The present invention relates to ice rink resurfacing machines for smoothing and renewing the surface of the ice in a skating rink after the same has been cut up and roughened by skaters, and its primary purpose is to provide a machine that is capable of refining the ice to a smooth, unblemished surface in the very minimum of time and with a minimum of labor.

The maintenance of a satisfactorily smooth surface on the ice is one of the major problems in connection with the operation of a skating rink, and after several hours of use, it is necessary to clear the ice of skaters to resurface the ice by scraping or shaving the same lightly, removing the shaved ice, and then spreading a thin film of water over the surface of the ice to fill in cracks or other depressions. Within a short time the water freezes, leaving the surface of the ice quite smooth and unblemished, and skating can then be resumed.

Heretofore, the usual method of cleaning off and smoothing the surface of the ice has been to send attendants out onto the ice to sweep off the cut ice with scrapers or sweeps that are pushed ahead of them; while in other instances, the ice is scraped clean by scraper blades mounted on towed sleds or on automotive vehicles such as the small, four-wheel drive vehicles formerly used in the military services and known popularly as the "jeep." In either case, after the surface of the ice has been scraped clean, a thin film of water is spread over the ice to fill in the cracks and low spots, and surplus water is then squeegeed away, usually by a number of attendants on skates, pushing the squeegees ahead of them.

Among the disadvantages of these prior methods of resurfacing the ice are the excessive length of time required to complete the operation, the relatively large amount of human labor involved, and the tendency of the ice to develop objectionable rough-surfaced areas where the newly added water mixes with shaved or cut ice missed by the scrapers to form a coarse-grained slush that freezes hard before the arrival of the attendants with squeegees. The squeegees have no effect on the hard-frozen rough ice, and the ice therefore remains rough until the next time that it is scraped.

Another undesirable result of prior resurfacing methods is a tendency of the ice to build up gradually in thickness, due to the addition of more water than is removed in the form of shaved ice. This increasing thickness of the ice is objectionable because of the adverse effect it has on the operating efficiency of the refrigerating system, and because of the tendency of the ice to melt on its surface, leaving puddles of water which cause much discomfort and inconvenience to the skaters. Both of these undesirable effects result from the fact that ice is a relatively poor conductor of heat, and therefore as the ice becomes thicker, the refrigerant must be maintained at a lower temperature in order to transfer heat at the required rate from the surface of the ice to the refrigerant. The present invention overcomes this difficulty by shaving away a thin layer of ice of substantially the same thickness as the layer of new ice which is built up when the newly added water is frozen.

Another object of the invention is to provide an ice resurfacing machine which leaves the ice with a completely smooth surface, free of any rough areas, and which removes approximately the same quantity of ice as is added in the form of water, so that the thickness of the ice remains substantially constant.

Another object of the invention is to provide a self-propelled vehicle that can be operated by one man, and which functions automatically to shave the ice, convey the shaved ice to a large receptacle attached to the vehicle, and then squeegee a thin film of water over the surface of the ice so as to provide a like-new surface when the water has frozen.

A further object of the invention in one of its aspects is to provide an attachment which can be mounted on the chassis of a jeep or other automotive vehicle to provide a self-propelled ice rink resurfacing machine at the minimum cost. The advantage of this feature is that the majority of skating rinks already possess one or more jeeps that can be used for this purpose, thereby reducing the investment required.

The foregoing and other objects and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following detailed description of the preferred embodiment thereof, reference being had to the accompanying drawings, wherein:

Figure 1 is a longitudinal vertical section, taken at 1—1 in Figure 3, through an ice rink resurfacing machine embodying the principles of my invention;

Figure 2 is a transverse vertical section through the same, taken substantially along the line 2—2 in Figure 1;

Figure 3 is a partially cut away top plan view of the rear end of the machine;

Figure 4 is a side elevational view of the rear
end of the machine, taken from substantially the same position as the view in Figure 1, but showing operating mechanisms raised to the transport position.

Figure 5 is an enlarged fragmentary section of a detail, taken at $5-5$ in Figure 2;

Figure 6 is a top plan view of the same, as seen at $6-6$ in Figure 5;

Figure 7 is a vertical section through the blade and worm screw conveyor, taken at $7-7$ in Figure 2;

Figure 8 is a sectional view through the blade adjusting mechanism, taken at $8-8$ in Figure 2;

Figure 9 is a side elevational view of another embodiment of the invention, showing a modified form of the apparatus mounted on a jeep; and

Figure 10 is a transverse vertical section through the same, taken at $10-10$ in Figure 9.

The abbreviations shown in Figures 1 to 6, inclusive, of the drawings will be described first.

