ICE RESURFACING MACHINE

Fig. 1

Fig. 2

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The invention relates to a self-propelled vehicle adapted to move over the surface of an ice rink and remove a layer of ice and subsequently spread a film of water over the shaved ice surface. The vehicle includes an ice removing unit located at the rear of the vehicle and mounted such that the unit is pushed, rather than pulled, over the ice surface. The ice removing unit comprises a cutting blade to shave the ice, and a rotating brush to sweep the ice and convey the shavings forward to a transverse auger conveyor which delivers the shavings to an elevator that functions to convey the shavings to a tank on the vehicle.

To provide a smooth, uniform surface for an ice rink, a thin layer of water is periodically applied to the surface of the ice and the water is frozen either by ambient temperatures or, in the case of an artificial rink, by a coolant which flows within coils embedded in the rink. The layer of ice acts as an insulating material, and as the ice builds up on an artificial rink the power requirements for cooling and freezing the water are correspondingly increased. Thus, from an economical standpoint it is necessary to remove a thin layer of the ice from the rink before applying a fresh film of water so that the layer of ice remains generally uniform in thickness throughout the season and the cooling requirements will be constant.

Moreover, the removal of a thin layer of ice results in a more uniform and smooth ice surface, for by shaving the ice, gouges or imperfections in the ice surface are eliminated or reduced in depth and a thinner film of water can thereby be applied to the shaved ice surface to restore the desired smooth and uniform surface characteristics.

Ice resurfacing machines, in general, are self-propelled vehicles adapted to move over the surface of an ice rink and take a thin shaving cut from the surface, remove the shavings and thereafter spread a thin film of water over the shaved surface. The resurfacing machine of the invention includes an ice removing unit or sled located at the rear of the vehicle and the forward end of the sled is connected by a pair of pivotal arms to the vehicle frame. The pivotal connection of the arms to the sled is ahead of the pivotal connection of the arms to the frame so that the sled is pushed across the ice surface, rather than being pulled, as the vehicle moves.

A blade is mounted transversely of the sled and is adapted to engage and take a shaving cut of the ice. The ice shavings are swept from the ice surface and conveyed by a rotating brush to a transverse conveyor mounted for rotation ahead of the brush. The transverse conveyor delivers the shavings to the bottom of a vertical elevator which lifts the shavings to a bin or tank mounted on the vehicle frame.

The unit of the invention is hydraulically driven with a separate hydraulic motor for each wheel. With this individual hydraulic drive, the vehicle is extremely maneuverable and can pivot or turn about the geometrical center of the four wheels. Moreover, the use of individually driven wheels enables the power to be delivered to each wheel in a more precise or finite manner than can be achieved through use of the friction clutch of a conventional mechanical drive system. This enables the unit to be accelerated more gradually and prevents slipping or spinning of the wheels on the ice surface.

In the unit of the invention, the sled is both raised and lowered by a hydraulic cylinder unit. Thus, the sled is forced downwardly against the ice by hydraulic pressure so that the pressure being applied to the blade is not merely dependent on the weight of the sled. As the sled is pushed across the ice rather than being pulled or drawn, the pushing force tends to pivot the sled in one direction, while the hydraulic cylinder unit acting on the rear of the sled tends to pivot the sled in the opposite direction with the result that the forces acting on the blade are balanced. The balanced, downwardly-acting forces on the blade enable the blade to take substantially heavier cuts than the conventional ice resurfacing machine.

Moreover, the individual drive for the wheels and conveying equipment also aids in enabling the unit to take heavier cuts. With the use of a single engine acting through a standard gear transmission, as in the conventional machine, a heavy cut cannot usually be taken when the vehicle is moving slowly. At slow speeds, the engine is required to run at low speed and the conveying equipment is also operating at slow speed, too slow to adequately remove the ice shavings generated by the heavy cut. With the unit of the invention, the conveying equipment is operated independently of the wheels, so the unit can take heavy cuts at slow speeds and the conveying equipment can be operated at a speed sufficient to convey the ice shavings generated by the heavy cut.

The ice resurfacing machine of the invention also provides a convenient adjustment for the blade height, as well as the angle of attack of the blade with respect to the ice. Thus, the operator can readily change the blade height to vary the depth of cut, as well as changing the angle of the attack of the blade on the ice.

