invention to provide for improved concrete cutting.

A further object of the present invention is to provide a concrete cutting machine having a rigid frame which runs the width of the entire machine and a rack and pinion gear blade carriage drive.

It is another object of the present invention to provide a concrete cutting machine having a positive depth control mechanism associated with each blade to automatically adjust for crowns or any other variations in the surface of the road.

It is still another object of the present invention to provide a concrete cutting machine which is relatively light in weight and which can be operated by a minimum number of personnel.

It is yet another object of the present invention to provide a concrete cutting machine on which the blades are independently driven by hydraulic motors which can vary the speed and direction of rotation of the saw blades.

These and other objects and a better understanding of the invention will be apparent if reference is made to the drawing and the following description of a specific embodiment, it being understood that this embodiment is intended as merely exemplary and in no way limitative.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation of a machine in accordance with the present invention as related to a strip of concrete pavement;

FIG. 2 is a plan view of the machine in accordance with the present invention;

FIG. 3 is a transverse section taken along line 3—3 of FIG. 2;

FIG. 4 is a partly broken away side elevation;

FIG. 5 is a detail sectional view of the saw depth control mechanism of FIG. 4;

FIG. 6 is a plan view of the mechanism of FIG. 5; and

FIG. 7 is a flow diagram of the hydraulic control system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, particularly FIGS. 1 to 3, the concrete cutting machine includes a rigid frame consisting of transverse beams 23, 24 and 25 and longitudinal beams 26 and 27. While hollow, square cross-sectional beams are shown, it will be clear that any suitable structural beams may be used, such as I-beams or T-beams. The frame also includes a smaller front beam 28. Various support beams 10 are also included as needed or as desirable to lend more strength and rigidity to the frame.

An engine 11, as, for example, a diesel engine, rides on the frame and drives a suitable hydraulic pump 12. Preferably two pumps are provided as discussed below. An hydraulic line 9 passes from the pump 12 to an hydraulic filter 13 and then to an oil shutoff valve 14. Downstream from the valve 14 the hydraulic line leads to various hydraulic hoses 20 which in turn lead to hydraulic motors or cylinders. The various hydraulic hoses 20 are supported by hose carriers 29 and 30. A hydraulic tank 22, an oil feed line from the tank 22 to the pump 12 (not shown) and an hydraulic fluid, e.g.,

oil, return line 21, which is connected (not shown) for return of hydraulic fluid thereto from the motors and cylinders, are also supported by the frame.

Individually driven hydraulic motors 17 and 18, powered by the pump 12 through the line 9 and other hydraulic lines (not shown) drive the pulling wheels 16 of the machine. The wheels 16 are mounted on axles 15 and it is the axles which are preferably driven by the motors 17 and 18. The frame also supports an operator's seat 60 and an hydraulic control panel 19. All of the hydraulic systems may be controlled from control 19 by a single operator.

The beams 24 and 25 in the mid section of the frame also each support, respectively, a rack gear 31 and 32. A saw blade carriage mechanism 90, seen more particularly in FIGS. 2 and 4, is supported by these beams and is driven along the rack gears 31 and 32 by pinion gears 38, 39, 40 and 41. Carriage mechanism 90 comprises a carriage frame 46 which is supported on a pair of carriage drive shafts 44 and 45. An hydraulic motor 37, powered by the pump 12 through the hoses 20, drives the drive shafts 44 and 45 by means of the motor drive shaft, sprockets 42 and 43 mounted thereon, carriage drive chains 35 and 36, and sprockets 42' and 43' mounted on the drive shafts 44 and 45, respectively. The rigid one-piece construction of the rack gears 31 and 32 ensure perfect alignment of the saw blade cuts as the pinion gears 38 - 41 drive the saw carriage across the length of the rack gears.