In this form of the invention, the machine is seen to comprise an automobile vehicle 20 comprising a chassis made up of two laterally spaced, fore and aft extending frame angle irons 21 and 22 which are joined at the front end 23 by an inverted channel member 19, and at the rear end by a box beam 23. Mounted on the chassis in any suitable manner is an internal combustion engine 24 which is connected to a transmission gear box 25. The transmission 25 is of the four-wheel drive type, and includes a driving connection through a forwardly extending propeller shaft 26 to a differential mechanism 28 on the front axle of the vehicle, by means of which the front wheels 31 are driven. The rear wheels 32 of the machine are driven by a rearwardly extending drive shaft 33 which is connected at its front end to the transmission 25 and at its rear end to a differential gear mechanism contained within a housing 34. The front wheels 31 are steerable, and are turned by means of steering gear 35 which is controlled by a wheel 36 at the rear end of a steering column 37. The column 37 is supported at its rear end by a post 41 which is fixed to and extends upwardly from the right hand frame member 22. The frame member 22 extends rearwardly beyond the steering wheel 35, and is connected to the rear end is a bucket seat 42 in which the operator rides. Suitable driving controls (not shown) are provided, whereby the operator can start and stop the engine, shift gears, apply the brakes on the wheels, etc.

Mounted on the frame members 21, 22 and extending upwardly therefrom at the front end, midsection, and rear end of the machine are vertical posts 45, 46 and 47 which support a large, open-topped receptacle, or snow box 30 above the chassis of the vehicle. The sides of the receptacle 30 project laterally beyond the frame members 21, 22 and are braced by diagonally extending members 51. Also mounted on either side of the chassis of the machine between the front and rear wheels thereof are water tanks 55 which supply the water for flooding the ice, as will be described in more detail.

Carried at the rear end of the machine is a frame 56 comprised of two fore-and-aft spaced, transversely extending angle irons 57 and 58 which are connected together at their ends by channel-shaped end plates 60 having inwardly turned flanges at their top and bottom edges. The bottom flanges of the end plates 60 act as sled runners to support the weight of the mechanism carried on the frame 56, and also serve to

gauge the depth of cut taken by the blade. Intermediate their ends, the angle irons 57 and 58 are additionally connected together by fore-and-aft extending members 61, 62, and 63.

The blade is designated by the reference numeral 70 and extends transversely to the direction of forward travel, with its sharp cutting edge inclined downwardly to take a shaving cut on the ice. The blade 70 is supported downwardly by means of two hangers 71 having hooks 72 at their lower ends which are engaged through eye bolts 73 screwed into the ends of the blade. Each of the hangers 71 extends upwardly through a hole in the top flange of the cross member 60 at that end of the frame, and its upper portion is fastened at 74 and received within an adjusting screw member 75. The adjusting screw member 75 is preferably in the form of internally threaded sleeves, the bottom ends of which rest on top of the end members 60 around the threads of the holes through which the hangers 71 are passed.

Each of the two adjusting screws 75 at opposite ends of the frame 56 is reduced in diameter and has a housing 76 journalled thereon which is connected to another housing 78 by a horizontally disposed leaf spring 80. The screws 75 are journalled at one end in the housing 78 and extends upwardly and inwardly therefrom to a point within convenient reach of the operator sitting in the bucket seat 42. Cross pieces 84 are welded to the top ends of the shaft 83 to provide handles, by means of which the operator is enabled to turn the shaft. Shafts 83 are supported near their inner ends by posts 85 and 86; the former being welded at its lower end to the backside of the rear frame member 59, and the latter being welded to a bracket secured to the rear frame member 62. Fixed to the end of the shaft 83 and screw member 75 within the housings 78 and 76, respectively, are intermeshing torque-transmission members (not shown in detail herein) which provide a flexible driving connection between the shaft and the screw member, whereby the latter is turned by the shaft. Since the hanger 71 is constrained against rotation by its engagement with the eye-bolt 73, it will be evident that rotation of the screw member 75 causes the hanger 71 to be raised or lowered, and thereby the blade 70 to be raised or lowered.

The operator is thus able to raise or lower one or both ends of the blade 70 for the purpose of leveling the blade or for increasing or decreasing the depth of cut; such adjustment being made by turning the handle 84 on the adjusting shaft 83.

