Aug. 5, 1958 H. S. NAGIN 2,845,851

MACHINE FOR MAKING ANTI-SKID CONCRETE ROAD SURFACES

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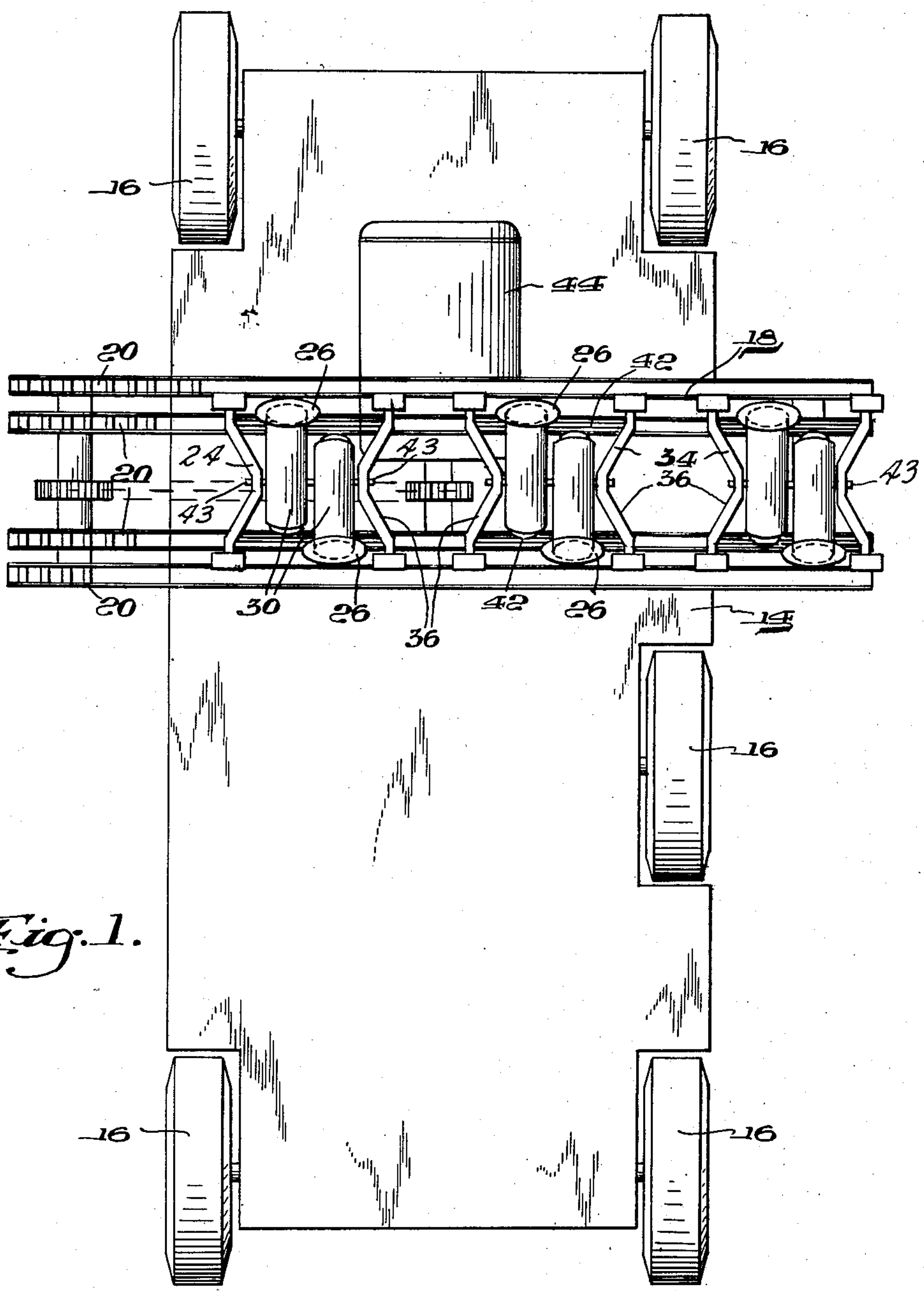


Fig. 1.

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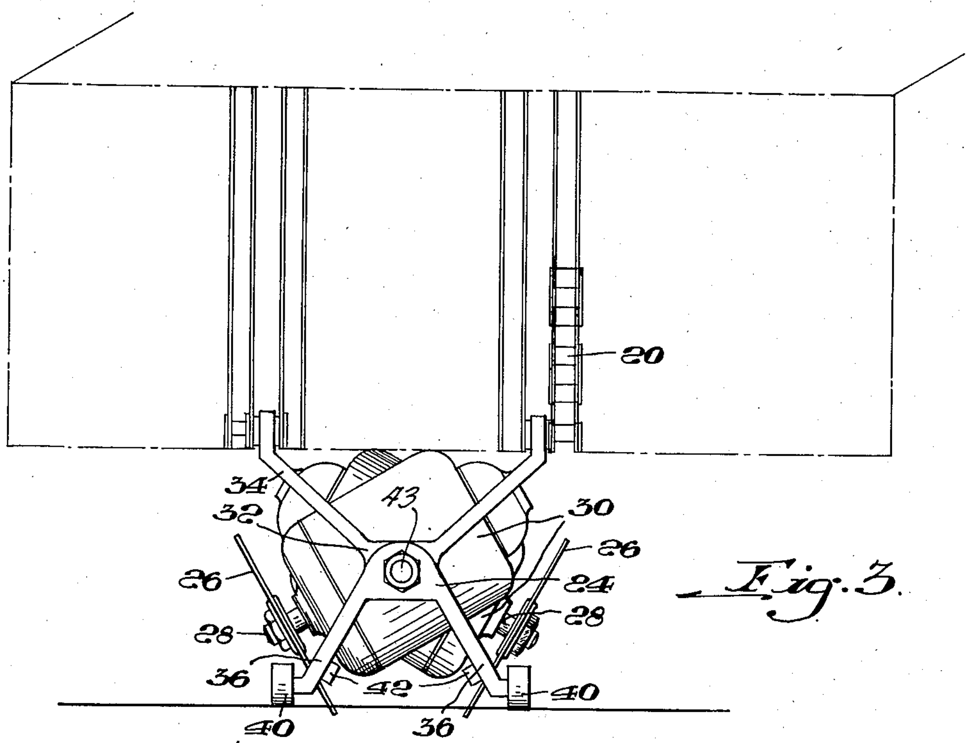


Fig. 3.