The resurfacing machine of the invention utilizes a hydraulic drive to operate the brush and conveyors, as well as to propel the vehicle across the surface of the ice. In the preferred form of the invention a separate hydraulic motor is used for each of the wheels of the vehicle, and the use of separate hydraulic motors provides an extremely maneuverable vehicle which is capable of turning about the geometrical center of the four wheels. This enables the machine to move into small-radius corners and to readily maneuver around any obstructions on the rink.

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated of carrying out the invention.

In the drawings:

FIG. 1 is a plan view of the ice resurfacing machine of the invention;
FIG. 2 is a side elevation of the machine;
FIG. 3 is an enlarged vertical section of the rear portion of the machine and the sled;
FIG. 4 is a rear elevation of the machine with parts broken away in section;
FIG. 5 is a horizontal section taken along line 5-5 of FIG. 3;
FIG. 6 is a schematic view of the hydraulic system for operation of the vehicle; and
FIG. 7 is a fragmentary, vertical cross section of the auger conveyor utilizing a modified form of resilient means to prevent accumulation of ice in the auger trough.

The drawings illustrate a self-propelled ice resurfacing machine which includes a frame 1 and a body 2 is mounted on the frame. A series of wheels 3 are journaled on the frame 1. Extending rearwardly from the frame 1 is a plat-
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The body 2 is divided into a series of compartments and the forward compartment 6 contains an engine unit generally indicated by 7. The central portion of the body defines a water tank or compartment 8 which contains water to be applied to the surface of the ice after the ice is shaved, while the rear portion of the body defines an ice tank 9 into which the shaved ice is delivered.

Mounted beneath the platform 3 is a sled 10 which includes a pair of side walls 11, a top wall 12, a rear wall 13 and a front wall 14. The walls 11, 12, 13 and 14 provide a generally rectangular, open-bottom shape for the sled 10.

The sled 10 is connected to the platform 3 by a pair of arms 15 having their upper ends pivotally connected by pins 16 to the platform 4, while the lower ends of the arms 15 are pivotally connected to brackets 17 which extend upwardly and forwardly from the front wall 14 of the sled 10.

The sled 10 is adapted to be raised and lowered between a transporting position, in which the sled is positioned above the ice, to an operating position in which the sled rides on the surface of the ice. The sled is raised and lowered by a hydraulic cylinder 18 which is pivotally connected to angle brackets 19 secured to the rear surface of the side walls of the sled 10. Piston rod 20 is pivotally connected to a pair of lugs 21 which extend upwardly from a cross bar 22 disposed above the top surface 12 of the sled 10. As best shown in FIG. 4, the ends of cross bar 22 are pivotally connected to arms 23 and the forward ends of the arms 23 are pivotally connected to brackets 24 which are secured to the body 2. As the piston rod 20 is retracted within the cylinder 18, the cross bar 22 is moved upwardly to thereby pivot the arms 23 about the pivot connection with brackets 24.

The sled 10 is adapted to be raised in accordance with upward movement of the cross bar 22 and arms 23 and this is accomplished by angle brackets 25 which are secured to the arms 23. Studs 26 are secured within the lower flange of each angle bracket and extend through the upper surface 12 of the sled 10. The lower ends of studs 26 are provided with enlarged heads 27, and as the arms 23 pivot upwardly the enlarged heads 27 engage the top wall 12 to thereby lift the sled 10. The studs 26 are positioned, in a fore and aft direction, slightly to the rear of the center of gravity of the sled 10 so that as the arms 23 pivot upwardly, the sled will be moved vertically and the forward end of the sled will tilt downwardly. This tilted position, in which the front end of the sled is down and the rear end is up, is an advantage when transporting, for the upwardly tilted rear end of the sled provides additional ground clearance when the vehicle is driven up or down a ramp or other incline.

The ice is shaved by a blade 28 which extends transversely of the sled 10 and is mounted on the lower flange of an angle support 29. The forward portion of the lower flange of angle support 29 is pivotally connected to the central portion of arms 30, while the forward ends of the arms 30 are pivotally connected to the side walls 11 of the sled. Pivotally connected to the rear ends of arms 30 are vertical supports 31 which extend upwardly adjacent the rear wall 13. The upper end of each vertical support 31 carries a nut 32 and an adjusting screw 33 is threaded within a boss in the top plate 12, as well as in the nut 32, so that threading of the screw 33 will tend to pivot the arms 30 to thereby raise and lower the blade 28. To guide the adjusting screws in movement, the lower end 34 of each screw has a reduced diameter and is slidably received within a guide ring 35 mounted on the central portion of each vertical support 31.

