

[54] **WATER APPLICATOR FOR A PAVEMENT
GROOVING MACHINE**

[75] Inventor: **Harold C. Miller**, Chicago, Ill.

[73] Assignee: **Engelhard Minerals & Chemicals
Corporation**, Murray Hill, N.J.

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239/568, 299/81**

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239/568**

[56] **References Cited**

UNITED STATES PATENTS

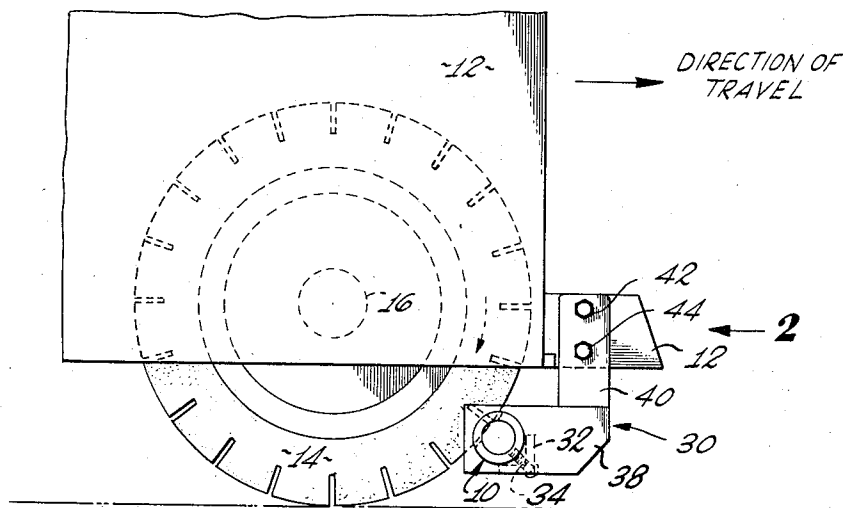
729,425	5/1908	Schuler	239/568 X
3,779,607	12/1973	Staab	299/39

