Jan. 9, 1962 F. A. VEREYKEN 3,015,938

SKATING RINK AND METHOD FOR PROVIDING THE SAME

Filed Aug. 29, 1958

2 Sheets-Sheet 1

FIG_1

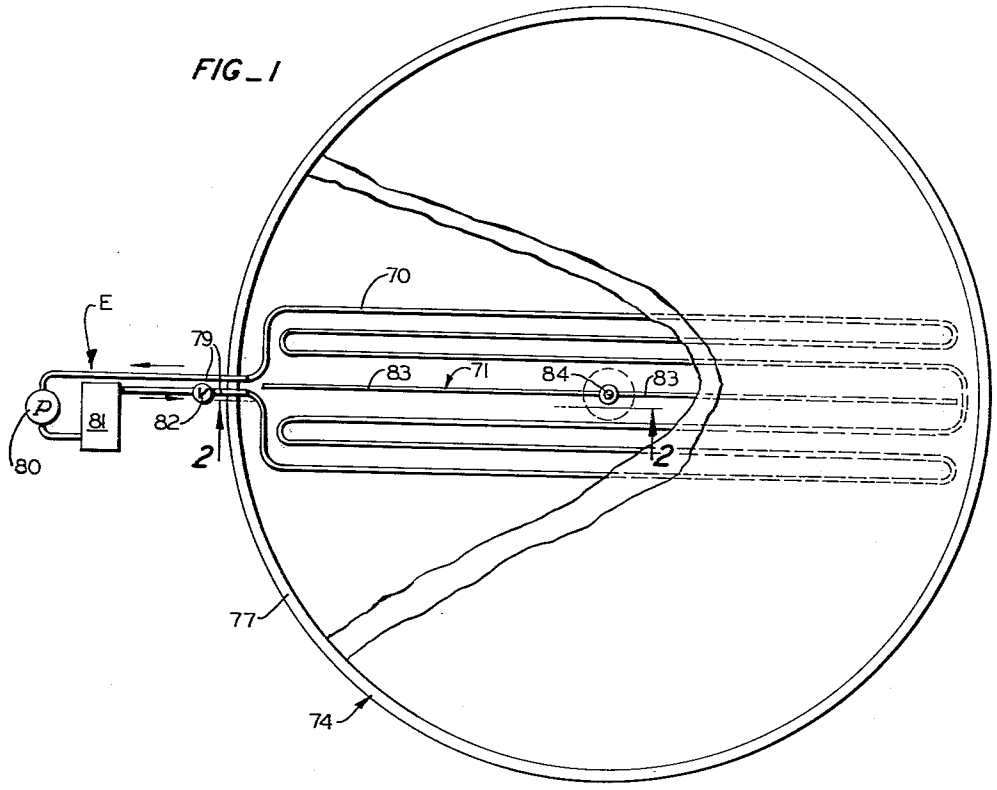
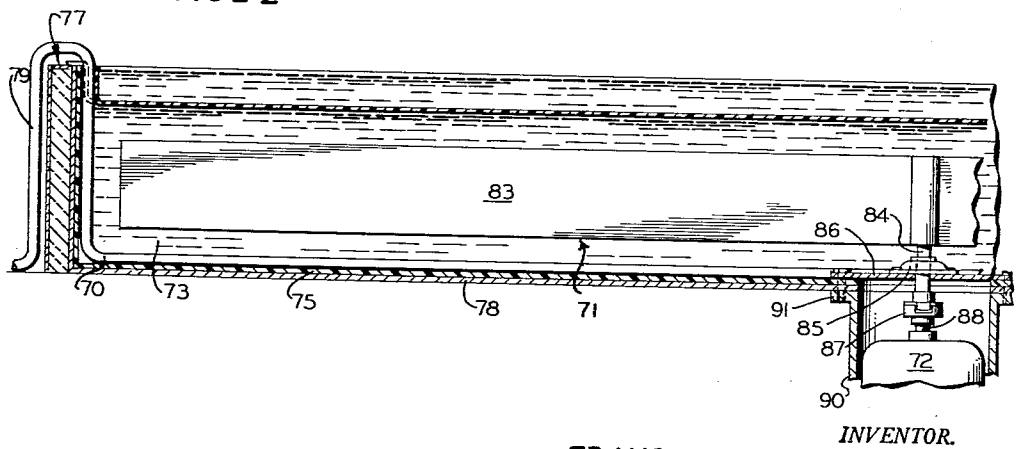