In addition to the adjustment for blade height which determines the depth of cut, a second adjustment is provided to vary the angularity of the blade with respect to the ice. In this regard an adjusting screw 36, as shown in FIG. 4, is located centrally of the width of the sled 10 and is threaded within a boss formed on the top wall 12 of the sled 10 and within a nut 37 which is pivotally connected to angle brackets 38 mounted on the vertical flange of the blade support 29. By threading the adjusting screw 36 into the nut 37, the angularity of the blade 28 can be varied as desired.

The machine of the invention has the ability to take a heavy cut due to the manner in which the sled is connected to the propelling vehicle. The pushing force exerted by the vehicle on the sled and the resisting force of the cutting blade act on the connecting linkage between the sled and the vehicle to create a downward force. This force is counterbalanced by the force of the hydraulic cylinder 18, with the blade as the fulcrum. Thus the greater the resistance caused by the depth of cut, the greater the downward force tending to penetrate the blade into the ice.

As previously mentioned, the forward edge of the blade is adapted to engage the surface of the ice and take a shaving cut. The ice shavings are then swept from the ice surface and conveyed forwardly by a brush 39 mounted on a shaft 40 which is journaled within the side walls 11 of the sled 10. The brush is located within a generally curved housing 41, and as the brush rotates, the bristles engage the surface of the ice and convey the shavings upwardly in the direction of the arrow 42. As shown in FIG. 3, against the housing 41, the brush is moved within the housing 41 to direct the shavings forwardly toward the center of the width of the sled 10. Attached between the ends of the flanking of the augers 42, at the midportion of the shaft 43, is a paddle 44 which extends axially of the shaft 43. The shavings being conveyed toward the center portion of the shaft 43 by augers 42 will be engaged by the paddle 44 and thrown forwardly toward a vertical conveyor or elevator, as will hereinafter be described.

The augers 42 are supported within a transverse trough 45 and, as best shown in FIGS. 3 and 5, covers 46 are hinged to the forward edge of trough 45 and extend upwardly over the auger sections 42. The rear ends of the covers 46 are supported from the top wall 12 of the sled 10 by a series of springs 47 or other resilient members. The connection of the covers 46 to the sled wall 12 by the resilient springs 47 permits the covers 46 to jiggles or vibrate as the vehicle is moved over the ice surface and thereby prevents arching or other accumulation of ice shavings within the forward end of the sled 10.

Located between the hinged covers 46 is a fixed cover member 48 which is also connected to the forward edge of trough 45 and extends rearwardly beyond the rear ends of the hinged covers 46 and serves to direct the ice shavings being thrown forwardly by paddle 44 toward the vertical conveyor or elevator.

The brush 39 and the auger sections 42 are driven by a hydraulic motor 50 which is mounted on the top wall 12 of the sled 10. As best shown in FIGS. 1 and 4, the drive shaft 51 of motor 50 is journaled within a pair of bearing brackets 52 and the shaft 51 carries a pair of sprockets 53 and 54. Sprocket 53 is connected by chain 55 to a sprocket 56 on the brush shaft 40, while the sprocket 54 is connected by chain 57 to a sprocket 58 on the auger shaft 43. Thus, rotation of the motor drive shaft 51 serves to rotate both the brush and the auger in the directions indicated by the arrows in FIG. 3.

As previously mentioned, the ice shavings are conveyed forwardly by auger sections 42 and paddle 44 through an opening 49 in trough 45, and are moved upwardly to the tank 9 by an elevator or a vertical auger 59.
mounted within a housing 60. The lower end of the auger shaft 61 is journaled within the bottom wall 62 of housing 60, while the upper end of auger shaft 61 extends through the top wall 63 of housing 60 and is operably connected to the drive shaft of a hydraulic motor 64. The lower end of housing 60 is provided with an inlet opening 65 located in alignment with opening 49 in conveyor trough 45.

The upper end of the housing 60 is provided with an opening disposed in alignment with an opening in the body 2 so that the shavings being conveyed upwardly within the housing will be discharged by the auger 59 into the ice tank 9.