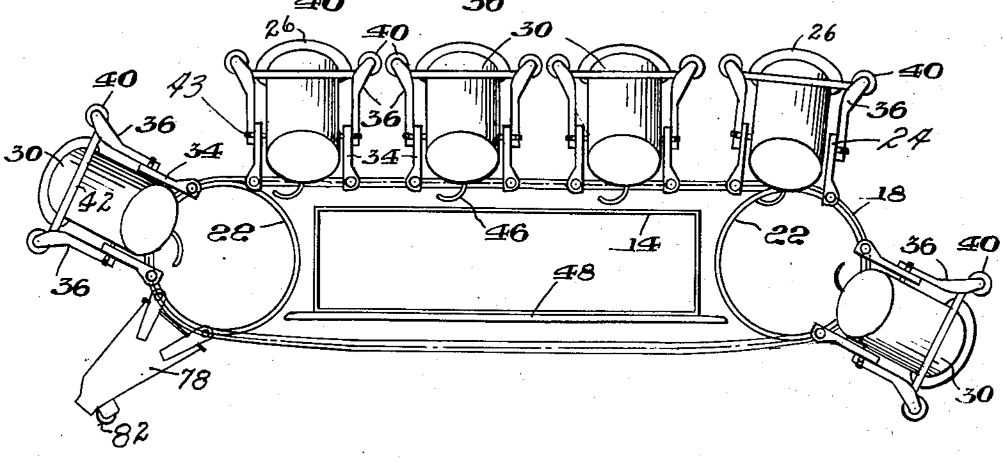


Fig. 2.

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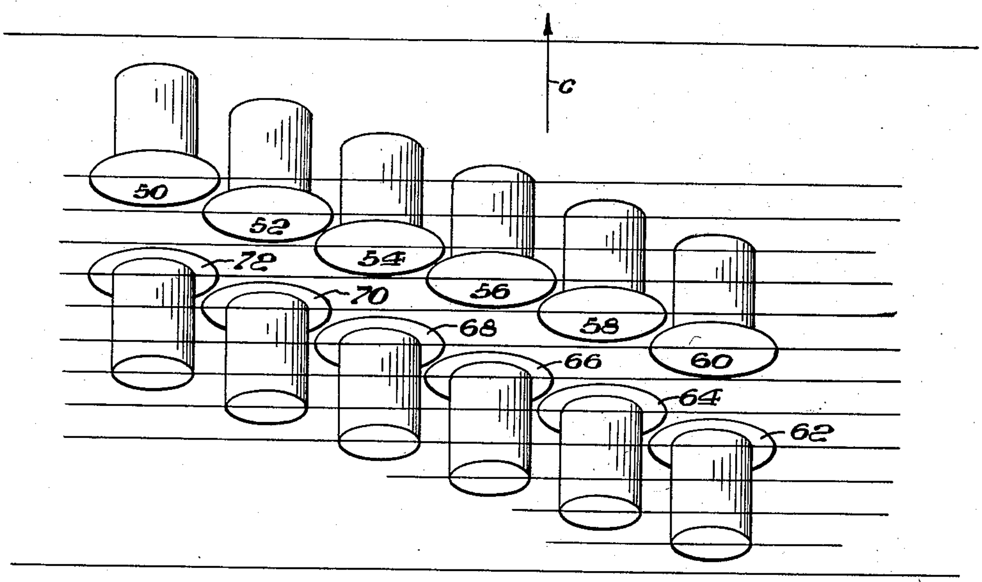


Fig. 4.

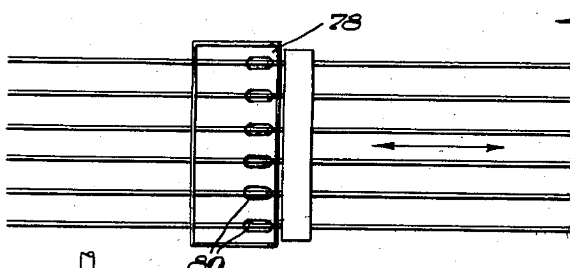


Fig. 5.

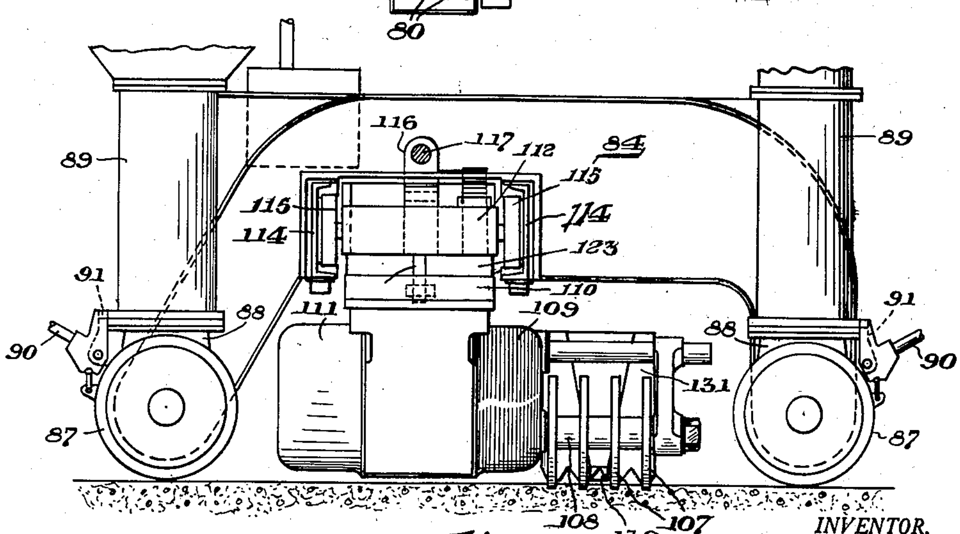


Fig. 7.