The carriage frame 46 supports two saw blade assemblies 61 and 62. The saw blade assemblies are depicted in detail in FIGS. 5 and 6. Each saw blade assembly 61 and 62 is provided with an hydraulic motor 56 which is hooked to a jack shaft 66 which drives the shaft 48 of the cutting blade 33 or 34 by means of a belt 63 and timing pulleys 64 and 65. The blade shaft 48 is supported by a blade box 50 by suitable bearings 49. The hydraulic motor 56 is powered by the pump 12 through the hoses 20.

The bottom plate 70 of blade box 50 is connected to a pivot shaft 57 and supports the entire saw assembly 61 including the motor 56. The pivot shaft 57 is supported by bearings 58 carried by the frame 46. The entire blade assembly 61 may be pivoted about the pivot shaft 57 in order to raise and lower the blade 33 from contact with the road 69. Hydraulic cylinders 55, fed by the pump 12 through the hoses 20, control this raising and lowering operation. The hydraulic cylinders 55 are each supported by an hydraulic cylinder mounting plate 54 connected to the frame 46 of the blade carriage 90. The piston rod 71 projecting from the cylinder 55 is connected to the blade box 50 by means of a connecting block 53 and a pair of push block tension springs 52. The function of the spring 52 is to relieve tension from the blade 33. If the blade 33 is pushed too hard or if the blade is cutting too hard, the tension is relieved by compression of the springs 52 and movement of the blade 33 upwardly. The hydraulic cylinder 55 does not push the blade down but only functions to lift the blade 33 out of the concrete 69; the weight of the blade box 50 itself pushes the blade 33 into the concrete 69. The present invention comprehends, however, hydraulic cylinders that function to both lift up and force downward.

FIG. 5 shows an important aspect of the present invention with which the blade 33 may be adjusted to give the desired depth of cut and also which provides

automatic adjustment for the crown of the road. A cam roller 47 is connected via a pivotal support arm 72 to a pivot shaft 73 connected to the blade box 50. The cam roller 47 and support arm 72 may be pivoted with respect to blade box 50 by means of a depth set screw 75 which is turned by a handle 51. The screw 75 turns within an internally threaded member 76 which is rigidly connected to the blade box 50 via a pair of support arms 74. The rectilinear motion of the screw 75 is converted to pivotal motion by a connecting link 77 which is pivotally connected to the pivotal support arm 72 at a pivot axle 78.

In this manner, the relative distance between the bottom of cam roller 47 and the bottom of blade 33 may be set. The cam roller 47 rides on the surface of the concrete 69. In this way, regardless of the contour of the road during the traverse of the saw blade 33, the depth of cut will always remain constant at a predetermined depth due to the relationship of the blade 33 with the roller 47 which rides on the surface of the road.

With the arrangement of the present apparatus including the rack and pinion drive and the rigid frame which runs the width of the entire machine, the cuts of saw blades 33 and 34 remain in perfect alignment, regardless of the amount of stress placed on the sawblades. It is only necessary to use a single blade carriage which traverses the entire width of the roadway along the rigid frame.

The blade mechanism itself adjusts for the crown in the road. Unlike prior machines which lack positive depth control and can adapt for low or high variations in the road and for crown or crest only by varying the entire carriage, if variation in the depth of cut is possible at all, the present device automatically follows the road surface and provides a constant depth of cut regardless of variation or road contour. In addition, the relative depth of the cut to the road surface is easily adjusted.

One mode of operation for the hydraulic system of the present invention is shown in FIG. 7 which will be understandable without explanation to one having normal skill. It can be seen that both pulling wheels are driven individually while the cylinders which raise and lower the blades into the concrete are hooked in series. As explained above, the saw blades are lowered by gravity by letting the oil off the cylinder. The motors which drive the cutting blades are hooked in series and are controlled by a single valve. These motors can be run in forward or reverse. This system preferably uses dual pumps. One pump drives the road travel, saw carriage travel, and raising and lowering of the blades while the other pump drives the saw motors only. Other modes of operating the present hydraulic system will be obvious to those skilled in the art, e.g., the cylinders which raise and lower the blades and the motors which drive the blades may be connected in parallel for individual control, rather than in series as shown.