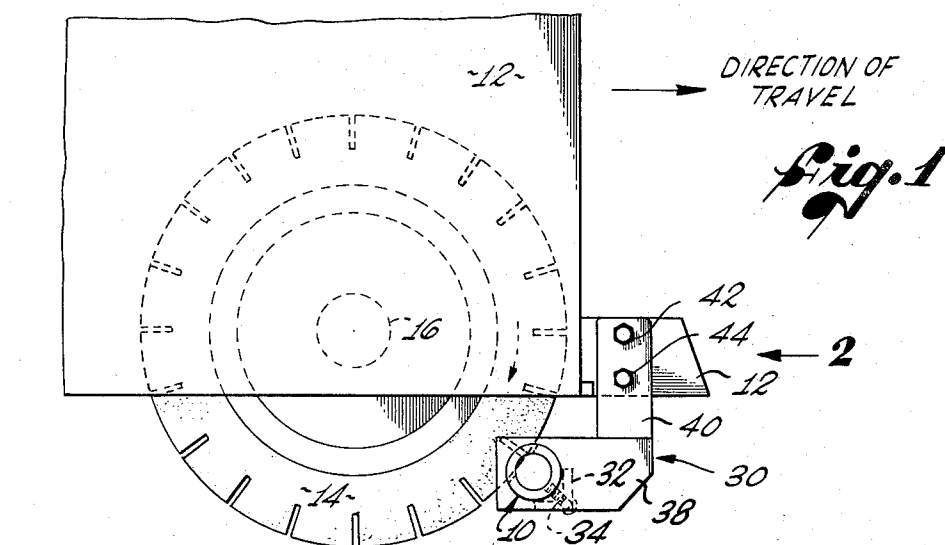
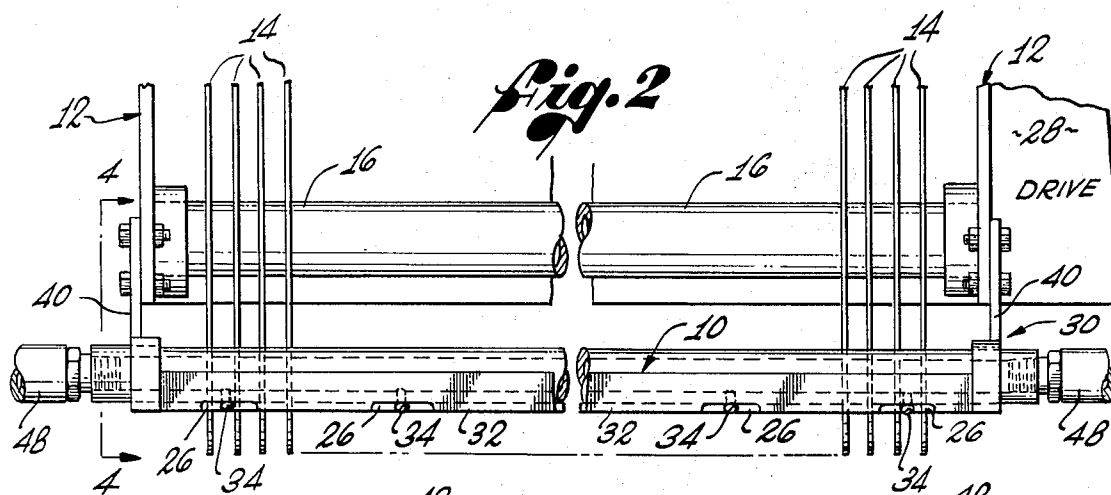
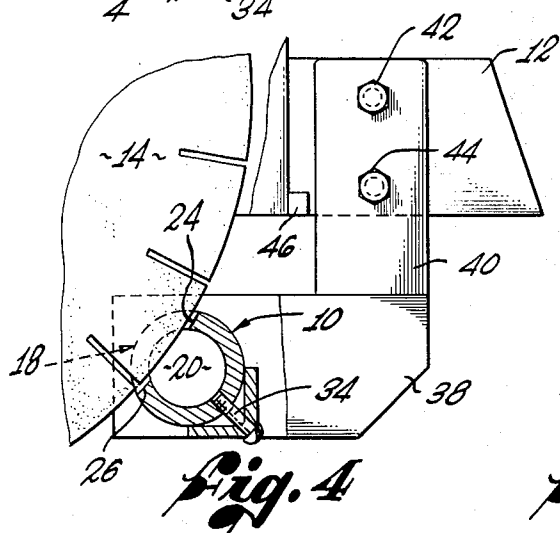
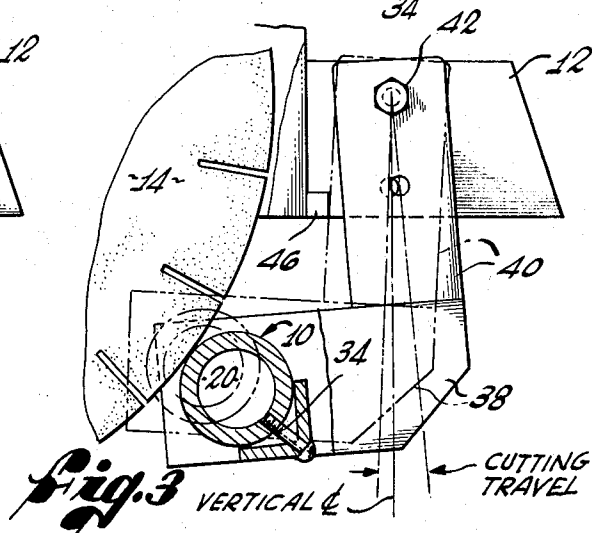
Primary Examiner—Ernest R. Purser