The angle of incidence of the blade 70 with respect to the surface of the ice is controlled by means of an adjusting wheel 90 which is fixed to the top end of a screw shaft 91. The shaft 91 passes downwardly through a trunnion block at 92 and is journaled for rotation therein, but constrained against axial movement with respect thereto. The trunnion block 92 has pintles 93 which extend laterally from opposite sides thereof, said pintles being journaled in bearing blocks 94 mounted on a transversely extending plate 95 which is supported at its extremities by the frame members 62 and 63. The screw shaft 91 projects downwardly from the trunnion block 92 through a hole in plate 95, and its lower end is screw threaded through another trunnion block at 96 having pintles 97 which are journaled in bearing blocks 98 on the rear end of an anxiety 90 at the end of the blade 70 at the midpoint thereof. Thus, it will be seen that rotation of the screw shaft 91 causes
the trunnion block 96 to move up or down the shaft, thereby increasing or decreasing the angle of incidence of the midpoint thereof are oppositely directed helical blades 24 and 25; the said blades being wrapped in such direction that when the shaft 121 rotates in a counter-clockwise direction, as viewed in Figure 1, the snow on both sides of the machine is carried in toward the center.

The adjacent ends of the two helical blades 124, 125 are spaced apart a short distance, and fixed to the shaft midway between them is a sprocket 126, around which is trained a conveyor chain 130 having a plurality of paddles 131 affixed thereto at equally spaced intervals along its length. The conveyor chain 130 and paddles 131 pass upwardly from the sprocket 126 through a long, rectangular housing 132 to the top rear corner of the snow box 50, where the chain is trained around another sprocket 133 mounted on a shaft 134. The shaft 134 is journaled in bearings 135 on opposite sides of the housing 132, and one end of the shaft projects beyond its bearing and has another sprocket 136 mounted thereon, over which a driving chain 140 is trained.

From sprocket 133, the conveyor chain 130 and paddles 131 extend forwardly through an opening in the front side of the housing 132 and pass above the open top of the snow box 50 to the front end thereof. At the front end of the machine, the chain 130 passes over a sprocket 141 which is mounted on a shaft 142 journaled in bearings 143. The bearings 143 are mounted on the front side of a vertically disposed, rearwardly facing channel member 144 which extends down the front of the receptacle 59 and is attached to the lower front corner thereof by an angle bracket 145. The channel member 144 is also attached by another angle bracket 146 to the front transverse beam 19 of the chassis, and rearwardly supported in the front end of the member in bearings 150 is a sprocket 151, around which the chain 130 passes and then travels rearwardly beneath the vehicle to sprocket 126.

In passing under the sprocket 126, the paddles 131 sweep close to the surface of the ice, scooping up some of the snow that has been carried in towards the center of the machine by the conveyor blades 124 and 125. The load of snow carried by each paddle is then elevated through the housing, 132, and upon passing over the top sprocket 133, is dumped onto a downwardly and forwardly inclined apron 152, from which the snow falls into the interior of the box 50. The apron 152 is fixed to the housing 132 along the bottom edge of the opening through which the conveyor leaves the housing.

The advantage of having the conveyor chain 130 travel forwardly across the open top of the box 50 from the back end thereof to the front, is that when the wet snow has piled up at the back end of the box to the level of the conveyor, the paddles 131 merely push their load of snow over the top of the pile to the front edge thereof, where the snow falls away from the paddles to build the pile forwardly until the box is entirely full. By virtue of this arrangement, the box 50 can be filled from end to end without any attention on the part of the operator, whereas if the conveyor merely dumped its load of snow on the apron 152 in passing over the sprocket 133, and then passed directly down to the lower sprocket 126, the snow would pile up to the apron and would thereafter prevent the conveyor from discharging its load of snow. This would necessitate stopping the machine and shoveling the snow out from under the discharge end of the conveyor, or else require the provision of other means for spreading the snow out over the entire area of the box.
The conveyor chain 130 and worm screw conveyor 120 are driven by the chain 140 which, as mentioned earlier, is trained over a sprocket 136 at the top end of the housing 132. The drive chain 140 passes downwardly from sprocket 136, around a small idler 153 which is rotatably supported by a bracket 154 mounted on the side of housing 132, and at its bottom end passes around a sprocket 155 which is rigidly fastened to a shaft 160 projecting laterally from a gear box 160. The gear box 160 is mounted on the front side of the housing 132 and is operatively connected by a drive shaft 162 and universal joints 163, 164 to a power takeoff shaft 161 projecting rearwardly from the transmission housing 25. The power takeoff shaft 161 is driven from the engine 24 through a clutch and transmission system independent of the clutch and transmission used to drive the vehicle, and the conveyors 120 and 130 can therefore be stopped whenever desired by merely disengaging the power takeoff clutch.

