Zamboni Ice Resurfacing Machine

http://www.madehow.com/Volume-7/Ice-Resurfacing-Machine.html

Background

An ice resurfacing machine shaves the ice, removes the shavings, washes and squeegees the ice, and has enough carrying capacity to clear the ice surface in one run, making it completely smooth. Ice resurfacing machines are widely known by the brand name Zamboni.

The main component of an ice resurfacing machine is the sled (also known as the conditioner). The sled houses the blade, which shaves the ice, and the towel, which acts as a squeegee.

It also distributes the wash water and the fresh water onto the ice. When the sled unit is lowered to the ice the machine is in operative condition. As the machine is driven forward, the blade takes a light shaving cut off of the ice to clean the surface.

The shaved ice is moved toward the center of the sled unit by the worm screw conveyor, picked up by the chain conveyor, and dumped into the snow box. The spreader receives water from the tank.

Surplus water is picked up from the ends of the spreader and discharged into the snow box. These ice machines can only get up to a speed of 9 mph (14.5 km/h).

History

Before Frank J. Zamboni invented the original ice resurfacing machine, he and his brother started up an ice block business. They manufactured ice for storage and transport.

Building on his knowledge of refrigeration, in 1934 Zamboni opened a 20,000 ft ^{2} (1,858 m ^{2}) open-air ice skating rink in Paramount, California. Soon the weather and use began to wear away at the ice, so Zamboni installed a dome to cover the rink.

Still the ice would deteriorate quickly. The ice-resurfacing process at the time required three to five workers to follow behind a tractor and shave the ice surface, shovel the shavings, wash down the ice, push the dirty water off the surface by hand using large rubber squeegees, and then wait for the ice to dry. The entire process took about an hour.

Some time around 1942, Zamboni began modifications on the tractor. He experimented with different blades that would scrape the ice and suction it up at the same time.

Soon Zamboni's tractor was able to scrape the ice, remove the shavings, and leave a trail of water that would quickly freeze, repairing any damage to the original ice surface. By 1949, the Zamboni ice resurfacing machine was in widespread use.

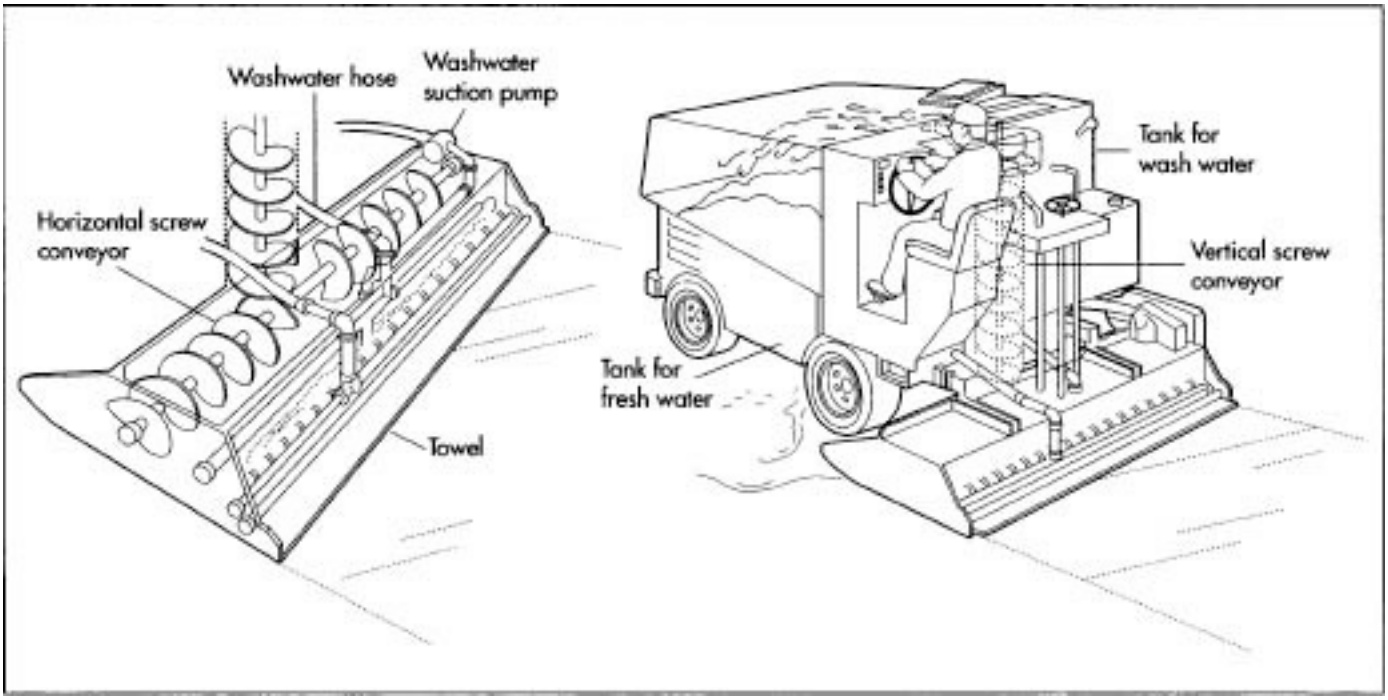
Original models of ice resurfacing machines were built on the top of four-wheel drive vehicles. As more space was needed for water and snow, just the chassis (the frame) was used.

Twenty to 30 chassis (built to order) were lined up, the roof portions cut off, and all of the new ice-resurfacing parts added by hand. In 1964, the dump tank was invented to simplify the removal of the snow from the machine.