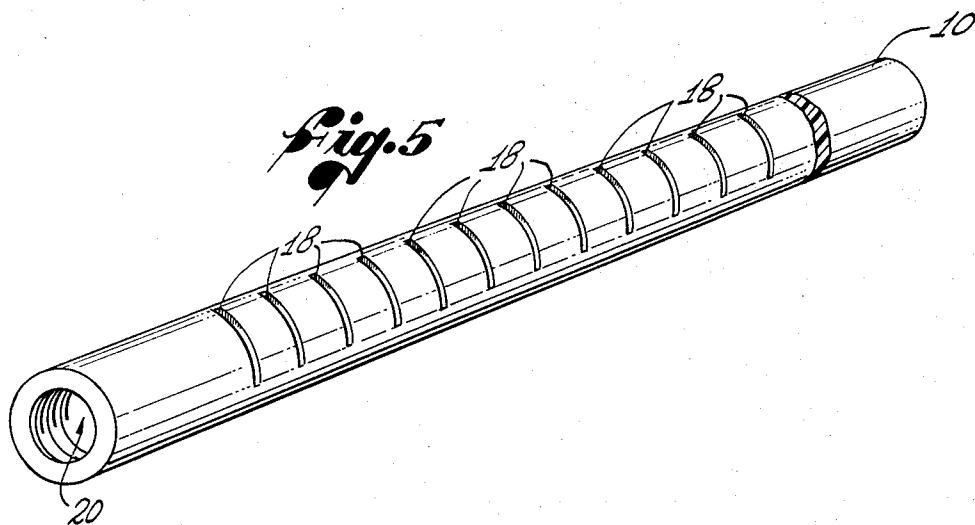
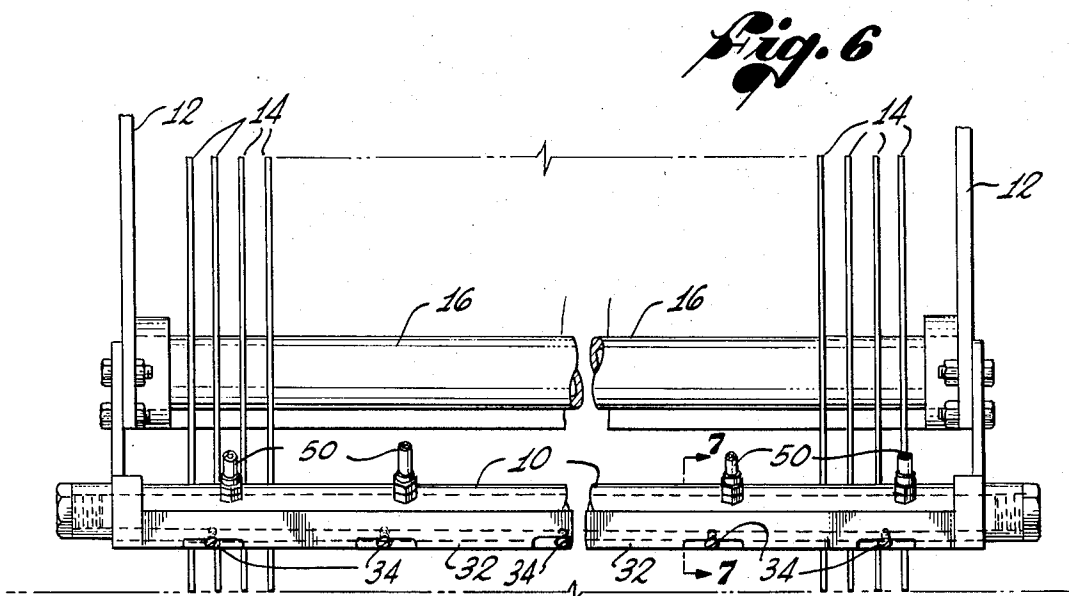
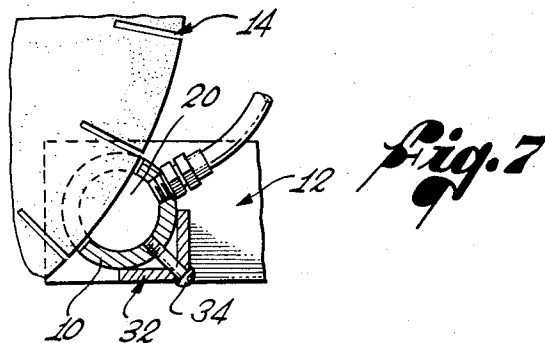
[57] **ABSTRACT**

A water applicator for attachment to a pavement grooving machine of the type including a cutter assembly which has a horizontal rotating shaft on which are mounted a plurality of parallel, rotary cutting blades at a predetermined spacing. The applicator includes a water tube having an internal passage and a plurality of notch-like openings which communicate with the passage. The openings are spaced along the tube at a corresponding spacing to the predetermined spacing of the cutting blades and each opening is sufficiently wide to loosely receive an associated one of the cutting blades which projects partially into the passage. The openings are initially formed by moving the tube, which is of rigid plastic material, against the cutting blades so that they cut through the tube wall.