The housing 60 is pivotally connected to the body 2 through a pair of angle brackets 66 which are welded to the housing 60 and connected by bolts to body 2. The brackets 66 provide the sole connection of the housing 60 to the vehicle body so that the lower end of the housing can move, vibrate or joggle, during operation of the machine and thereby prevent the buildup or accumulation of ice at the inlet to the housing 60.

The blade 28 takes a cut of ice from the surface of the rink and the shavings are conveyed forwardly by the brush 28 and deflected by the housing 41 to the auger sections 42. The auger sections serve to convey the shavings toward the center of the sled where it is propelled by the paddle 44 through the opening 49 in trough 45 and into the opening 65 in the lower end of vertical conveyor housing 60. The auger 59 then conveys the shavings upwardly within the housing, discharging the shavings into the tank 9.

The unit of the invention also applies a thin coating of water to the shaved ice. As shown in FIG. 3, a manifold 67 is mounted on the rear wall 13 of sled 10 and extends substantially the length of the sled. Water is supplied to the manifold through a hose 68 which is connected to the lower end of the water tank 9. Spaced along the manifold 67 are a series of nozzles 69, and water is discharged through the nozzles into the open, upper end of a bag 70 which rides on the surface of the ice. The upper end of the bag 70 is supported by a generally rectangular frame 71 mounted on the rear wall 13 of sled 10. The bag 70 is formed of a flexible, water porous material such as canvas or the like and the water is discharged evenly from the bag onto the scraped surface of the ice in the form of a thin uniform film.

Located ahead of the bag 70 is a resilient scraper 72 which is mounted through a bar 73 to the lower end of wall 13. The scraper 72, made of rubber or other resilient material, is adapted to scrape along the surface of the ice and prevent shavings from being coated with the layer of water. This insures that the water will not be applied over ice shavings or other particles which may tend to provide a rough surface.

Attached to the side walls 11 of the sled 10 are guide bars 74 which extend forwardly from the sled. Bars 74 are provided with bent forward ends that extend inwardly at an angle toward the fore and aft center line of the vehicle. The kickboards located along the edge of the rink are often irregular, and the diagonal forward end of the guide bar 74 rides against the kickboards and prevents the sled from catching on any protruding board or edge. Normally, there will be an accumulation of ice to serve to raise the kickboards and increase the activity on the rink, and the guide bars 74 are formed with a minimum height, or depth, so that the accumulation of ice shavings along the kickboards will ride over the guide bar and into the sled, rather than being plowed along the kickboard as would occur if a deep cut of ice were allowed.

As previously mentioned, the vehicle itself, as well as the brush 39 and augers 42 and 59, are driven hydraulically. The engine 7, which is located in forward compartment 6, has a pair of drive shafts 75 which extend from opposite ends of the engine, as shown in FIG. 1. One of the shafts 75 is connected to a constant volume pump 76, while the other shaft serves to drive a variable volume pump 77.

Each of the wheels 3 is driven by an individual hydraulic motor and, as best shown in FIG. 1, each wheel is mounted on an axle 78 which is journaled within the frame 1 of the vehicle. Each axle 78 carries a sprocket 79 which is connected by a chain 80 to a sprocket 81 on the drive shaft 82 of a hydraulic motor 83. The hydraulic motors, as shown in FIG. 1, are indicated by 83a, 83b, 83c and 83d, for the four individual wheels.

FIG. 6 illustrates the hydraulic system for the ice resurfacing machine. As shown in this drawing, hydraulic fluid is supplied through line 84 from a reservoir 85 to the variable volume pump 77, and the discharge line 86 of pump 77 is connected to a flow diverter 87 which divides the flow. One of the outlet lines 88 from flow divider 87 is connected to a three-way valve unit, indicated generally by 89. Valve 89 is manually operated and serves to either operate the drive wheels 83a and 83b in a forward or reverse direction. Lines 90 and 91 connect to valve 89 with the motors 83a and 83b, respectively. The outlet lines 92 and 93 are connected to the outlet from motor 83b and are connected to lines 92 and 93. Lines 92 and 93 are connected through valve 89 to the discharge line 95 which is connected to the reservoir 85.