The housing 132 is supported at its lower end on the frame 56 and is attached thereto by means of a transversely extending pivot pin 165 and by bolts 166. The pivot pin 165 extends horizontally across the front of the housing 132 and is attached at its ends to bracket 170 projecting upwardly from the frame members 62, 63. Other brackets 171 project forwardly from the front side of the housing 132 and are drilled to provide holes through which the pivot pin 165 passes. The bolts 166 are disposed on either side of the housing 132 and are spaced rearwardly from the pivot bolt 165. The bolts 166 pass downwardly through angle brackets 172 which are fixed to the sides of the housing 132, and through the horizontal flanges of frame members 52 and 53, respectively. When the frame 56 is lowered on the ice, the brackets 172 are raised slightly from the members 62, 63, and the bolts 166 thus provide a loose connection between them. This arrangement provides a limited amount of looseness between the transversely extending frame 56 and the upwardly extending housing 132, so that any swinging movement of the latter in the fore-and-aft direction due to jerky movement of the driving or conveyor chains 140 and 130, or to inertia forces, has no effect on the frame 56.

The housing 132 is attached at its top end to the front member 144 by means of a tie rod 175, said tie rod being connected by a pivot pin 176 to a bracket 177 which is welded or otherwise fixed to the top end of member 144. The rear end of the tie rod 175 is connected by a turnbuckle 190 to a block 191 which is pivoted to 192 to a bracket 193 on the top end of housing 132. The pivotal connection of the ends of tie rod 175 with member 144 and housing 132 permits the latter to be raised from the working position shown in Figure 1, to the transport position shown in Figure 4, while at the same time maintaining the housing 132 in a vertical position.

Spaced rearwardly from the frame 56 and extending generally transverse to the direction of forward travel is a water distributing device 185 comprising a plate 186 having two parallel strips 187 and 188 of hard felt or other resilient material attached to the underside thereof. The strips 187, 188 extend lengthwise of the plate 186 and are spaced apart in the fore-and-aft direction to form a channel 190 which is closed at its ends. Elbow pipe fittings 191 and 192 are connected to the plate 186 in communication with the channel 190, and these are connected by lengths of flexible hose 193 and 194 to a T-fitting 195. The fitting 195 is connected, in turn, by a hose or flexible rubber hose 196, 197, and valve 196 to the water tank 155 on the vehicle chassis. The valve 196 is located within convenient reach of the operator on the seat 42, and when the valve 196 is opened the water in the tank flows by gravity or air pressure to the distributing device 185, where it fills the channel 190 and spreads transversely over the surface of the ice. Since the channel 190 is closed on all sides, the water is confined therein and is prevented from escaping laterally over the surface of the ice. Thus, the water fills up any cracks or depressions in the ice as the distributor 185 passes over the same, while the rear strip 187 acts as a squeegee to scrape up the surplus water and leave only a thin film of water on the ice behind the machine.

Attached perpendicularly to the front edge of the plate 156 is a plate 200, the bottom edge of which scrapes on the surface of the ice to sweep up and carry along any shaved ice that might pass over the top of the blade 76 or otherwise be missed thereby. Vertically disposed side wings 201 are fixed to the ends of the plate 200 and project forwardly therefrom to keep any shaved ice or surplus water from escaping along the ends of the water distributor. The water distributing device 185 is towed along behind the machine by two draft chains 202, each of which is connected at its rear end to the plate 200 and at its front end to one of the end members 60 of the frame 56.

The frame 56, with its blade 70, worm screw conveyor 120, and elevator housing 132, together with the water distributing device 185 is adapted to be raised from the working position shown in Figure 1 to the transport position shown in Figure 4, by means of a hydraulic lift in the form of a cylinder 203. The cylinder 203 is pivotally connected at its bottom end by a pin 204 to a bracket 205 mounted on the underside of the box beam 59 and extending rearwardly therefrom. The cylinder 203 extends upwardly from its pivot support, and projecting from the top end thereof is a piston rod 206 which is connected by a pin 207 to an arm 208 extending forwardly and upwardly from a transverse shaft 209.

The shaft 209 is journaled in bearings 210 mounted on the back side of the vertical box supporting posts 47, and fixed to the extreme ends of the shaft are rearwardly extending arms 211. Lift chains 212 are attached to the outer ends of the arms 211 and hang downwardly therefrom; the bottom ends of the chains being attached to lever arms 213 intermediate the ends thereof. The front ends of the lever arms 213 are connected by pins 214 to brackets 215 on the front frame member 57, and the lever arms extend rearwardly from the brackets 215 between two laterally spaced, vertically extending bars 216 which are bridged at their top ends by a bolt 220. The bolt 220 serves as a limit stop to limit the upward swinging movement of the lever arm 213, while at the same time permitting a certain amount of motion of the arm.