16 Claims, 7 Drawing Figures







WATER APPLICATOR FOR A PAVEMENT GROOVING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to a water applicator for applying water to the cutting blades of pavement grooving machine. In particular, the applicator is intended to deliver water individually to each of the blades of ganged assembly of rotary cutting blades mounted on a common shaft, forming the cutting assembly of the pavement grooving machine.

To improve traction on rain-soaked pavement surfaces such as roads and aircraft runways, it is known to cut shallow, parallel grooves in the pavement to promote escape of water between the pavement surface and a vehicle wheel traveling thereon. Grooving of the pavement is commonly performed by specialized pavement grooving machines such as, for example, the pavement grooving machine disclosed in U.S. Pat. No. 3,407,005 to Sims et al. Such pavement grooving machines usually include a wheeled frame movable along the pavement and supporting a cutter assembly for cutting grooves in the surface. The cutter assembly can include a horizontal, transverse rotating shaft on which are mounted a plurality of parallel rotary cutting blades at a predetermined spacing, which engage the pavement to cut grooves in it. The cutting blades may comprise metal discs approximately a foot in diameter having abrasive cutting segments bonded around the periphery of the disc, such as the cutting discs disclosed in U.S. Pat. No. 3,376,673 to Metzger et al.

In using such a pavement grooving machine, it is essential to provide a continuous flow of water to each of the cutting blades to prevent the blade from becoming overheated, to lubricate its cutting action and to flush away the abraded pavement material. For this purpose, it has been common to mount a horizontal transverse spray bar in front of and adjacent to the rotating cutting blades to direct a continuous flow of water against the edges of the blades through a plurality of spaced nozzles mounted along the spray bar.

Although widely used, prior spray bar system may sometimes prove unsatisfactory for several reasons. A major problem arises due to clogging of one or more of the spray nozzles. The pavement cutting action of the machine throws up considerable quantities of flaked, chipped and abraded pavement material which not infrequently enters and clogs individual spray nozzles. In addition, the source of water being sprayed, which may typically be recirculated spray water or water obtained from roadside borrow pits, may also include suspended solid impurities which can clog the nozzles. If a nozzle becomes clogged, the flow of water to the blades adjacent the nozzle can be reduced to such an extent that the blade overheats and the abrasive segments can become unbonded from the disc or otherwise damaged. If this should occur, operation of the paving machine must be stopped, the cutter assembly taken apart, and the defective blade replaced by a new one. The economic costs of such spray nozzle failure are very high, both in the loss of expensive blades and the costly down time involved during the interruption of a pavement grooving job.

Another problem with the use of spray nozzles is that structural considerations usually prevents them being pitched closer together than approximately 1 1/2 inches to 2 inches. However, the spacing at which the pave-

ment grooves are specified to be cut usually require the cutting blades to be pitched more closely together, e.g., a typical pitch would be 3/4 inch apart, so that it is not possible to align each cutting blade with an associated spray nozzle. To avoid starving those blades which are positioned between adjacent nozzles, it is necessary to provide a very high rate of water flow through the nozzles which leads to unnecessary overconsumption of water. In addition, the spray nozzles spray not only the blades but also the space between the blades leading to further wastage of water. It is therefore an objective of the present invention to promote economical use of water by supplying each blade individually with its own water requirements and by avoiding application of water to the space between blades.

A further problem with the use of spray nozzles is that an air film which tends to adhere to the peripheral edge of the rotating blade, coupled with the centrifugal action of the spinning blade, makes it difficult to apply water effectively to the peripheral edge face of the blade. The most efficient application of water, therefore, is to the sides of the blade in the region adjacent the peripheral edge, as it has been found that water applied thereto is then carried outwardly by the centrifugal action to the cutting surface of the blade. However, the use of spray nozzles is relatively inefficient in applying water to the sides of each blade as well as to the peripheral edge.

SUMMARY OF THE INVENTION

A water applicator according to the present invention is intended to supply water individually to each of the rotary cutting blades of a pavement grooving machine without the possibility of clogging of the blade water supply. By preventing clogging and ensuring continuous uninterrupted flow of water to each blade, the possibility of individual blade damage due to overheating is effectively eliminated, thereby effecting significant maintenance economies and avoiding expensive down time during the performance of pavement grooving jobs.