Valves 96, 97 and 98 are located in lines 93, 90 and 94, respectively, and by selective opening and closing of these valves, the flow of hydraulic fluid can be directed to either or both of the motors 83a or 83b. Valves 96, 97 and 98 are shown as separate valves, but in practice, it is contemplated that these valves would all be located in a common valve block.

Line 99, which is connected to flow diverter 87, is also connected to a valve 100, similar to valve 89, and the discharge lines 101 and 102 from valve 100 are connected to motors 83c and 83d in a manner similar to that described with respect to motors 83a and 83b. Fluid is discharged from the motors 83c and 83d through lines 103 and 104, respectively, and a by-pass line 105 connects lines 103 and 104. Lines 103 and 104 are connected through valve 100 to a discharge line 106 which leads to the reservoir 85.

Valves 107, 108 and 109, which are similar to valves 96, 97 and 98, are located in lines 103, 102 and 108, respectively, and by opening or closing the valves, the flow of fluid can be directed to either of the motors 83c or 83d or to both motors, as desired.

Thus, by proper actuation of the valves, the hydraulic fluid can be selectively directed to any one of the four motors 83a-83d or to any pair of motors. This enables the vehicle to be extremely maneuverable and permits the vehicle to rotate about the geometrical center of the four wheels if desired. Moreover, the flow of hydraulic fluid to the four hydraulic motors can be varied to provide the optimum speed-power relationship for transporting over the highway and for ice resurfacing.

As shown in FIG. 6, hydraulic fluid is introduced through line 110 to pump 76 and is discharged through line 111 to a valve unit 112. When the valve unit 112 is in one operating position, line 111 will be in communication with line 113 of the hydraulic cylinder 118 which serves to raise and lower the fluid carriage from the opposite end of the cylinder through line 114. Line 114 is connected through valve 112 to line 115 which is connected to a second valve unit 116. When the manual valve unit 116 is in one operating position, line 115 will be in communication with line 117. A flow diverter 118 is located in line 117 and divides the flow between lines 110 and 120 which are connected to hydraulic motors 50 and 63, respectively. The motor 50 serves to drive the horizontal augers and the brush, while the motor 63 functions to drive the vertical conveyor 59. Fluid dis-
charged from the motors 50 and 63 is conducted through line 121 to valve 116 and then through line 122 to reservoir 85. By reversing the position of valve unit 112, fluid in line 111 will be directed through line 114 to the upper end of cylinder 18 which results in the sled 10 being lowered. Similarly, by reversing the position of valve unit 116, fluid from line 115 will flow through line 121 to operate the motors 50 and 63 in the reverse direction.

FIG. 7 shows a modified form of the structure designed to prevent the accumulation or arching of ice shavings above the transverse auger. In this embodiment, an auger 122 is rotated for rotation in housing 124, similar to auger housing 45. The forward portion of auger housing 124 is connected to the forward wall 125 of the sled, and an opening 126 is provided in housing 124 through which the ice shavings are conveyed to the elevator.

The belt-like sheet 127 is draped over the auger flighting with one edge of the sheet being connected to front wall 122 and the other edge being connected to the top wall 128 of the sled. The sheet extends the length of the auger 123 and during operation, the edge of the auger flighting rides against the sheet 127 and tends to continually flex or deform the sheet. This continuous flexing of the sheet prevents build-up of ice in the upper portion of the sled above the auger.

The ice resurfacing machine of the invention is a self-propelled unit which is capable of taking a relatively heavy shaving cut of ice from a rink, depositing the shavings in a tank on the vehicle and applying a thin layer of water to the resurfaced ice. The brush 39, which is located ahead of the blade, serves to sweep the shavings from the ice surface and convey the shavings to the horizontal auger sections 42 which in turn act to deliver the shavings to the vertical auger 59.

If a transverse auger, similar to auger 42, was mounted ahead of the blade and the brush 39 eliminated, it would be necessary for a relatively large quantity of shavings to be accumulated before the auger would act to convey the shavings to the elevator 59. However, with the use of the brush 39, the ice shavings are continually swept from the ice surface and delivered to the auger 42 and this eliminates any accumulation of shavings ahead of the blade and prevents arching of the ice shavings in the rear portion of the sled, above the blade.

The resilient connection of the covers 46 to the sled, or the use of the flexible cover member 127, prevents the buildup of ice over the auger sections 42, and similarly the freeing of the longer end of the flexible housing 60 eliminates any possible accumulation of ice in the opening 65 of the housing.