When both the frame 56 and water distributing device 185 are resting on the ice, the lever arms 213 are substantially horizontal, and the limit stop bolt 220 is spaced several inches above the top edge of the lever arm. As the lift chain 212 is pulled upwardly by the arm 214, the lever arm 213 is raised, lifting the water spreading device 185 clear of the ice without raising the frame 56.
until the lever arm 213 engages the bolt 220. At
this point, the lever arm 213 picks up the frame
56, and further lifting of the chain 212 causes the
frame 56 to be raised to the transport position.

Fluid pressure for operating the lift cylinder 203
is derived from a hydraulic pump 221 mounted
on one side of the motor 24 and driven by a belt 222.
The fluid discharged by the pump passes through
either or both of two flexible lines 223 and 224 to
one end of the cylinder 203; the other line serves
as a return pipe to carry the exhaust fluid back
to the pump. The flow of fluid from the pump 221
is controlled by a selector valve 225 having an
operating lever 226 which is connected by a push
rod 227 to a pivoted control lever 230 on the steer-
ing column support post 41. To operate the lift
cylinder 203, the operator merely moves the con-
trol lever 230 either forwardly or rearwardly from
the neutral center position, thereby changing the
fluid pressure from the pump 221 to be transmit-
ted to either the top or bottom end of the cylinder.

In its operation, the machine is driven over the
ice with the blade 70 carefully leveled and set to
take a light shaving cut on the ice. The shaved
ice is carried by the blade toward the center line of the machine by the worm screw
conveyor 120, where it is picked up by the paddles
131 on elevator chains 130 and raised through
housing 132 for discharge into the snow box 26.
At the same time, the valve 108 is opened, allow-
ing water from the tank 100 to flow by gravity
down through the water distributing device 185,
where the water is applied to the surface of the
ice as a thin film. When the entire surface of
the ice has been re-surfaced, the machine is driv-
en to a suitable unloading place where the shaved
ice is emptied out of the snow box. To facilitate
this unloading operation, one side of the snow box
is preferably hinged at 235 so that the side can be
lowered, making it easier to shovel the snow out of
the box.

Each form of the invention is illustrated in
Figures 9 and 10, wherein the machine is seen to
comprise an attachment that is adapted to be
mounted on a jeep 250 or other automotive vehi-
cle. In this case, a stationary frame consisting of
side members 251, rear cross member 252, and
front cross member 253 is most prominently
attached to the chassis of the jeep 250 in any
suitable manner. Welded to the side mem-
bers 251 and extending upwardly therefrom are in-
verted V-shaped members 254 having brackets
255 at the apex thereof which are connected by
pivot bolts 256 to brackets 257 on the underside
of a receptacle 250 at the midsection thereof.
Mounted within the box 260 along the sides
thereof are water tanks 261 which supply water
to the distributing means.

Mounted on the rear end of the box 260 by
structural member 262 and braces 263 is a ver-
tically extending housing 264 of rectangular cross
section, which encloses and cooperates with an
elevating conveyor 265. The housing 264 is spaced
slightly behind the rear member 252 of the sta-
tionary frame, and the bottom end of the hous-
ing includes a return attached to a transversely extend-
ring frame 266. As in the preceding embodiment,
the frame 266 consists of two fore-and-aft
spaced, laterally extending angle irons 270 and
271 which are joined together at their ends by
channel-shaped end plates 272 and 273 that
slide on the ice in the manner of sled runners.

A blade 274 is mounted on the frame 266 in
a manner similar to that shown in the preceding
embodiment, and directly ahead of the blade is a
worm screw conveyor 275 having oppositely di-
rected blades which carry the shaved ice toward
the center line of the machine. The shaft of the
worm screw conveyor 275 projects through
one of the end members 272 and has a sprocket
280 fixed thereto which is driven by a chain 281.
The chain 281 is trained around another sprocket
282 that is mounted on a short shaft 283 journaled
in a bearing 284 on the frame 266.
The shaft 283 is driven from a rearwardly pro-
tecting power take-off shaft 285 of the jeep, and
is connected thereto by a telescoping drive shaft
286 having universal joints 291 at each end there-
or, and by belted gears 296.
The elevating conveyor 265 consists of two lat-
erally spaced endless chains 291 which are trained
around sprockets 292 on the shaft of the worm
screw conveyor 275, and extend upwardly there-
from through the housing 264. Attached at both
ends to the chains 291 are paddles 293 which carry
the shaved ice up to the top of the housing 264
and then dump the same into the box 260. At the
top end of the housing 264, the chains 291 pass
over sprockets 294 and 295 and extend forwardly
therefrom to a sprocket 296 at the front end of the
machine.