In addition, the water applicator of the present invention operates with greater economy in the use of water than systems dependent on spray nozzles, because it eliminates the need for oversupply of water to avoid water starvation of some of the blades and, further, eliminates the problem of delivering water to the empty space between blades. Moreover, the water is applied more efficiently to the blades by wetting the side surfaces of each blade adjacent is peripheral edge so that water is carried by centrifugal force directly to the peripheral cutting edge of the blade.

The foregoing desirable results are achieved by providing each blade with its separate individual water supply in contrast to the former systems which utilized spray nozzles pitched apart at a greater distance than the spacing between individual cutting blades. To achieve this result, the water applicator includes a transversely extending water tube having a plurality of notch-like openings along its length at the same spacing as the spacing of the cutting blades. Each opening is sufficiently wide to loosely receive an associated one of the cutting blades. The water tube is supported by adjacent portions of the pavement grooving machine in spaced parallel relation to the blade mounting shaft. The blades project through the notched openings and extend partially into an internal passage extending cen-

trally through the water tube. Water under pressure is supplied to the passage in the spray bar and distributed to each of the cutting blades individually through the openings. Any solid material, such as flaked or abraded pavement material thrown up during pavement cutting, which becomes positioned between any blade and the edges of its associated opening is acted on by the blade and abraded away before it can become an obstruction preventing flow of water to the blade. As a result, the possibility of cessation of flow of water to any of the blades due to clogging is avoided, thereby greatly minimizing blade damage due to overheating.

The water tube is a rigid circular tube made from a plastic, such as nylon, and the notched openings are initially formed by forcing the tube against the cutting blades so that they cut through the wall of the tube wall into its interior. The depth of cut is such that the peripheral extent of each opening constitutes only a minor arc of the circular cross-section of the tube. After the notched openings have been cut, the water tube is moved radially away from the blades by a short distance, for example, 1/16th inch or so, to space the cutting edges of the blades out of contact with the tube and provide space for flow of water between the peripheral edge of each blade and the tube.

Each blade extends into the passage through the center of the passage to a distance of approximately one-fourth to one-half of the internal diameter of the passage. The remaining cross-sectional area of the internal diameter of the tube is unobstructed by the blades so that water can flow freely along the internal passage to all the blades. The water in the passage is applied to the edge of each blade and also to the sides of the blade adjacent its peripheral edge so that some of the water is carried by centrifugal action out to the peripheral edge of the blade.

The foregoing and other advantages of the invention are described further in the detailed description hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

A water applicator according to the invention is illustrated in the accompanying drawings in which:

FIG. 1 is a side view of a portion of a cutting assembly of a pavement grooving machine, provided with a water applicator constructed in accordance with the preferred embodiment of the invention;

FIG. 2 is a front view of the cutting assembly and water applicator shown in FIG. 1 looking in the direction indicated by arrow 2 therein;

FIG. 3 is a side view on an enlarged scale, partially in cross-section, of the water applicator unit shown in FIG. 1, illustrating an initial step in constructing the water applicator in which openings are cut in a tube forming a part of the invention;

FIG. 4 is a side view of the water applicator shown in FIG. 3 after the openings have been cut and the applicator have been fixed in its working position on the cutting assembly;

FIG. 5 is a perspective view of the water tube shown in FIG. 4;

FIG. 6 is an end view of a water applicator constructed in accordance with a second embodiment of the invention; and

FIG. 7 is a cross-sectional side of a portion of the applicator shown in FIG. 6 taken along the line 7-7 therein.

DETAILED DESCRIPTION

A water applicator according to the present invention includes a horizontal water tube 10 (FIGS. 1 and 2) extending transversely of a pavement grooving machine, portions of the frame of which are indicated generally 12. The water tube 10 distributes water individually to each of a plurality of transversely spaced, identical cutting blades 14 secured to a horizontal rotating shaft 16 mounted transversely in the frame 12. The water tube 10 (FIG. 5) has a plurality of notch-like openings 18 spaced along its length at a corresponding spacing to that of the cutting blades 14 and is mounted (FIG. 4) so that each cutting blade projects through an associated one of the openings 18 partially into a passage 20 through the center of the spray bar. Water under pressure is supplied to the passage 20 so that as the cutting blade passes through the opening 18, the peripheral edge and the adjacent side surfaces of the blade are immersed in the water. Spacing is provided between the peripheral edge of each cutting blade and upper and lower edges 24 and 26 of each opening 18 to permit water to be carried outwardly with the blade in sufficient quantity to cool and lubricate the blade during its cutting action and flush away the abraded pavement material.