FIG_2



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FIG_3

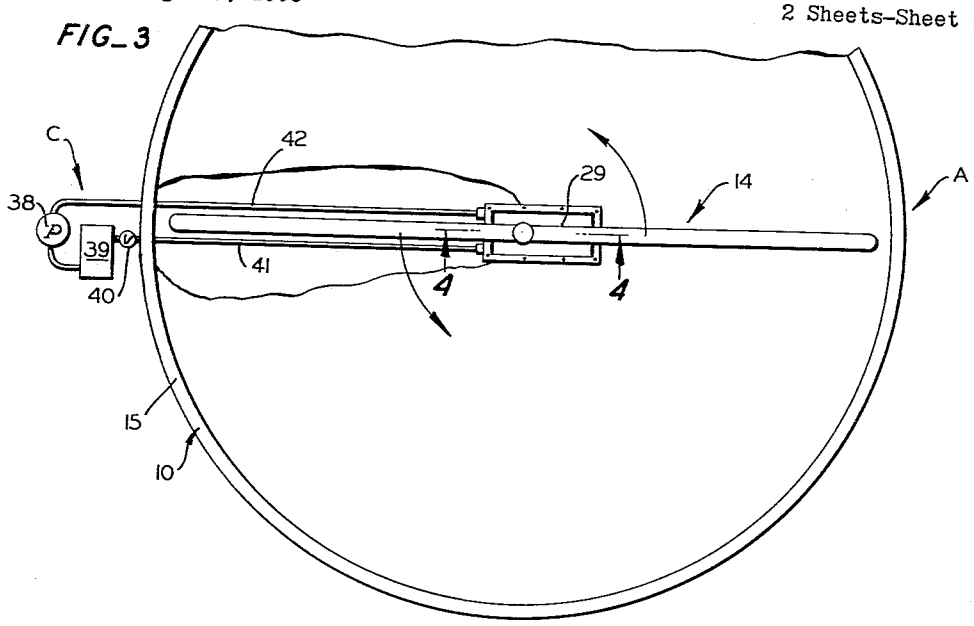
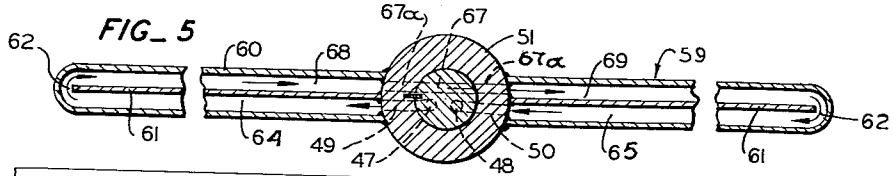