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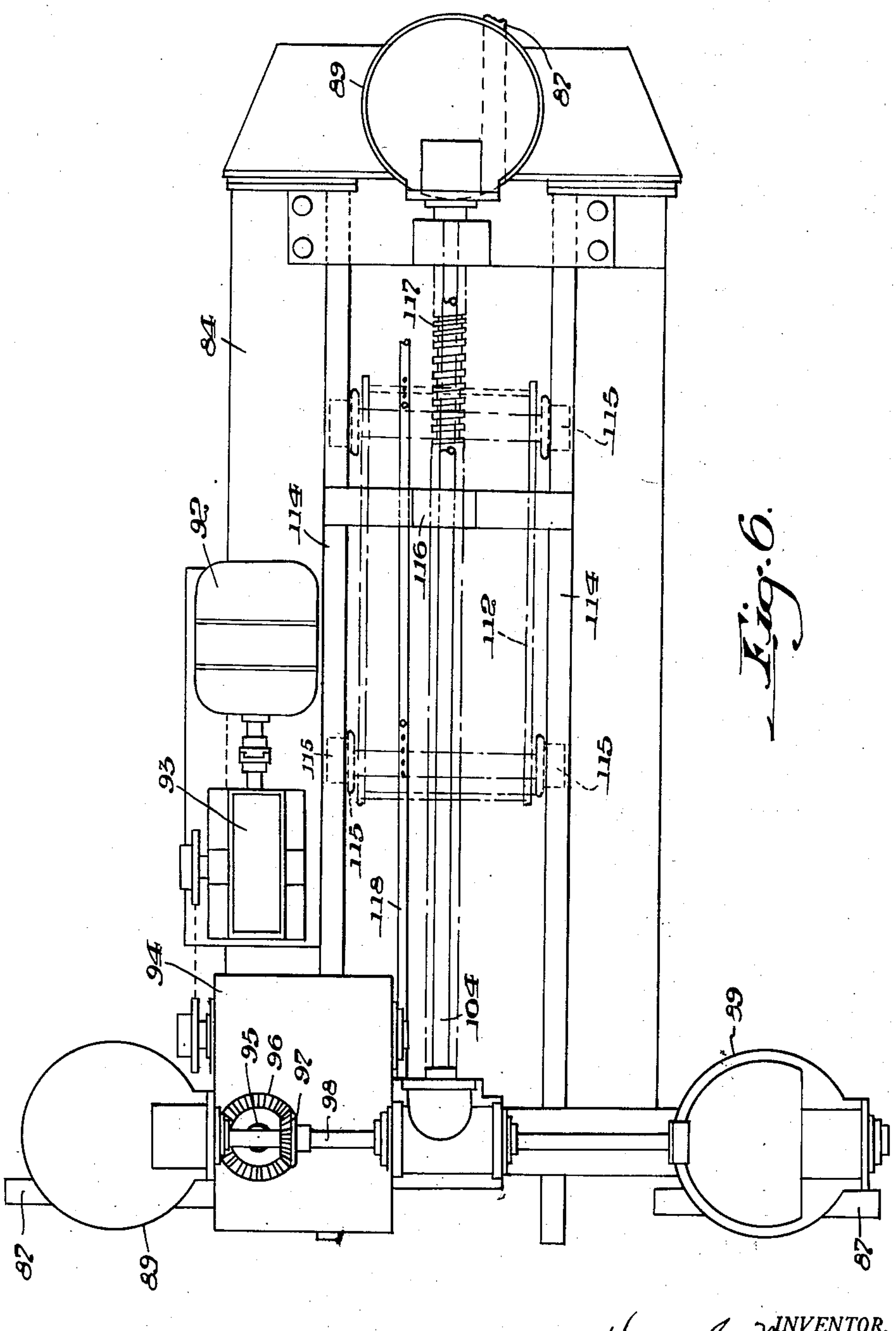


Fig. 6.

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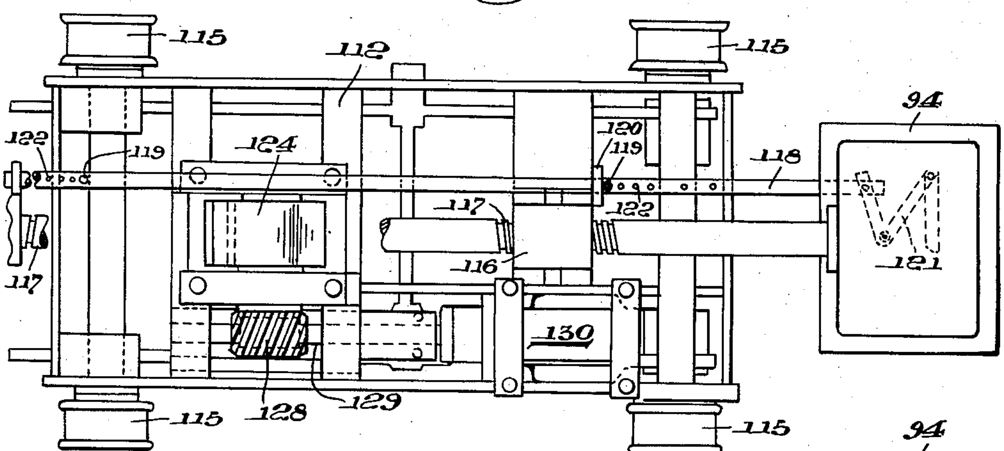
Fig. 8.



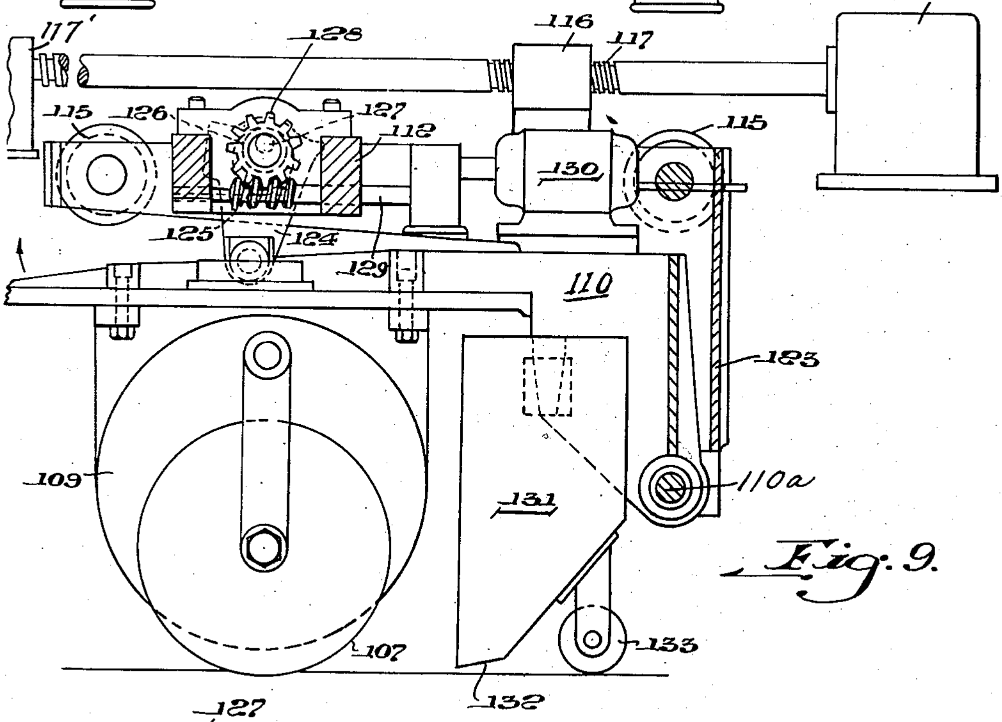




Fig. 9.