The sprocket 296 is mounted on a shaft 300
which is journaled in bearings 301 mounted at
the top end of a supporting structure 302. The
structure 302 includes side members 303 and
braces 304 which are attached to the sides of
the box 260 near the front end thereof. The
worm screw conveyor 275 is driven in a clockwise
direction as viewed in Figure 9, and the left
hand course of the conveyor chain 281 within
the housing 264 is therefore ascending, while the
right hand course is descending. Shaved ice
picked up by the paddles 293 is carried up to
the top of the housing, and dumped into the box
260 as the conveyor chain passes over the top sprocket
294. The empty conveyor chain then travels
forwardly around the front sprocket 296 and
then doubles back to the housing 264, where it
passes over the sprocket 295 and descends within
the housing to sprockets 292 at the bottom end
thereof.

An inverted channel member 305 is fixed to
one side of the housing 264 and extends rear-
wardly therefrom, and mounted on the outer
end of the member is a bucket seat 306 for the
operator. The channel member 305 is braced on
both sides by members 307 extending down-
wardly and forwardly to the rear frame member
271, where they are attached in any suitable
manner.

The regular steering wheel of the jeep is re-
moved, and in its place is a flexible drive con-
nection 310 of any conventional form, which
connects the steering shaft with a rearwardly
extending shaft 311. The rear end of the shaft
311 is rotatably supported in a bearing 312 at
the top end of a supporting post 313, and fixed
to the end of the shaft is a steering wheel 314. Other
c conn a tions (not shown) are made to the
clutch pedal, brake pedal, gearshift, and igni-
tion switch of the jeep, so that the same can be op-
erated from the operator's seat 315.
To the rear of the frame 266 and extending transverse to the direction of forward travel is a
water distributing device 315 which is substan-
tially identical to that described in the preceding
embodiment. Water is carried from the two
supply tanks 316 to the distributor 318 through
pipes 316 and 317 which connect into a T-fitting
320. Extending downwardly from the T-fitting
320 is another pipe 321 having a valve 322 connected into the line so that the operator can control the flow of water from the tanks. The bottom end of the pipe 321 is connected by a flexible hose 323 to a pipe line 323' which carries water to both ends of a channel in the underside of the distributor 315.

The distributor 315 is connected at its ends by two draft chains 324 to the frame 266; and is also connected to the seat support member 305 by a lift chain 335. It will also be noted at this point that the frame 266 is connected to the jeep 250 by draft chains 326 which extend forwardly from points of attachment with the frame members 270 to brackets 330 on the side frame members 251. The ends of the frame 266 are also connected to the bottom rear corners of the box 260 by lift chains 331.

The box 260 with its attached equipment is adapted to be rocked about the supporting pivot 256 by means of a hydraulic lift cylinder 332 which is pivotally supported at 333 on a bracket 334 at the rear end of the jeep body. The piston rod of the cylinder is connected by a pin 285 to a bracket 336 on the underside of the box 260 near the rear end thereof. Fluid pressure for operating the lift cylinder is derived from a hydraulic pump 340 which is preferably belt-driven from a power take-off shaft on the jeep. Fluid pressure from the pump 340 is transmitted through one or the other of two lines 341, 342 which connect into the opposite ends of the cylinder 332. A selector valve (not shown) with a control handle located adjacent the operator's station, enables the operator to direct fluid pressure into the bottom or top end of the cylinder 332, to raise or lower the rear end of the box 260. When the box 260 is thus tilted forwardly, the frame 266 is lifted by the chain 331, while the water distributor 315 is lifted by chain 315. The front end wall of the box 260 may be hinged, if desired, to facilitate discharging the shaved ice from the box; in which case, the box would preferably be rocked about the pivot 256 so that its front end is inclined downwardly.

The many advantageous features of the present invention are believed to be self-evident to those skilled in the art. While I have shown in considerable detail what I believe to be the preferred forms of my invention, it will be understood that various changes may be made in the shape and arrangement of the several parts thereof without departing from the principles of the invention. For example, it is contemplated that the apparatus of the invention might be mounted on a sled and towed behind a vehicle, instead of being mounted directly on or attached thereto. Furthermore, the conveyor mechanism need not necessarily be driven by the vehicle motor, but might be driven, instead, by a separate auxiliary motor.