It will be appreciated that with the construction described, the possibility that water flow to a blade will be cut off due to clogging of its water supply is effectively eliminated because any solid material lodging between the blade and the edges of the associated opening 18 will be abraded away by the blade. Thus, one of the major causes of blade failure encountered in prior systems is overcome.

Another important advantage is that water usage is more efficient than can be obtained with spray nozzles which cannot be pitched as closely together as the cutter blades. With the individual openings 18 of the present invention, water is applied to each blade separately so that there is no wastage of water due to spraying water in the space between the blades nor is there any need to oversupply water in some regions to insure that water reaches blades that would otherwise be spaced relatively far away from the nearest spray nozzles if nozzles were to be used.

In addition, the way in which the water is applied to the blades is more efficient. Because each blade is rotating rapidly, it is difficult to apply water directly to the peripheral edge surface of the blade because of the adhesion of a layer of air to the peripheral edge and because of the action of centrifugal force. However, as each blade passes through its associated opening 18, the blade side surfaces adjacent the peripheral edge become wetted by the water and centrifugal force then moves the water outwardly to the peripheral edge to achieve the desired lubricating and cooling thereof.

In the preferred embodiment, the water applicator of the present invention is utilized on a pavement grooving machine of the type disclosed in U.S. Pat. No. 3,407,005 to Sims et al., relevant portions of which are incorporated herein by reference, although the applicator may be used on other abrading machines and pavement grooving machines as desired. The pavement grooving machine includes a frame, of which the previously mentioned portions 12 constitute a part, supported on wheels for longitudinal motion in a forward direction along the pavement in which grooves are to

be cut. The shaft 16 is journaled in the frame 12 extending transversely thereof in a horizontal disposition and is rotated by a drive unit 28 (FIG. 2) in the direction shown by the arrow in FIG. 1. Thus the forward edge of each of the blades 14 mounted on the shaft 16 is rotated downwardly into contact with the underlying pavement to cut a groove therein.

Each of the cutting blades 14 comprises a circular steel disc having a plurality of cutting segments bonded to its periphery. The cutting segments comprise diamond particles embedded in a matrix. In the preferred embodiment, the cutting blades are of the type disclosed in U.S. Pat. No. 3,376,673 to Metzger et al., although other known cutting blades may be utilized.

The water tube 10 intersects the blades 14 in the lower forward quadrant of the blades at approximately the midpoint of quadrant (FIG. 1). The openings 18 are positioned in the upper rear quadrant of the supply tube facing upwardly. The water has only a short peripheral distance to travel from the water tube to the point of application of the cutting blades to the pavement. Although the location of the tube has been described with reference to a down cutting mode of operation of the blades, it will be understood that for some cutting applications it is preferred to use an up cutting mode in which the blades rotate in an opposite direction relative to the direction of travel in which case the water tube would be located on the rearward side of the blades.

Support for the tube 10 is provided by a supporting assembly designated generally as 30 (FIGS. 1 and 2). The supporting assembly includes an L-section transverse beam 32 abutting the forward lower quadrant of the tube 10 and secured thereto by spaced bolts 34. The bolts pass through transversely elongate slots 36 in the beam 32 and are tapped directly into the wall of the tube 10. At its opposite transverse extremities, the beam 32 is secured to two horizontal, longitudinally extending arms 38. Forwardly of the beam 32, each horizontal arm 38 is connected by a vertical arm 40 to adjacent portions of the frame 12 by upper and lower bolted connections 42 and 44, respectively.

A further significant aspect of the invention resides in the method by which the water applicator is fabricated. The tube 10 is formed from a rigid plastic material having an appreciable wall thickness in relation to its overall diameter. In the preferred embodiment, the tube is of circular cross section, but tubes of square, rectangular, triangular or other cross section may be used. In the preferred embodiment, a rigid nylon tube is utilized, although other materials such as polyvinyl or polyethylene may be utilized. The tube 10 is mounted on the supporting assembly 30 which is initially connected with the frame 12 by only the upper bolt 42 with the lower bolt 44 not in place, as shown in full lines in FIG. 3. At this time the assembly 30 is free to pivot about the upper bolt towards the cutting blade in a generally radially inward direction relative to the shaft 16.