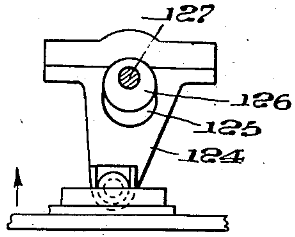



Fig. 9a

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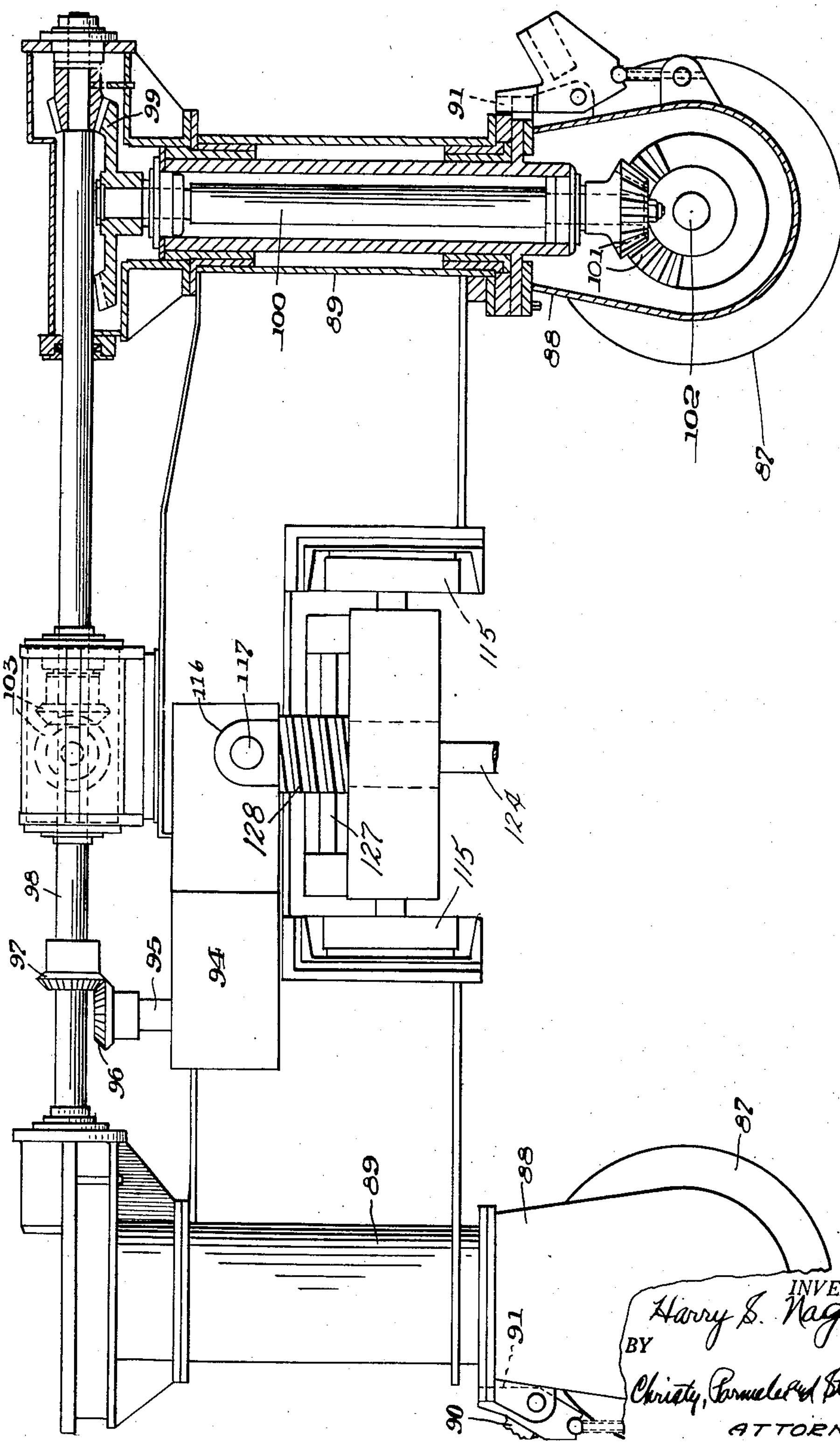


Fig. 10

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MACHINE FOR MAKING ANTI-SKID CONCRETE ROAD SURFACES

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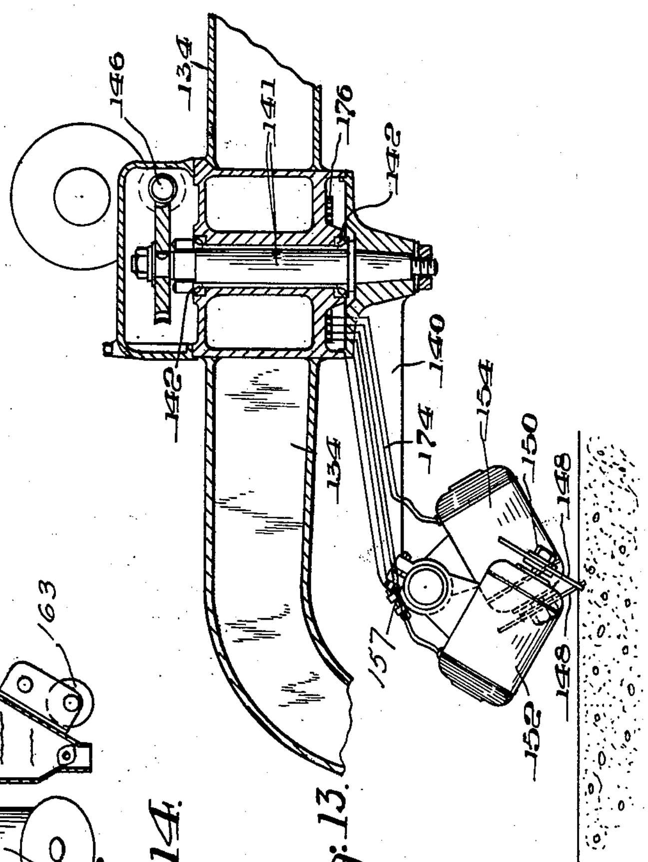


Fig. 13.