The ice delivered to the tank 9 can be either melted or removed from the tank by conveying equipment. For example, a sprinkler head can be mounted in the wall bordering the tank 9 and by connecting the sprinkler head through a hose to a source of warm water after the resurfacing operation has been completed, water will be sprayed on the shavings to melt the same. Alternately, the side of the tank 9 can be provided with a hinged door, and the shavings can be discharged, either manually or by the use of power equipment, through the door to the exterior.

The sled 10 is raised and lowered through operation of the hydraulic cylinder 18. The sled can be readily raised to a position above the ice for transporting and when resurfacing, the pressure of the hydraulic fluid in cylinder 18 can be utilized to urge the sled downwardly against the ice and thereby provide a more uniform cutting action. As a further point of novelty, the sled, instead of being drawn or pulled across the ice, is pushed by the vehicle. This pushing force tends to pivot the sled counterclockwise, as shown in FIG. 3, and this force is balanced by the downward force of the hydraulic cylinder on the rear end of the sled which acts to pivot the sled clockwise.

Thus, a positive, yet balanced, downward force is applied to the blade during the resurfacing.

As each of the wheels 5 is driven by an individual hydraulic motor, and as hydraulic fluid can be individually supplied to each of the motors, the vehicle is extremely maneuverable enabling the vehicle to move into the corners of the rink and to maneuver around obstructions on the rink.

While the drawings illustrate an ice resurfacing machine adapted for resurfacing larger sized rinks, it is contemplated that a similar, but smaller, electrically driven unit, incorporating electric motors in place of the hydraulic motors, can be used for smaller indoor rinks.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I. An ice resurfacing machine, comprising a self-propelled vehicle including a tank to receive ice shavings, an ice removing unit located at the rear portion of the vehicle and connected to the vehicle by a pushing connection arranged so that forward movement of the vehicle pushes said unit forwardly along the surface of the ice with a downward component of force, said unit including a sharp generally horizontal blade for engaging the ice and taking a shaving cut thereof, and elevator means for elevating the ice shavings to the tank on said vehicle.

2. The ice resurfacing machine of claim 1, and including a rigid arm, one end of said arm being connected to said vehicle and the opposite end of said arm being connected to said ice removing unit, the connection of the arm to the ice removing unit being located forwardly of the connection of the arm to the vehicle.

3. The ice resurfacing machine of claim 2, and including means for mounting said ice removing unit for vertical movement between a transporting position in which said unit is located above the level of the ice to an operating position in which said unit is disposed in contact with the ice surface.

4. The ice resurfacing machine of claim 1, and including means for mounting said ice removing unit for vertical movement between a transporting position in which said unit is located at a predetermined level of the ice to an operating position in which said unit is disposed in contact with the ice surface.

5. The ice resurfacing machine of claim 4, in which said water spreading means comprises a flexible, open top water-permeable bag disposed to the rear of said unit and extending transversely substantially the width of said unit, and a water supply line located above the bag for supplying water to the interior of the bag, said bag disposed to ride on the ice surface and apply a uniform film of water to the ice surface.

6. The ice resurfacing machine of claim 4, in which said water supply means includes a receptacle having an open top and includes a transverse manifold, and a series of nozzles spaced along the length of the manifold and arranged to spray water into the open top of the receptacle.

7. The ice resurfacing machine of claim 1, in which said vehicle includes a series of wheels and each wheel is driven by an individual power source.

8. The machine of claim 1, in which said ice removing unit includes a generally horizontal auger located forwardly of said blade means and disposed to convey ice shavings to said elevator means, closure means disposed above said auger, and means for oscillating said closure means to prevent the buildup of ice above said auger.

9. The machine of claim 8, in which said closure means is a flexible sheet-like member disposed in contact with said auger, rotation of said auger serving to continuously flex said flexible member to prevent the buildup of ice above said auger.

10. The ice resurfacing machine of claim 1, and in-
including a guide member extending forwardly from a side edge of said ice removing unit, said guide member extending diagonally inwardly from said side edge toward the fore and aft center line of said machine and disposed to ride against the edge of an ice rink, said guide member having a substantially greater length than height whereby ice particles located along the edge of the rink will ride over said guide member and into said ice removing unit.