With the cutting blades 14 rotating, the assembly 30 is pivoted rearwardly to move the tube 10 in a radially inward direction relative to the shaft 16 into contact with the cutting blades so that they cut their way through the tube wall and enter the internal passage 20. The inward pivoting motion is continued until the outermost portion of the peripheral edge of each cutting

blade is positioned at a location inwardly of the passage 20 between one-fourth and one-half of the internal diameter of the passage. At this time the peripheral extent of each opening 18 constitutes only a minor arc of the peripheral length of the cross-section of the tube. Further inward pivoting motion of the connecting assembly about the bolt 42 beyond that point is prevented by impingement of the upper arm 40 against a shoulder 46 secured to the frame 12, as shown in broken lines in FIG. 3. The connecting assembly is then pivoted backwardly through a minor part of its travel to a position in which the lower bolt 34 can be inserted and secured, as shown in FIG. 4. The limited backward movement spaces the upper and lower edges 24 and 26 of the opening 18, cut in the tube wall by the blade, away from the blade edge to leave a clearance, or spacing, of approximately 1/16th inch in the preferred embodiment. However, the positioning of the stop 46 may be varied so that different clearances may be provided. In addition, because of the abrasive nature of the segments of the cutting blades and some lateral play in the movement, the side surfaces of each segment will sufficiently wear away the adjacent side surfaces of the associated opening 18 so that the blade is loosely received within the opening. This permits some water to also pass between the side surface of the blade and the adjacent side edges of the opening.

Water is delivered to the passage 20 in the tube 10 through water supply pipes 48 (FIG. 2) which are threadedly connected with the transverse axial extremities of the tube 10 extending internally thereof (FIG. 2).

In an alternative embodiment of the invention shown in FIG. 6, the transverse axial extremities of the tube 10 are plugged and the water is supplied to the passage 20 through a plurality of transversely spaced water supply hoses 50 having horizontally disposed threaded connections which enter the supply tube radially on the opposite side thereof from the cutting blade.

Summarizing, the water applicator of the present invention provides each cutting blade with an individual supply of water which is not subject to interruption due to clogging. As a result, the possibility of blade failure due to overheating as a result of interrupted waterflow is effectively eliminated.

Another advantage is that the available water is used more efficiently than by a comparable system utilizing spray nozzles because water is not sprayed in the area between blades nor is there any requirement to overspray in some areas to insure that blades remote from spray nozzles are not starved. In addition, the water supplied to the blades is directed most effectively to the peripheral edge of each blade by insuring that the sides of the blade adjacent the peripheral edge are also immersed in the water.

The fabrication of the tube wherein it is forced against the blades to cut the notch-like openings therein is a much simpler form of construction than that involved in obtaining machined spray nozzles and assembling them at predetermined spacing along a spray bar.

Although the invention has been described with reference to certain preferred embodiments, it will be understood by those skilled in the art that modifications and changes may be made without departing from the spirit and scope of the invention.

For example, the liquid applicator may be used on a cutting assembly comprising only a single cutting blade as the rotating shaft.

I claim:

1. A water applicator for attachment to a pavement grooving machine of the type including a cutter assembly which has a rotating shaft on which are mounted a plurality of parallel rotary cutting blades at a predetermined spacing, the blades engaging the pavement to cut grooves therein, the water applicator including:

a water tube having,

a tubular wall having,

at least one enclosed internal passage extending in a direction axially of said tubular wall,

a plurality of notch-like openings extending through said tubular wall into communication with said passage, said openings spaced along said tubular wall at a corresponding spacing to the predetermined spacing of the cutting blades, each said opening being of sufficient width to loosely receive an associated one of the cutting blades;

and supporting means adapted for connection to the pavement grooving machine for supporting said water tube in spaced parallel relation to the rotating shaft with the cutting blades projecting through the associated said openings in said tubular wall partially into said passage.

2. A water applicator as defined in claim 1, wherein said water tube is formed from rigid plastic material and wherein said openings are formed by moving said tubular wall radially against the cutting blades to cause the blades to cut through said tubular wall and extend partially into said passage.