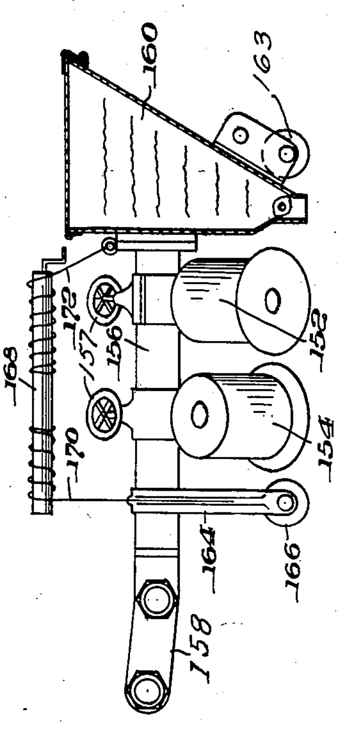


Fig. 14.

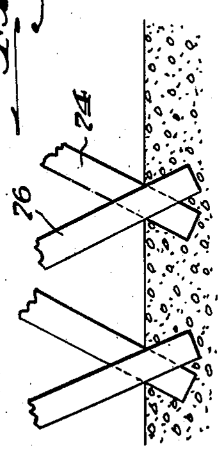


Fig. 11

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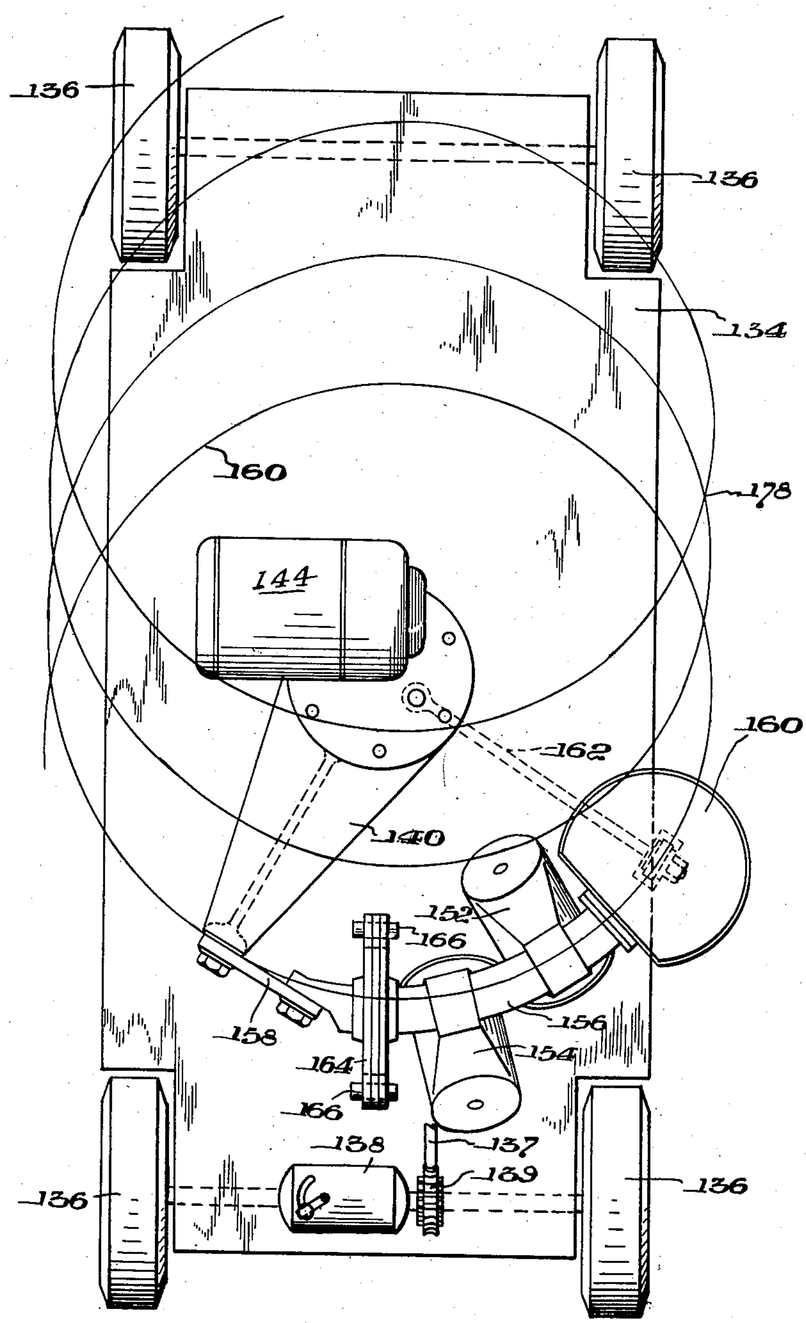


Fig. 12.

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# MACHINE FOR MAKING ANTI-SKID CONCRETE ROAD SURFACES

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Application June 3, 1952, Serial No. 291,430

4 Claims. (Cl. 94—45)

This invention relates to anti-skid surface for concrete roads. More particularly, the invention relates to machines for making grooves in the surface of a concrete road with such a design that when the grooves are filled with an abrasive cement the grooved surface will overcome the tendency of rubber-tired automobiles and trucks to skid on the surface.

The concrete decks of bridges and the concrete surfaces of paved roads, specially on curves, present hazards to the most careful drivers of automobiles and trucks. Although the bridge decks and concrete road surfaces give good traction when the surface is clean and dry, these surfaces are vulnerable to skidding when they become wet or have a thin coating of ice or gravel thereon.

I have found that if narrow grooves of substantial depth are formed in the deck or road surface so as to cross the surface at approximately right angles to the longitudinal axis of the road, and these grooves are filled with an abrasive cement which is harder than the cement from which the concrete road is made, such a surface will be substantially skid-proof. It is important to make the cuts with well-formed side walls, so that the filling material will be anchored in the grooves and supported by the concrete road. Further, the filling material must be united with the body of the concrete road between the grooves so that the surface of the road between the grooves will not be weakened and caused to disintegrate. The groove-filled ribs must be close enough so that two ribs will be engaged by an automobile tire at one time.