FIG_5



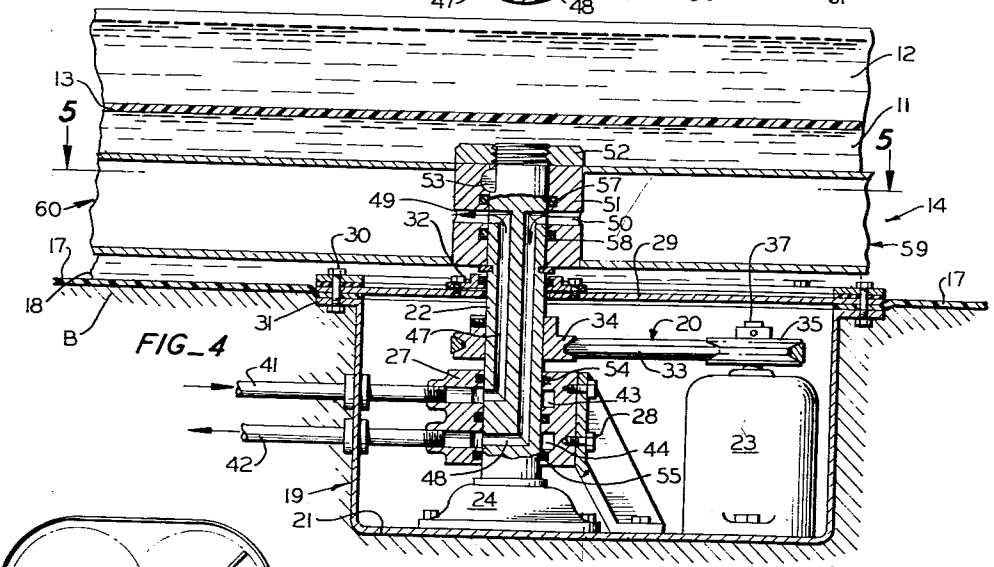


FIG_4

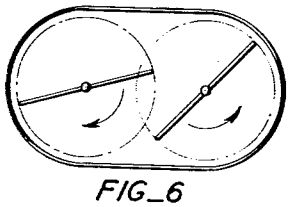


FIG_6

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SKATING RINK AND METHOD FOR PROVIDING THE SAME

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7 Claims. (Cl. 62—66)

The present invention relates to a skating rink, and pertains more particularly to a mechanism and method for providing a skating rink by freezing a layer of fresh water on a base layer of refrigerated brine.

Skating is a popular and healthful sport, but except in colder climates, and during the winter, it is necessary to provide an artifically frozen sheet of ice in order to practice it. In the past, several arrangements have been devised for artificially freezing a sheet of ice suitable for use as a skating rink, but most such arrangements have been quite expensive to build, non-portable, and difficult to maintain.

The present invention provides a simple, inexpensive arrangement for freezing a sheet of ice suitable for use as a skating rink.

A further object of the invention is to employ a shallow pool of brine, with refrigerating means immersed in, and moving relatively to the brine to thereby chill it below the freezing point of fresh water, and to float a sheet of fresh water on the brine, the brine and the fresh water being separated from each other by a water tight membrane, whereby the fresh water is frozen to provide a skating surface.

A further object of the invention is to provide an improved and simplified means and method for freezing a sheet of ice to provide a skating rink.

These, and other objects and advantages of the invention, will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a plan view of one embodiment of the invention, portions being broken away.

FIG. 2 is an enlarged, fragmentary sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a partial plan view of a preferred form of the invention, portions being broken away.

FIG. 4 is an enlarged, fragmentary, sectional view taken along 4—4 of FIG. 3.

FIG. 5 is somewhat enlarged fragmentary, sectional view taken as along line 5—5 of FIG. 3, intermediate rotor portions being broken away.

FIG. 6 is a diagrammatic view in reduced scale of a plurality of refrigerating units mounted in a larger tank for providing a larger rink.

Briefly, the preferred form A of the invention illustrated in FIGS. 3–5 comprises a tank **10** of suitable diameter, having a shallow pool **11** (FIG. 4) of brine therein, the brine having a layer **12** of fresh water floating thereon, and separated from the brine by a waterproof membrane **13**. The brine **11** is chilled below the freezing point of the fresh water **12** by refrigerating means **14**, immersed in and moving relatively to the brine **11**, thereby freezing the fresh water **12** to provide a skating rink.

Referring to the drawings in detail, and describing first the preferred form A of the invention illustrated in FIGS. 3–5, the shallow tank **10** comprises an encircling wall **15** of a height slightly greater than the combined depths of the brine pool **11** and the overlying fresh water sheet **12** to be contained therein. A tank liner **17**, which may be of suitable, water-proof material, such as, for example, flexible sheet plastic material, is provided over the entire bottom of the enclosure formed by the wall **15**, and may, if desired, rest directly on the ground B, the surface **18** of which has been first smoothed and leveled.