It is also contemplated that means might be provided for melting the shaved ice that is removed from in front of the blade, filtering the water thus obtained, and then returning the water to the surface of the ice through the water distributing device. This would eliminate the need for separate water tanks, and would insure that the amount of water added to the ice was almost exactly equal to the amount of shaved ice removed. These and other changes which will occur to those skilled in the art are considered to come within the broad scope of the invention as defined in the appended claims.

1. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle attached thereto, a sharp-edged blade arranged generally transverse to the direction of forward travel and disposed to take a light, accurately controlled shaving cut on the ice, said blade being mounted on and positioned with respect to the surface of the ice by a supporting frame resting directly on the surface of the ice and floating with respect to said vehicle, said blade being attached at its ends to said supporting frame, spring means on said frame engaging said intermediate its ends and pressing the same down against the ice, and means for collecting the shaved ice produced by said blade and depositing the same in said receptacle.

2. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle attached thereto, a frame connected to said vehicle to be towed thereby, said frame resting directly on the ice when said machine is in operation, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light, accurately controlled shaving cut on the ice, and conveyor means driven by the vehicle motor for clearing away the shaved ice from in front of said blade and depositing the same in said receptacle.

3. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle and a water tank attached thereto, a sharp-edged blade at the rear end of said vehicle arranged generally transverse to the direction of forward travel and disposed to take a light, accurately controlled shaving cut on the ice to remove shallow scratches and surface roughness caused by skate blades, conveyor means driven by the vehicle motor for removing shaved ice from in front of said blade and depositing the same in said receptacle, and means for distributing the water in said tank in a thin film over the surface of the ice behind said blade so as to fill up deep scratches and cavities extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by said blade, whereby the thickness of the ice after resurfacing is substantially the same as before.

4. An ice rink resurfacing machine comprising a motor-driven vehicle, a frame attached to said vehicle by a draft connection permitting free vertical movement of the frame relative to the vehicle between transport and working positions, said frame sliding on the ice and being solely supported thereby when in said working position, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice, a receptacle, means for collecting the shaved ice produced by said blade and depositing the same in said receptacle, and power-driven means for raising or lowering said frame from one of said positions to the other.

5. An ice rink resurfacing machine comprising a motor-driven vehicle, a frame attached to said vehicle by a draft connection permitting free vertical movement of the frame relative to the vehicle between transport and working positions, said frame sliding on the ice and being solely supported thereby when in said working position, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice, a receptacle, means for collecting the shaved ice produced by said blade and depositing the same in said receptacle, and power-driven means for raising or lowering said frame from one of said positions to the other.
on the ice, a receptacle, means for collecting the shaved ice produced by said blade and depositing the same in said receptacle, a hydraulic pump driven by said vehicle motor, a hydraulic lift mounted on said vehicle and connected to said frame to raise or lower the same from one of said positions to the other, and means operatively connecting said pump to said frame including a valve controllable by the operator.

6. An ice ring resurfacing machine comprising a motor-driven vehicle having a receptacle and a water tank mounted thereon, a frame attached to the rear end thereof to slide on the ice, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice to remove shallow scratches and surface roughness caused by said blades, conveyor means mounted on said frame and driven by the vehicle motor for removing shaved ice from in front of said blade and depositing the same in said receptacle, and water distributing means mounted on said frame to the rear of said blade and connected with said tank for distributing the water therein uniformly over the surface of the ice so as to fill up deep scratches and cavities extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by said blade, whereby the thickness of the ice after resurfacing is substantially the same as before.

7. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle and a water tank mounted thereon, a frame mounted on said vehicle at the rear end thereof, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice to remove shallow scratches and surface roughness caused by said blades, conveyor means mounted on said frame and driven by the vehicle motor for removing shaved ice from in front of said blade and depositing the same in said receptacle, transversely disposed water distributing means mounted on said frame to the rear of said blade and connected with said tank for spreading the water therein uniformly over the surface of the ice so as to fill up deep scratches and cavities extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by the blade, whereby the thickness of the ice after resurfacing is substantially the same as before, a rod shaft journaled on said vehicle and having arms connected to both said frame and said water distributing means, a hydraulic pump driven by said vehicle motor, a hydraulic cylinder mounted on said vehicle and having a piston rod connected to said shaft to rock the same, and means operatively connecting said pump to said cylinder, including a valve controllable by the operator.

8. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle and a water tank mounted thereon, a frame mounted on the rear end of said vehicle for vertical movement with respect thereto between transport and working positions, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice to remove shallow scratches and surface roughness produced by said blades, conveyor means mounted on said frame and driven by the vehicle motor for removing shaved ice from in front of said blade and depositing the same in said receptacle, transversely disposed water distributing means mounted for vertical movement with respect to said frame to the rear of said blade, said water distributing means being operatively connected with said tank for spreading the water therein uniformly over the surface of the ice so as to fill up deep scratches and cavities extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by said blade, whereby the thickness of the ice after resurfacing is substantially the same as before, and power lift means driven by the vehicle motor for raising both said frame and said water distributing means.