The inherent nature of cement, concrete and the methods of laying road surfaces will not permit strips or ribs to be placed in the surface as it is laid. Therefore, I have devised a practical method of inserting the anti-skid strips in a road surface so that it will be serviceable and effective against skidding.

The primary object of the present invention is to provide a method of and apparatus for grooving a concrete road surface so that an anti-skid cement may be anchored in the grooves to form a strong monolithic ribbed surface which will wear well and provide a non-skid surface.

A further object of the invention is to provide a method of and apparatus for grooving a concrete road surface rapidly and at a comparatively low cost.

With these and other objects in view, the invention consists in the method of and apparatus for inserting non-skid strips in the surface of concrete roads.

The various features of the invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a top plan view of concrete road surface grooving machine embodying a preferred form of the invention;

Fig. 2 is a view in side elevation of the grooving cutters shown on the machine of Fig. 1 but for clarity of illustration only the motors and cutters on the side of the machine nearest the viewer are shown;

Fig. 3 is a view in front elevation of one pair of grooving cutters of the machine of Fig. 1;

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Fig. 4 is a diagrammatic view showing the relation of groove cutters in making six pairs of grooves across the face of a concrete road;

Fig. 5 is a diagrammatic view of a concrete road illustrating a groove filler for filling grooves in a road surface with abrasive cement;

Fig. 6 is a top plan view of a modified form of transverse groove cutting machine;

Fig. 7 is an end elevation of the groove cutting machine illustrated in Fig. 6;

Fig. 8 is a top plan view of the cutter carrier used in the machine of Fig. 6;

Fig. 9 is a side elevation of the cutter carrier used in the machine of Fig. 6;

Fig. 9*a* is a detail view in side elevation of a link and cam for raising the groove cutter shown in Fig. 9;

Fig. 10 is a view in front elevation of the machine carriage of Fig. 6, showing the driving mechanism for the cutter carriage;

Fig. 11 is a detail vertical sectional view of a concrete road showing the shape of the grooves that are cut in a road surface with the machine of Figs. 1 and 12;

Fig. 12 is a top plan view of a third type of groove cutting machine embodying the present invention for cutting a spiral groove in a concrete road;

Fig. 13 is a view in side elevation showing the rotating carrier and the cutters of the grooving machine shown in Fig. 12; and

Fig. 14 is a view in side elevation showing the cutters, cutter carrier, and cement layer of the groove cutting machine of Fig. 12.

The groove cutting machine illustrated more particularly in Figs. 1 to 5 inclusive, consists of a carriage **14** mounted on wheels **16** which has a carrier **18** positioned transversely across the carriage. The carrier **18** consists of two pairs of chains **20** (Fig. 1) which run between pulleys **22** with the tight run of the chains **20** passing above the body of the carriage **14** and the loose run of the chain passing below the body of the carriage (see Fig. 2). To the chains **20** are attached a series of frames **24** (Fig. 3) in each of which are mounted two cutting disks **26**. The cutting disks **26** are mounted on the ends of shafts **28** of motors **30** by which the disks are rapidly rotated for the purpose of cutting grooves in the concrete surface. The frame **24** is made up of side members **32** which have arms **34** that are connected with links of chains **20** (Fig. 3), and arms **36** which are provided with rollers **40** that roll on the surface of the concrete road. Between the side frames **32** are connected tie members **42** (Figs. 1 and 3) which hold the frame in rigid position and support the motors and disks in the desired position for cutting the grooves in the surface of the road. The cutters **26** and motors **30** are so supported in the frames **24** that the plane of the surface of the cutters form an acute angle with each other in order to cut grooves in the road such as illustrated in Fig. 11. Two cutter disks are required for cutting a groove, as hereinafter explained. The motors are mounted for adjustment on trunnions **43** so that disks in the frames may be adjusted in the frame such that the cuts made by two disks will cross each other with narrow portions of the intersecting grooves at the surface of the road. The adjustment of motors **30** on trunnions **43** will act to vary the depth of groove being out in the roadway. The grooves extend below the surface of the road a distance equal to substantially twice the width of a cutter disk. As illustrated in Fig. 11, the pair of cuts in the road surface is wider at the base thereof than at the point of entrance of the cutter at the surface of the road so that when the groove is filled with an abrasive cement the hardened cement will be well anchored in the groove and will form a strong monolithic structure at the road surface.

As illustrated in Fig. 2, in which for purposes of more clearly showing the arrangement only the motors and cutters on the near side of the machine are shown, six sets of disk cutters are mounted on the carrier 18, and these cutters are positively carried across the surface of the road by movement of the chains 20 and rotation of pulleys 22. The movement of the carrier chains is obtained by means of a motor 44 which is mounted on the body of the carriage 14 and is connected by sprockets and chain for positively driving the axles of the pulleys 22. In the normal operation for cutting the grooves, the chains 20 will make a complete movement of the circuit to carry all six of the pairs of cutter disks across the road and then the movement of the chains will be stopped. When the chains are stopped, the cutter frames will all be above the road as shown in Fig. 2, and then the carriage will be advanced a distance equal to the sum of the distances apart of six grooves. Thereafter the chains 20 will be driven by motor 44 to bring the cutters 26 into contact with road surface, and the motors 30 of the disks will be set into operation when a trolley 46 engages a trolley bar 48 mounted on the bottom side of the carriage 14. Electric power may be supplied to the trolley bar 48 by a motor generator set (not shown) which preferably is mounted on carriage 14. The motors 30 will continue to rotate as the disks are carried across the road by the chains 20, and will discontinue rotation when the trolley 46 becomes disengaged from the bar 48. As the cutting disks move from the end of the cutting position back to the starting position, the motors 30 for the cutter disks are idle.

Referring to Fig. 4 is a diagrammatic illustration of an arrangement of the cutter disks which are mounted on the carrier 18. The disks shown in Fig. 4 may be numbered 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70 and 72 for the purpose of illustration. It will also be noted that the disks are mounted in staggered relation across the carrier and two disks are mounted on each frame of the carrier; for example, disks 50 and 72 are on one frame; 52 and 70 are on another frame, and then disks 54 and 68; 56 and 66; 58 and 64, and 60 and 62 are on following frames. All of the disks shown in the lower part of Fig. 4 cut grooves with an angle such as illustrated at 74 in Fig. 11, and all of the disks shown in the upper part of Fig. 4 cut grooves at an angle such as shown at 76 in Fig. 11. It will be noted that one disk follows the other, and each of the disks of the lower row cuts a groove independently of the groove cut by the disks of the upper row. As the six pairs of disks pass across the roadway twelve cuts are made. The spacing of the cutters 26 is the same on each frame 24 and this determines the spacing of the grooves formed in the roadway. With the frames following one another in staggered relation the left-hand cutter of a following frame will enter the groove cut by the right-hand cutter of the next preceding frame. Therefore after the cutters have made a set of cuts across the roadway, the carriage is advanced a distance equal to the spacing apart of six grooves. Only one groove of the pair will be cut by the right cutter of the last frame, and the carriage when advanced will be positioned to place the left cutter of the first frame in the groove of the incompleted pair of grooves of the preceding set of cuts.