In order to prevent leakage of the contents of the tank

10, the marginal edges of the liner **17** may be carried up along this marginal wall **15**, as shown in FIG. 2, to a height greater than the combined maximum depths of the liquids **11** and **12** to be contained in the tank.

A compartment **19** for housing the rotor drive mechanism **20** is flush-mounted in a cavity **21** provided therefor in the ground B centrally of the tank **10**. The rotor drive mechanism **20** comprises a rotor support shaft **22**, and an electric drive motor **23**, which may be of a conventional, reduction-geared type. The rotor support shaft **22** is journaled in a base thrust bearing **24**, secured to the bottom of the compartment **19**. A main shaft bearing **27** is mounted co-axially with the base bearing **24**, and is secured to a mounting bracket **28**, which in turn is secured to the compartment **19**.

A compartment cover plate **29** is secured by screws **30** to a compartment top flange **31**, and a seal ring **32** prevents the entry of brine into the compartment **19** between the shaft **22** and the cover plate **29**. The tank liner **17** is gripped between the flange **31** and the cover plate **29**, and acts as a gasket to insure a water tight seal between the compartment and its cover plate.

The rotor shaft **22** is driven at a sufficiently slow rate of speed to prevent undue agitation of the brine **11**, for example, of the order of one revolution per minute, by a V-belt **33** which passes around a grooved driven pulley **34** secured to the shaft **22**, and also around a grooved drive pulley **35**, secured to the drive shaft **37** of the reduction-geared motor **23**.

Refrigerating mechanism C for chilling the brine **11** may be of the well known compressor-condenser-expander type, as illustrated in FIG. 3, and comprises a usual compressor **38**, condenser **39** and expanding valve **40**. A pair of gas conducting tubes **41** and **42** are secured, in gas-tight relation, from the refrigerating mechanism C to the rotor shaft bearing **27**, in vertically offset relation to each other.

The refrigerant conducting tubes **41** and **42** communicate with annular passages **43** and **44** respectively, provided in the bearing **27**, and surrounding the rotor shaft **22** when the latter is mounted in said bearing. The annular passages **43** and **44** communicate, respectively, with the lower ends of a pair of passages **47** and **48** provided in the rotor shaft **22**. The upper ends of the shaft passages **47** and **48** open to opposite sides of the rotor shaft **22**, and are located to register with a pair of oppositely extending passages **49** and **50** provided in a rotor hub **51** (FIGS. 4 and 5).

The rotor hub **51** is fitted onto the upper end of the rotor shaft **22**, and is removably secured thereon by a nut **52** and key **53** (FIG. 5). Seals **54** and **55** are provided above and below the annular bearing channels **43** and **44**, respectively, and similar seals **57** and **58** also are provided above and below the hub passages **49** and **50**.

A pair of hollow rotor blades **59** and **60** are secured to the hub **51** to extend in diametrically opposite directions therefrom, and each blade is provided with a longitudinal partition **61** therein. Each partition **61** extends, in edge-sealed relation, from the hub **51** throughout the length of its rotor blade, with the exception of its radially outward end. The outer end of each partition **61** is spaced slightly from the end of its hollow rotor blade so as to provide a gas passage **62** around the partition end.

The shaft passage **47** and its registering hub passage **49** opens into a passage **64** (FIG. 4) on one side of the partition **61** in rotor blade **60**, while the other shaft passage **48** and its registering hub passage **50** opens into a passage **65** on the same side of the partition **61** in the other rotor blade **59**. A passage **67** (FIG. 5) also is provided through the rotor shaft **22** and registers with pas-

sages 67*a* through the hub 51 to communicate blade passage 68 and 69 on the other sides of the partitions 61 in the blades 59 and 60 from the blade passages 64 and 65.