3. A water applicator as defined in claim 1, wherein adjacent portions of said tubular wall defining said openings are configured to extend in parallel relation to the peripheral edges of the associated cutting blades and are spaced out of edge-to-edge contact therewith.

4. A water applicator as defined in claim 3, wherein said tubular wall is of circular cross-section and wherein the peripheral extent of each said opening constitutes only a minor arc of said circular cross-section.

5. A water applicator as defined in claim 4, wherein each said opening faces in a generally upward direction toward the associated cutting blade with said supporting means supporting said water tube at a vertical location below the horizontal diameter of the cutting blades.

6. A spray unit as defined in claim 4, wherein the radially innermost portion of each cutting blade relative to said internal passage extends inwardly thereof to a position in the range of one-fourth to one-half of the diameter of said passage.

7. A water applicator as defined in claim 3, further including:

water means connected to said tubular wall for supplying water under pressure to said internal passage.

8. A water applicator as defined in claim 7, wherein said water means comprises at least one water supply pipe connected to an axial end of said tubular wall for delivering water axially of said internal passage.

9. A water applicator as defined in claim 7, wherein said water means comprises:

at least one water supply pipe connected with said tubular wall intermediate the extremities thereof for directing water in a radial direction into said passage.

10. A liquid applicator for attachment to a cutting assembly which has a rotating shaft on which are mounted a plurality of parallel rotary cutting blades at a predetermined spacing, the liquid applicator including:

a tube having,

a tubular wall having,

an enclosed internal passage extending in a direction axially of said tubular wall,

a plurality of notch-like openings extending through said tubular wall into communication with said passage, said openings spaced along said tubular wall at a corresponding spacing to the predetermined spacing of the cutting blades, each said opening being of sufficient width to loosely receive an associated one of the cutting blades; and

supporting means adapted for connection to the cutting assembly for supporting said tube in spaced parallel relation to the rotating shaft with the cutting blades projecting through the associated said openings in said tubular wall partially into said passage.

11. A pavement grooving machine comprising:

a frame extending in a longitudinal direction;

wheel means supporting said frame for longitudinal motion along the pavement;

a cutting assembly, including,

a horizontal, rotating shaft mounted in said frame extending transversely thereof,

a plurality of rotary cutting blades mounted in transversely spaced parallel relation along said rotating shaft, said cutting blades at their lower peripheral extremities extending into contact with the pavement to cut longitudinally extending grooves therein during motion of said frame;

a water applicator fixedly connected to said frame including,

a transversely extending, tubular wall positioned in spaced parallel relation to said rotating shaft,

a transversely extending, enclosed internal passage within said tubular wall,

a plurality of transversely spaced, notch-like openings through said tubular wall communicating with said passage, each said opening being aligned with and loosely receiving an associated one of said cutting blades which projects partially into said passage; and

means for supplying water under pressure to said passage.

12. A pavement grooving machine as defined in claim 11, wherein said water tube is formed from rigid plastic material and wherein said openings are formed by moving said tubular wall radially against the cutting blades to cause the blades to cut through said tubular wall and extend partially into said passage.

13. A pavement grooving machine as defined in claim 11, wherein adjacent portions of said tubular wall defining said openings are configured in the vertical plane to extend in parallel relation to the peripheral edges of the associated cutting blades and are spaced out of edge-to-edge contact therewith.

14. A pavement grooving machine as defined in claim 13 wherein said tubular wall is of circular cross-section and wherein the peripheral extent of each said opening constitutes only a minor arc of said circular cross-section.

15. A pavement grooving machine as defined in claim 14, wherein the radially innermost portion of each cutting blade relative to said internal passage extends inwardly thereof to a position in the range of one-fourth to one-half of the diameter of said passage.

16. A liquid applicator for attachment to a cutting assembly which has a rotating shaft on which is mounted at least one rotary cutting blade, the liquid applicator including:

a tube having,
a tubular wall having,
an enclosed internal passage extending in a direction axially of said tubular wall,
at least one notch-like opening extending through said tubular wall into communication with said passage, said opening being of sufficient width to loosely receive the cutting blade, and
supporting means adapted for connection to the cutting assembly for supporting said tube in spaced parallel relation to the rotating shaft with the cutting blade projecting through said opening in said tubular wall partially into said passage.

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