After the carrier chains 18 have made one complete rotation to finish six complete grooves, a concrete bucket is moved across the roadway to fill the grooves with an abrasive cement which is harder and more abrasive than the material from which the concrete road is made. The abrasive concrete bucket 78 is attached to links of chains 20 immediately behind the last bucket on the carrier to pass over the road as illustrated in Fig. 2. In Fig. 5 is illustrated six grooves with a concrete bucket 78 passing thereover to fill the grooves with abrasive cement. A series of openings 80 (Fig. 5) are formed in the bottom of the bucket, one opening being positioned above each groove. Below and behind the bucket is mounted in a pressure roller 82 for each groove, such as illustrated more particularly in Fig. 2 for the purpose of pressing down the cement which has been inserted in the groove through the openings 80. Preferably the grooves which are cut in the road are filled immediately after they have been cut so that a monolithic surface is formed. The carrier 18 may be used for pulling the bucket 78 back and forth across the carriage 14 in the same way that the carrier frames 24 are carried across the carriage.

In Figs. 6, 7, 8 and 9 and 10 are illustrated a second form of a machine for grooving a concrete road surface. This form of apparatus is mounted on a three-wheel carriage 84, which is adapted to move along a roadway which is to be grooved transversely of the longitudinal axis of the road. The carriage wheels 87 are carried by trucks 88 which are rotatably mounted at the base of vertical posts 89 of the carriage 84. The trucks may be rotated by handles 90 to set them at any desired angle, and be locked in position by latches 91 to arrange the wheels 87 for movement along a bridge deck to maintain the position of the carriage for cutting grooves. The latches 91 which are only schematically shown are of a character commonly used in dollies and wheeled industrial equipment. As shown the latch is a pivoted element having one edge which engages one of several notches in the periphery of the pedestal at the base of each post above each wheel mounting. The wheels 87 are positively driven by a motor 92 which is mounted on the carriage 84 and connected through a speed reducer 93 with a gear box 94. A shaft 95 having a gear 96 engages a bevel gear 97 on a horizontal shaft 98 (Fig. 10). The shaft 98 extends into the front posts 89 and is connected by bevel gears 99 with vertical shafts 100 rotatably mounted in the posts. The shafts 100 are connected by bevel gears 101 with the axles 102 on which wheels 87 are fixed. Bevel gears 103 in the mid portion of shaft 98 connect shaft 98 with a shaft 104 (Fig. 6) which extends to the rear post 89 and is connected with a shaft similar to shaft 100, to the axle for the rear wheel 87. Gear controls are mounted in box 94 by which the wheels 87 may be rotated in a clockwise or counter-clockwise direction. The wheels 87 must be in parallel alignment to go forward or backward. To turn the carriage, each of the individual wheel trucks may be angularly adjusted manually through the operation of the handles 90 so that when the wheels are driven by the motor, the carriage will be turned.

The machine illustrated in Figs. 6 to 10 is constructed to cut perpendicular grooves in the concrete roadway. As shown in Fig. 7, four cutting wheels 107 are mounted on a shaft 108 which projects outwardly from a gear box 109 mounted in a supporting frame 110 at the end of the motor housing 111. The motor 111 is connected with the gear drive 109 which is manually controlled to control the cutting operation. The gear box 111 is a standard speed reducing gear furnished as part of the motor. The frame 110 is connected with a carrier 112 (Figs. 8 and 9) which is mounted to travel across the carriage 84 on tracks 114 that extend from the front to the rear of the carriage. The carrier is mounted on four flanged wheels 115 that ride in the rails 114. When cutting grooves in the roadway, the cutter disks 107 are rotated and simultaneously the carrier is moved transversely of the road. To move the carrier, a threaded block 116 (Figs. 8 and 9) on the carrier 112 is mounted on a screw 117 which extends from gear box 94 at the front of the carriage 84 to a bearing 117′ at the rear of the carriage (Fig. 6). A reversing link 118 is mounted on the carriage parallel to the screw 117 which carries pins 119 arranged to be engaged by an arm 120 secured to the block 116 to shift the link 118 and a bell crank 121 in the gear box 94 to change the direction of rotation of the screw **117**. Thereby the carrier **115** will be carried back and forth by the screw. The reversing link **118** may be set in neutral position to allow the carrier **112** to remain stationary. The screw is rotated by the motor **92** through the gear box **94**. The speed reducer **93** is used to control the rate of movement of the carrier for the cutting stroke. Preferably the gears for the return movement of the carrier will give a quick return.

The grooves are preferably cut from right to left (viewing Fig. 6) and when the carrier **112** has made its cutting movement, it is raised through the operation of the mechanism including the link **124** hereinafter described to clear the cutters from the road surface and then the gear shift is operated to return the carrier to the starting side. A series of openings **122** are placed in the shifting lever **118** to vary the travel of the carrier.

The frame **110**, motor **111**, and gear box **109** are quite heavy to steady the operation of the cutters **107**. The frame **110** to which parts are connected, is pivoted at **110***a* at the rear to a downwardly projecting arm **123** (Fig. 9) on the carrier **112** and is suspended near the front end by a link **124** which has an opening **125** (Fig. 9*a*) engaging an eccentric cam **126** fixed on a shaft **127** journaled in the carrier **112**. A worm gear **128** fixed on the shaft **127** meshes with a worm on a shaft **129** driven by a motor **130** mounted on the carrier **112**. Rotation of the shaft from the position shown causes the cam **126** to raise the link **124** and thereby rock the frame **110** in a vertical arc to raise the cutters **107**. The rotation of the motor is automatically stopped at the end of the lifting movement of cam **126**. A continued rotation of the motor will lower the cutters for making the grooves in the road, at which point the motor may be automatically stopped. The opening **125** is sufficiently long so that when the cutters engage the surface of the paving the lifting cam can continue to rotate and the weight of the assembly then bears on the periphery of the cutters so that as they cut they can sink by their own weight to their full limit permitted by the slot **125** and the position of the cam **126**. In other words, there is a lost motion connection provided between the mounting and the lifting means through the elongated slot or opening **125** in the link.