In the event than that a larger rink may be desired than that which can be provided by means of a single rotor 14 of reasonable size, a plurality of rotors 14*a* and 14*b* (FIG. 6) may be mounted in a larger tank 10*a* and driven to rotate synchronously in opposite directions so as to clear each other. A two-rotor arrangement is shown in FIG. 6.

In using the mechanism A shown in FIGS. 3–5, and assuming that said mechanism is to be mounted directly on bare ground, the surface of the ground B is leveled and smoothed, and the cavity 21 is provided therein to receive the compartment 19. The compartment 19, with the rotor support and drive mechanism 20 installed therein, is mounted in the cavity 21, and the tank liner 17 is spread on the ground and is gripped in water tight relation between the compartment cover 29 and the compartment flange 31.

The refrigerant conducting tubes 41 and 42 are connected from the refrigerating mechanism C to the rotor bearing 27, as shown in FIG. 4, and may be buried if desired in the ground B. Usual electrical connections, not shown, are provided, as required, and the steps necessary to place the refrigerating mechanism C in operative condition to circulate chilled refrigerant through the system are too well known to require explanation herein.

The rotor 14 is mounted on the shaft 22, and the wall 15 is erected substantially concentrically with said shaft. The tank liner 17 is sealed marginally to the wall 15 to prevent loss of liquid from the tank 10, for example as illustrated in FIG. 2 and described previously herein. Brine 11 is introduced into the tank 10 to a sufficient depth to cover the rotor 14, and a sheet 13 of suitable membrane material, such as, for example, water proof plastic sheet material, is then provided over the brine 11. This membrane 13 also is sealed marginally to the wall 15, or may be carried up along the wall to a height above the maximum fresh water level therein as shown in FIG. 2.

A sheet 12 of fresh water of suitable depth is then introduced on top of the membrane 13, care being exercised to exclude or remove any large air bubbles which may tend to form from beneath the membrane 13. This sheet 12 of fresh water preferably is of a depth of the order of one inch, since a layer of the ice one inch thick will provide a suitable skating surface for most purposes.

The refrigerating mechanism C is placed in operation to circulate chilled refrigerant through the rotor passages 64, 65, 68 and 69 as indicated by the arrows in FIGS. 4 and 5. The rotor drive motor 23 is energized to cause the rotor 14 to be rotated slowly by means of the drive belt 33. The rotating, chilled rotor 14 chills the brine 11 below the freezing temperature of the layer 12 of fresh water, and thereby freezes the latter to provide a skating rink.

The mechanism A can be set up either indoors or outdoors, but if set up outdoors, of course, a suitable shelter or enclosure (not shown) to shield it from the heat of the sun should be provided.

It is obvious that if a permanent installation is desired, instead of the portable type tank 10 a shallow tank similar in size and shape to the tank 10 may be made of concrete or other suitable material. Since the construction of such a tank would be within the routine capabilities of an ordinarily skilled worker, it will be unnecessary to illustrate it and describe the details thereof herein.

In the modified form D of the invention illustrated in FIGS. 1 and 2, the tank 74 may be generally similar to the tank 10 illustrated in FIGS. 3–5 and described previously herein. In this modified form D of the invention, however the brine refrigerating means comprises a stationary coil 70, and the rotor 71 is not refrigerated as is the rotor 14 of FIGS. 3–5. The rotor 71 is driven by a reduction geared motor 72 at a slow rate of speed to cause a slow, rotative circulation of brine 73 in the tank to thereby provide relative movement between the brine 73 and the stationary refrigerating coil 70.

The tank 74 may have a plastic liner 75 generally similar to the liner 17 (FIGS. 3 and 5) which covers the bottom of the tank 74 and extends in a continuous sheet up the tank wall 77 to a height above the maximum liquid level therein. A tank bottom member 78, of suitable material, such as, for example, sheet metal, may be used to provide a smooth, level bottom for the tank.