9. An ice rink resurfacing machine comprising a motor-driven vehicle having a receptacle and a water tank mounted thereon, a frame mounted on the rear end of said vehicle for vertical movement with respect thereto between transport and working positions, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice to remove shallow scratches and surface roughness produced by said blades, conveyor means mounted on said frame and driven by the vehicle motor for removing shaved ice from in front of said blade and depositing the same in said receptacle, transversely disposed water distributing means mounted for vertical movement with respect to said frame to the rear of said blade, said water distributing means being operatively connected with said tank for spreading the water therein uniformly over the surface of the ice so as to fill up deep scratches and cavities extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by the blade, whereby the thickness of the ice after resurfacing is substantially the same as before, a pair of laterally spaced lever arms pivotally connected to said frames and extending rearwardly therefrom to points directly above said water distribut-
ing means, the rear ends of said arms being connected to said water distributing means by lift chains, a transverse rock shaft journaled on said vehicle and having rearwardly extending arms fixed thereto directly above said lever arms, said arms on said rock shaft being connected to said level of the water distributing means by said frame limiting the upward swinging movement of said lever arms, whereby said frame is raised with respect to said vehicle after said water distributing means has been raised a short distance with respect to said frame, and means driven by the vehicle motor for rocking said rock shaft to lift said frame.

11. An ice ring resurfacing machine comprising a vehicle having a water tank mounted thereon, a frame attached to said vehicle, a sharp-edged blade mounted on said frame transverse to the direction of forward travel and disposed to take a light shaving cut on the ice to remove shallow scratches and surface roughness produced by skate blades, and a water spreading device extending generally transverse to the line of travel behind said blade, said device comprising a plate having a thickness of resilient material attached to the underside thereof which is adapted to rest on and slide over the surface of the ice, said material having a closed-end channel formed therein which extends from one end of the device to the other, and a pipe line connecting said tank to said channel so that the water in the tank is conveyed to the channel to fill the same, thereby spreading a uniform film of water over the ice to fill in deeper cracks extending below the cutting edge of the blade, and to restore to said ice a volume of water approximately equal to the volume of ice removed by the blade, whereby the thickness of the ice after resurfacing is substantially the same as before.

12. In an ice ring resurfacing machine, the combination of a vehicle having an operator's station provided thereon, a frame attached to said vehicle, a blade disposed transverse to the direction of forward travel, said blade being supported at its ends from said frame by vertically adjustable screws having hooks engaged in eyes on the blade, operating means attached to said screws and extending toward said operator's station so as to be operable therefrom, an arm extending rearwardly from said blade, and adjustable screw means connecting the rear end of said arm with said frame, whereby the angle of incidence of the blade with respect to the surface of the ice can be increased or decreased, said last-named screw means being also operable from said operator's station.

13. An ice rink resurfacing machine comprising a self-propelled vehicle having a receptacle attached thereto, a frame connected to said vehicle by a draft connection permitting free vertical movement of the frame relative to the vehicle, said frame sliding on the ice and being solely supported thereby when the machine is in operation, a sharp-edged blade mounted on said frame generally transverse to the direction of forward travel and disposed to take a light shaving cut on the surface of the ice, and means for collecting the shaved ice produced by said blade and depositing the same in said receptacle.

14. An ice rink resurfacing machine comprising a self-propelled vehicle having a receptacle attached thereto, a sharp-edged blade arranged generally transverse to the direction of forward travel and disposed to take a light shaving cut on the ice, and means for collecting the shaved ice produced by said blade and depositing the same in said receptacle, said means including a conveyor comprising a pair of laterally spaced chains having a plurality of transverse paddles connected thereto at their ends, said conveyor rising vertically from a point adjacent said blade, an enclosure surrounding said vertically rising portion of said conveyor to confine the shaved ice thereto, and sprockets at the top end of said enclosure over which said chains are trained, said conveyor passing substantially horizontally across the top of said receptacle from one end thereof to the other, the shaved ice being dropped through the space between said chains and paddles into said receptacle, said conveyor building the pile of shaved ice in said receptacle up to its own level, after which ice carried by the conveyor is pushed along the top surface of the pile and dropped far side thereof, thereby distributing the shaved ice from said one end to the other.

FRANK J. ZAMBONI.

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