11. In an ice resurfacing machine, a self-propelled vehicle including a tank to receive ice shavings, an ice removing unit located at the rear portion of the vehicle and including blade means for engaging the ice and taking a shaving cut thereof, connecting means for connecting the ice removing unit to the vehicle, said connecting means being connected to the vehicle at a location spaced in a fore and aft direction from a vertical transverse plane passing through said blade means and said connecting means being arranged so that forward movement of the vehicle exerts a downward force on the portion of the ice removing unit to which said connecting means is attached, power operated means operably connected between the vehicle and the ice removing unit for applying a downward force to said unit, the connection between the power operated means and the ice removing unit being located on the opposite side of said plane from the connection of said connecting means to said ice removing unit whereby the downward force of said connecting means is balanced by the downward force of said power operating means, and elevator means for elevating the ice shavings to the tank on said vehicle.

12. The machine of claim 11, wherein the connection between said connecting means and said ice removing unit is located forward of said plane and the connection of said power operating means and said ice removing unit is located to the rear of said plane.

13. The ice resurfacing machine of claim 11, wherein said connecting means comprises a rigid arm, the rear end of said arm being connected to the vehicle and the arm extending downwardly and forwardly and the forward end of the arm being connected to said ice removing unit at a location forward of said plane.

14. The ice resurfacing machine of claim 11, in which said power means comprises a fluid cylinder unit.

15. In an ice resurfacing machine, a self-propelled vehicle including a tank to receive ice shavings, blade means mounted at the rear of the vehicle and extending transversely of the direction of travel of the vehicle for engaging the ice and taking a shaving cut thereof, a brush located forwardly of said blade means with the axis of the brush disposed transversely of said direction, conveying means located forwardly of the brush and extending transversely of said direction, said brush being driven to sweep the ice surface ahead of the blade means and to convey the ice shavings upwardly and forwardly to said conveying means and said conveying means acting to convey the ice shavings delivered by said brush to a collection zone, and elevator means having its lower end located at said collection zone and its upper end disposed to discharge ice shavings into the tank on said vehicle.

16. The ice resurfacing machine of claim 15, in which said conveyor means comprises an auger, and means for rotating the brush and said auger in the same direction.

17. The ice resurfacing machine of claim 15, in which said elevator means comprises a vertically extending housing, a conveying member disposed within the housing and acting to convey ice shavings upwardly within said housing, and means for connecting one end portion of said housing to the vehicle with the opposite end of said housing being free of connection to said vehicle whereby said opposite end of the housing is free to vibrate during operation of the machine to prevent buildup of ice within said housing.

18. An ice resurfacing machine, comprising a self-propelled vehicle including a tank to receive ice shavings, an ice removing unit connected to the vehicle whereby forward movement of the vehicle moves the unit forwardly along the surface of the ice, and elevator means for elevating the ice shavings to the tank on the vehicle, said ice removing unit comprising a frame, a sharp generally horizontal blade mounted on the frame for engaging the ice and taking a shaving cut thereof, and a brush located forwardly of the blade, said brush having its axis disposed transversely of the direction of movement of the vehicle and operating to sweep the ice surface ahead of the blade and convey the ice shavings forwardly of said blade, said ice removing unit also comprising a conveying member, said conveying member disposed forwardly of the brush and operating to deliver ice shavings from the brush to the lower end of said elevator means.

19. The ice resurfacing machine of claim 18, and including a housing partially enclosing said brush and arranged to direct the ice shavings forwardly in the direction of travel of said vehicle.

20. The ice resurfacing machine of claim 18, in which said conveying member includes a pair of axially aligned auger sections extending transversely of the direction of movement of said vehicle, said auger sections having opposite pitches and each auger section arranged to each convey ice shavings toward the center of width of said unit, and paddle means operably connected to said auger sections and located adjacent said center and disposed to deliver ice shavings to the elevator means.

21. The ice resurfacing machine of claim 18, in which said conveying member comprises a generally horizontal auger with the axis of said auger disposed transverse to the direction of travel of said vehicle.

22. The ice resurfacing machine of claim 21, in which said auger and said brush rotate in the same direction.

23. The ice resurfacing machine of claim 21, and including a trough partially enclosing said auger, said trough including a movable cover portion extending over the top of said auger, and resiliently connecting means connecting said cover portion to the frame to permit said cover portion to vibrate during operation of said machine and prevent the accumulation of ice in said trough.

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