The refrigerating coil 70 may be of suitable tubing, such as, for example, copper tubing, mounted upon the bottom of the tank 14 so as to be immersed in the brine 73 therein, and to be cleared by the rotor 71. The tubing 79 from the coil 70 may be carried unbroken up over the tank wall 77, as shown in FIG. 2, to avoid the necessity of providing water proof, sealed passages for the tubing through the tank wall.

The outer ends of the tubing 79 (FIG. 1) are connected to a usual type of refrigerating unit E, which may be similar to the unit C described for the mechanism A illustrated in FIGS. 3–5. Gas from the refrigerating mechanism E passes from a usual compressor 80 through a condenser 81, through an expander valve 82, whereby the gas is expanded and chilled, and thence through the tubing 79 and the coil 70 immersed in the brine 73 and back to the intake side of the compressor 80, where the cycle is repeated.

The rotor 71 comprises a pair of blades 83 which may be of suitable material, such as steel or an aluminum alloy, and may be either solid or hollow as desired. If not of rust resistant metal, they should be coated with a suitable rust resistant coating, such as red lead, to withstand the corrosive effects of the brine in which they are immersed. The blades 83 are mounted on a rotor shaft 84 to extend in diametrically opposite directions therefrom. The shaft 84 is journaled in a sealed bearing 85, mounted in a compartment cover 86. The rotor shaft 84 has driven connection, by means of a flexible connector 87, to the drive shaft 88 of the conventional reduction geared motor 72 mounted in a compartment 90 buried flush with the ground F. The compartment 90 is sealed marginally to the plastic tank liner 75 by gripping the latter between a compartment flange 91 and the cover 86.

As used herein the term "brine" is intended to mean any suitable liquid with a freezing temperature well below that of fresh water.

The invention comprises a simple and inexpensive skating rink, and one which can be made either large or small, depending upon the surface requirements for each installation thereof.

While I have illustrated and described a preferred embodiment of the present invention, and one modified form thereof, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims.

I claim:

1. In a mechanism for freezing a sheet of ice to form a skating rink of the class wherein a shallow tank having a top area of sufficient size to form a skating rink has a layer of brine in the bottom thereof, with a flexible water proof membrane overlying the brine in said tank, and a layer of fresh water floating on the brine and separated therefrom by the membrane; the combination wherein hollow rotor means extending substantially the entire width of the tank is immersed in said brine and arranged to sweep substantially the entire bottom area of the tank, refrigerating means circulating refrigerant throughout the hollow rotor, and power drive means for slowly ro-

tating the refrigerated rotor in the tank thereby to produce a slow, relative, rotative non-turbulent movement between said refrigerated rotor and the brine in said tank for uniformly chilling the brine throughout the bottom area of the tank, thereby to uniformly freeze the fresh water floating on the brine.

2. In a mechanism for freezing a sheet of ice to form a skating rink of the class wherein a shallow tank has a layer of brine in the bottom thereof, with a water proof membrane overlying the brine in said tank, and a layer of fresh water floating on the brine and separated therefrom by the membrane; the combination wherein a rotor is immersed in said brine, said rotor comprising a hub, a pair of rotor blades mounted on the hub and extending diametrically in opposite directions therefrom, a partition extending longitudinally within the hollow interior of each rotor blade and in edge-sealed relation with the blade and the hub, the outer end of each partition being spaced from the blade in which it is mounted, thereby providing a refrigerant passage along both sides of and around the outer end of each partition, said hub having a refrigerant inlet communicating with the interior of one blade on one side of the partition therein, said hub having a refrigerant outlet communicating with the interior of the other blade on one side of the partition therein, a passage transversely of the hub intercommunicating the interiors of the blades on the other sides of said partition, refrigerating means circulating refrigerant through the hub inlet, throughout the hollow interior of both blades, and out of the hub outlet, and power drive means for slowly rotating the rotor, thereby to uniformly chill the brine throughout the bottom area of the tank and to freeze the water floating on the brine.