The dump tank stores the excess ice scrappings in a tank similar to a dump truck. When it is full, the ice resurfacing machine leaves the ice rink and dumps the shavings outside.

Raw Materials

The main three raw materials used in the production of an ice resurfacing machine are plastic for the housing, rubber for the hoses and towel, and steel for the conveyors, tanks, and other miscellaneous parts.



A standard ice-resurfacer.

The main components of an ice resurfacing machine are mostly contained in the sled: a horizontal screw conveyor, wash water hose, wash water suction pump, the blade, and the towel.

Other components are directly connected to the sled (also knows as the conditioner), such as the horizontal screw conveyor and the separate tanks which hold the wash water and the fresh water.

The rest of the machine has similar components to an automotive vehicle, such as tires, metal, and a range of plastic materials. The frame of the device is welded steel with metals and rubber components.

Design

There are several different ice resurfacing models that vary in size, with smaller machines designed for small ponds, and the largest machines designed for speed-skating rinks. The engine of the machine also differs.

There are ice-resurfacing machines that are electric and several models that are primarily powered by propane.

Many of the components of the machine are patented and each can vary its specified design. The standard machine used on professional hockey rinks uses horizontal and vertical screw conveyors that are 10 in (25.4 cm) in diameter.

It can hold a total of 264 gal (1,000 1) of water. The standard machines are usually about 13 ft (4.1 m) long and 7.1 ft (2.16 m) high. The shaving blade is 0.5 × 5 × 77 in (1.27 × 12.7 × 195.6 cm).

A full machine weighs 8,780 lb (3,983 kg). Some of the towels are able to get to varying levels of proximity to the ice. Some ice resurfacers come equipped with a dump tank, others simply push the ice shavings off the rink to a designated spot outside. The machine operates off of a 2.5 liter engine.

The Manufacturing Process

1. The first step is the manufacturing of the engine and chassis. Typically, both are manufactured from an outside automobile plant and shipped to the ice resufacer plant. A metal frame is then welded to the chassis. The frame will hold the water tanks.
2. The water tanks are made out of injection molded plastic. Plastic pellets are melted in a hopper. The liquid plastic is injected into the die, which is shaped like the water tank. After the die cools, the molded plastic is ejected.
3. The tanks are then fit into the metal frame.
4. The tanks and fenders are bolted onto the chassis. Tanks stored underneath the bin and in front of the driver store water for conditioning and cleaning the ice.
5. The sled is made from two transversely extending angle irons joined to end plates. The bottom edges of the end plates are bent inwardly to form runners on the ice.
6. Then, mounted on the rear of the unit, perpendicular to the direction of travel is the conditioner with a blade bolted to the underside of an inverted T-shaped beam. The blade shaves a thin layer of ice as screw conveyors remove the shavings.
7. The worm screw conveyor has two oppositely wound helix blades mounted on the inside face of the end plates. A sprocket wheel is secured to the shaft, and paddles pick up shaved ice pushed in to the center by the worm screw conveyor. At the top of the housing is another sprocket mounted on a shaft and the conveyor chain passes over the last sprocket and leaves the structure. Side wings keep the snow from falling away from the paddles until the snow passes over the snow box and drops into the snow box.
8. The spreader is connected to the sled unit by two slings that hang from the ends of rear extending arms. The arms are fixed to opposite ends of a rock shaft which is held in place by bearings mounted on the back of the unit.
9. The towel is attached to the sled. The towel is a thick rubber that arrives at the plant in sheets. The sheets are placed on a conveyor belt and passed under an automatic punch press. The hydraulic press has the desired shape imbedded in steel. The press then punches down and cuts through the rubber.
10. The towel is fit into the sled and bolted into place. It sprays the water from holes in a discharge pipe at 180°F (82°C). The large bin in front of the ice resurfacing machine catches the ice shavings scraped by the blade in the conditioner.
11. The final step is to manufacture the housing of the ice resurfacing machine. The housing is also injection molded. Once it has cooled sufficiently, it is attached to the machine and bolted into place.

Quality Control

During the manufacturing, each part is tested separately for damages. The tanks

are filled and checked for leaks, and the blade is checked for sharpness. After the product has been assembled, it is completely filled and also checked for any leakage.

The machine is then tested on ice to see if a sufficient amount is shaven and enough water is being distributed.

Byproducts/Waste

When defects are found in the plastics or rubbers, they are either sent back to the manufacturer or melted down and remolded. This can only happen a limited amount of times before the quality of the product will be effected. Any defects found in the engine or chassis are sent back to the manufacturer to be corrected.

If any defects are found after the machine has been sold, it is returned to the plant. When the defects are too severe to be fixed, undamaged parts are salvaged and the rest of the machine is scrapped.

The Future

Ice resurfacing machines continue to evolve additional features to fulfill the demands of maintaining ice surfaces. Portable models are available for smaller rinks and ponds.

Automatic machines are in the works that will not require a driver, but will be equipped with sensors that can detect how close the machine is to the boards. It is doubtful that this machine will be widely available for many years.

Where to Learn More
Other

The Zamboni Web Page. December 2001. < http://www.zamboni.com >.

United States Patent and Trademark Office Web Page. December 2001. < http://www.uspto.gov/patft/index.html >.

Zamboni, Richard F. "Ice-Resurfacing Machines." *Scientific American Web Page.* Dec. 2001. < http://www.sciam.com >.