Preferably the grooves formed by cutting disks **107** are filled with an abrasive cement immediately after they are formed. To accomplish this, a cement bucket **131** (Fig. 9) is mounted in the frame **110** behind the cutters **107**. The bucket has a series of spouts **132**, one for each groove being cut, to direct cement into the grooves. Rollers **133** are mounted on the bucket **131** behind each spout to press the cement into the grooves.

Attention is called to the fact that with all of the rotary disks for cutting grooves, diamond points are mounted in the peripheral cutting face of the disks so that a smooth faced groove is cut without breaking away the sides of the grooves in the concrete. When this smooth faced groove is filled with cement, it becomes a solid monolithic structure, so that the road surface will not disintegrate under heavy traffic. The hard abrasive cement preferably projects slightly above the surface of the road for the purpose of giving traction to automotive tires, but the abrasive cement will provide on the surface, a series of low ridges to which the tires may grip to prevent skidding.

A third form of road surface grooving machine is illustrated in Figs. 12, 13 and 14. This form of machine consists broadly in mounting a pair of disk cutters on a rotary carrier which makes a complete rotation, and preferably the carrier is mounted on a carriage which is advanced as the carrier rotates, so that a spiral shaped groove is cut in the surface of the road. The carriage **134** is mounted on wheels **136** which preferably has a driving rod **137** geared to the axles of the wheels **136**. The driving rod **137** is driven by a motor **138** with which it has a worn drive connection **139**. A carrier **140** is connected to the lower end of a vertical shaft **141** (Fig. 13) which is rotatably mounted in bearings **142** of the main body of the carriage **134**. The carrier is rotated by means of a motor **144** which has a worm drive connection **146** with the shaft **141**. The disk cutters **148** are mounted on shafts **150** extending from motors **152** and **154** which are adjustably connected with the carrier **140**. The disks **148** are mounted on a curved bar **156**. The bar **156** is connected at its leading end to the carrier **140** by a pivoted link **158**. The rear end of the bar has a refractory cement bucket **160** connected thereto, and a brace rod **162** (Fig. 12) extends from the bucket to the carrier **140**. With this pivotal connection, the weight of the motors will hold the disks **148** in cutting position in the road. A pressure roll **163** is secured to the back side of the bucket **160** behind each cement spout to force cement deposited by the bucket spout into the grooves in the pavement. A post **164** (Fig. 14) having leveling rolls **166** mounted in the bottom thereof, is attached to the bar **156** in advance of the cutter motor **154**. In order to raise the cutter disks, rolls **166** and cement bucket up above the road surface to permit the carriage **134** to be moved from place to place, a winch **168** (Fig. 14) is mounted on the carriage **134** above the bar **156**. Cables **170** and **172** are connected respectively to the post **164**, and bucket **160**, and pass around winch **168** to raise and lower the cutter disks. The motors **152** and **154** are adjustably mounted on the bar **156** by clamping frames **157** to position the cutting disks **148** at an acute angle to the vertical to make the cuts illustrated in Fig. 11. One disk makes the cut **74**, while the other disk makes the cut **76**, and both enter the roadway so as to make the cuts intersect at the road surface. Electric power wiring connections **174** extend from each of the motors **152** and **154** to a slip ring **176** on the carriage to supply electric current for operating the motors while the carrier is being rotated. The angular setting of the cutting disks **148** assists in positioning the cutters for making the spiral groove.

It has been found that in order to securely anchor strips of refractory cement in the grooves in the road, it is necessary to make the depth of the groove from one and one-half to two times the width of the groove.

In Fig. 12 is illustrated by curves **178** the spiral shape of the groove which is cut by the rotary disks as the carrier makes its complete rotation while the carriage is advancing a distance equal to the spacing of the grooves in the road surface. It will be noted that the grooves intersect one another as the grooving continues, but these intersections will be filled with cement and will act to effectively provide a non-skid surface for the road.

It will be noted that with all of the forms of machines used in grooving the face of the concrete road, that the grooves extend transversely of the longitudinal axis of the road and transversely of the normal line of travel of motor vehicles on the road. The abrasive cement which fills the grooves preferably will be slightly above the face of the road and will have a different physical composition than the road surface which will form an effective anti-skid surface. It is not practical to place preformed hardened strips of abrasive concrete material in the surface of a concrete road as it is being formed, but with the present invention the abrasive cement may be filled into grooves which are cut in the road after it has been laid and hardened to form a monolithic surface that will have a strength substantially equal to that of the original surface and still provide an effective non-skid surface.

The preferred form of the invention having been thus described, what is claimed as new is:

1. Apparatus for grooving previously formed and cured hard surface roads whereby abrasive material may be filled into the grooves, comprising a mobile frame

designed to span the width of the road area to be processed, a trackway in said frame, a carriage movable along the trackway, motor-driven means on the frame for moving the carriage along the trackway at a uniform predetermined speed, a mounting member suspended from the carriage having a cutter shaft with rotatable cutters thereon carried by the mounting member, the cutter shaft being transverse to the direction of travel of the carriage, means for driving the cutter shaft, the suspension for the mounting member from the carriage including a lifting means on the carriage, and a link providing limited relative movement between the mounting member and the lifting means for raising and lowering the mounting member.

2. A machine for cutting grooves into a road surface comprising a mounting on which is carried a driving motor and shaft, said shaft having a plurality of cutting disks thereon, a carriage from which the mounting is pivotally hung at one end, the other end of said mounting being hung from the carriage by a link, a lifting mechanism on the carriage with which the link is engaged and relative to which the link has a limited vertical motion whereby as the cutters cut the surface beneath them the mounting may lower by gravity to the limit permitted by the link and lifting mechanism to thereby control the depth of the cut, a frame, a trackway in the frame along which the carriage is movable, and motor-driven means on the frame for driving the carriage back and forth along the trackway.



3. A machine for cutting grooves into a road surface as defined in claim 1 in which the axis about which one end of the mounting pivots relative to the carriage is transverse to the length of the trackway along which the carriage moves.

4. A machine as defined in claim 2 wherein there is a hopper on the carriage at one side of said mounting located in a position to discharge plastic abrasive compound into the grooves cut by the cutters progressively as the cutters advance, and means associated with the hopper for compacting material discharged therefrom into the grooves.


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