3. In a mechanism for freezing a sheet of ice to form a skating rink of the class wherein a shallow tank having a top area of sufficient size to form a skating rink has a layer of brine in the bottom thereof, with a flexible water proof membrane overlying the brine in said tank, and a layer of fresh water floating on the brine and separated therefrom by the membrane; the combination wherein a hollow rotor means is immersed in said brine, and is of a radius to sweep substantially the entire bottom area of the tank, refrigerating means circulating refrigerant throughout the hollow rotor, and power drive means for slowly rotating the refrigerated rotor means at a rate to produce a slow, relative, rotative non-turbulent movement between said rotor means and brine in said tank for uniformly chilling the brine throughout the bottom area of the tank, thereby to uniformly freeze the fresh water floating on the brine.

4. In a mechanism for freezing a sheet of ice to form a skating rink of the class wherein a shallow tank having a top area of sufficient size to form a skating rink has a layer of brine in the bottom thereof, with a flexible water proof membrane overlying the brine in said tank, and a layer of fresh water floating on the brine and separated therefrom by the membrane; the combination wherein hollow rotor means is immersed in said brine and of a size and arrangement to sweep substantially the entire bottom area of the tank, refrigerating means circulating refrigerant throughout substantially the entire length of the hollow rotor, and power drive means for slowly rotating the rotor means, thereby to produce a slow, relative, rotative, non-turbulent movement between said narrow refrigerating means and the brine in said tank for uniformly chilling the brine throughout the bottom area of the tank, thereby to uniformly freeze the fresh water floating on the brine.

5. In a mechanism for freezing a sheet of ice to form a skating rink of the class wherein a shallow tank having a top area of sufficient size to form a skating rink has a layer of brine in the bottom thereof, with a flexible water proof membrane overlying the brine in said tank, and a layer of fresh water floating on the brine and separated therefrom by the membrane; the combination wherein a narrow, refrigerated element is immersed in said brine, said refrigerated element being of a length substantially coextensive with the width of said tank, and power drive means for slowly sweeping said refrigerated element across substantially the entire bottom area of the tank, thereby to produce a slow, relative movement between said refrigerated element and the brine in said tank without causing turbulence of the brine or the superposed fresh water for uniformly chilling the brine throughout the bottom area of the tank, thereby to uniformly freeze the fresh water floating on the brine.

6. A skating rink comprising a substantially flat, horizontal tank bottom surrounded by a marginal tank wall to form a shallow tank having a top area of suitable size for a skating rink, a supply of brine partially filling the tank to leave exposed above the brine a portion of the marginal tank wall, a thin, flexible, waterproof membrane closely overlying the entire top surace of the brine and with its marginal portion extending upwardly along the marginal wall of the tank to thereby form a shallow, waterproof receptacle for the reception of a layer of fresh water, a layer of fresh water contained in the receptacle thus formed and pressing said membrane into close, overall contact with the underlying brine and urging the upwardly extending marginal portion of the membrane toward the marginal wall, a narrow, elongated refrigerating element immersed in the brine and extending throughout substantially the entire width of the tank bottom enclosed within said wall, said refrigerating element being mounted parallel to the tank bottom and movable in recurring cycles over substantially the entire area of the tank bottom, and power driven means operatively connected to the refrigerating element for producing a slow, non-turbulent, relative movement in recurring cycles of the refrigerating element through substantially the entire mass of the brine in the tank, thereby to uniformly chill the brine throughout its entire mass and to uniformly freeze the overlying layer of fresh water in the receptacle without disturbing it to provided a smooth, uniform skating sheet of ice.

7. The method of providing a sheet of ice which comprises forming a shallow pool of brine, immersing in said brine narrow refrigerating means of a length to substantially span the brine, producing a slow relative movement between the refrigerating means and the brine to chill the latter to a temperature well below the freezing point of fresh water, covering the brine with a membrane of water-proof sheet material, and floating a layer of fresh water onto the membrane for support by the underlying brine, whereby the layer of fresh water is frozen.

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