Another factor which is very important is that in the present device the speed and direction of rotation of the blades can be controlled. Because the machine uses hydraulic motors to drive the sawblades the operator can instantly, from his seat, change the direction of rotation of the sawblades as well as permit the blades to run at variable speeds. Variable speed control permits better blade life because each piece of pavement has an optimum speed at which the blade performs better than

another. The rotational change has the advantage of allowing a better quality of cut on one pavement versus another depending on the age of the concrete and the type of aggregate used. In some cases the up cut is better and in others the down cut is more desirable. Gasoline powered drive shafts cannot reverse the rotation nor can the speed of the blades be altered.

It will be obvious to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown in the drawings and described in the specification.

What is claimed is:

1. A concrete cutting machine comprising a vehicle having:

a rigid main frame;
a rack gear means traversing the width of said frame;
saw carriage means for sawing an elongated, straight slit of uniform depth in the concrete suspended from said rack gear means and including pinion gear means for driving said saw carriage means along said rack gear;

said saw carriage means comprising a carriage frame, said pinion gear means, sawing means for sawing said slit, hydraulic means for raising and lowering said sawing means into and out of contact with the concrete; and depth setting means for ensuring a uniform depth of cut throughout the path of travel of said saw carriage means when said sawing means is in engagement with the concrete.

2. A concrete cutting machine in accordance with claim 1, wherein:

said rack gear means comprises two parallel rack gears traversing the width of said main frame; and said pinion gear means comprises a shaft, a pinion gear connected to each end of said shaft, each said pinion gear operably connected to one of said rack gears, and a hydraulic motor for driving said shaft; wherein said carriage frame is suspended from said shaft.

3. A concrete cutting machine in accordance with claim 1 wherein said sawing means comprises:

a reversible, variable speed hydraulic motor; and a saw blade drivingly connected to said hydraulic motor.

4. A concrete cutting machine in accordance with claim 1 wherein said saw carriage means further comprises:

a second sawing means connected to said carriage frame for sawing said slit in alignment with the cut of said first sawing means;
a second hydraulic means for raising and lowering

said second sawing means into and out of contact with the concrete; and

a second depth setting means for ensuring a uniform depth of cut throughout the path of travel of said saw carriage means when said second sawing means is in engagement with the concrete.

5. A concrete cutting machine in accordance with claim 1 wherein said saw carriage means further includes:

a blade box pivotally connected to said carriage frame and carrying said sawing means thereon, said blade box being connected to said hydraulic means whereby raising and lowering by said hydraulic means of said blade box will cause raising and lowering of said sawing means;

spring means connected to said hydraulic means for urging said blade box toward the lowest position and for relieving tension on said saw means by allowing upward motion of said blade box with respect to said hydraulic means.

6. A concrete cutting machine in accordance with claim 5 wherein said depth setting means comprises:

a cam roller;
a pivotal support arm connected to said roller and pivotably connected to said blade box;
depth set screw means for setting the angular position of said support arm with respect to said blade box whereby the vertical distance between the bottom of said cam roller and the bottom of said saw means will remain fixed at each setting.

7. A concrete setting machine in accordance with claim 1 further including:

support wheels attached to said main frame;
two hydraulic motors drivingly connected one each to two of said wheels; and
means connected to said hydraulic motors for independently controlling each of said motors.

8. A concrete cutting means in accordance with claim 7, further including:

a hydraulic system controllable by a single operator comprising:
said hydraulic means for raising and lowering said sawing means;
said hydraulic motors drivingly connected to said wheels;
a hydraulic motor for driving said pinion gear means and therewithin;
a variable speed, reversible hydraulic motor for driving said sawing means and therewithin; and
pump means for driving said hydraulic means and hydraulic motors.

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