Artificial Sea Ice And Retrieval Of Icebergs For Freshwater

The Problem:

Increasingly warmer seawater in polar regions resulting from climate change causes more icebergs to calve off glaciers. Icebergs calving off glaciers float into shipping lanes. The icebergs' freshwater is wasted when they melt into the seawater. Countries suffering from a lack of freshwater would benefit in the preservation and retrieval of these icebergs.

The Solution:

Artificial Sea Ice in the water around glaciers will reduce warming. Artificial Sea Ice in conjunction with a number of Arctic Buoys will create a corral enclosure to prevent icebergs from floating into shipping lanes. The Arctic Buoy corral will keep the icebergs clustered for retrieval in the spring by using semi-submersible heavy-lift ships.

Specification:

Sea ice forms from sea water and melts into the ocean seasonally. Arctic sea ice borders polar land masses. The glaciers on the polar land masses that overhang the ocean produce freshwater icebergs. In winter, sea ice locks the icebergs into the face of the glaciers and the icebergs do not drift into the ocean. Due to anthropogenic climate change, sea ice melts earlier in summer in both the Arctic and Antarctic. This earlier melting sea ice allows more icebergs to drift into open waters under the influence of wind, currents and tides, making navigation increasingly difficult. Larger areas of ice-free polar sea waters increase the quantity of solar radiation absorbed in the darker exposed water thus increasing the sea water temperature.

Artificial Sea Ice:

Artificial Sea Ice is a manmade floating fabrication that mimics the properties and actions of natural sea ice. Artificial Sea Ice is modular in design and manufactured in a shape similar in structure and size to chunks of sea ice that naturally float in polar waters. The modular shape of Artificial Sea Ice might be hexagonal in its perimeter, (Fig. 3, 4, 5 and 6) as that shape is known for its interlocking efficiency. Artificial Sea Ice replicates the buoyancy property of sea ice. A strong interlocking field of ice is created when Artificial Sea Ice is combined with sea ice. Unlike sea ice, however, Artificial Sea Ice does not melt. Like sea ice, Artificial Sea Ice is highly reflective and incorporates high albedo properties akin to the reflection of sunlight. Either a reflective coating is applied to the Artificial Sea Ice, or the Artificial Sea Ice is constructed of a highly reflective material with high albedo. The sea ice, when combined with the Artificial Sea Ice will extend the overall number of days of reflective properties. Increasing the reflective quality of Artificial Sea Ice floating in polar regions will mitigate climate change.

Mechanism for Controlling the Distribution of the Artificial Sea Ice and Trapping Icebergs:

In order to prevent the Artificial Sea Ice from drifting apart, a floating corral enclosure is built from a number chained Arctic Buoys (Fig. 1 and 2). An Arctic Buoy is an ocean buoy with 7/8th of its mass in the shape of an inverted cone underwater ballast, and a top with pentagonal sides (Fig. 7, 8, 9 and 10). The Arctic Buoy has a reflective surface similar to an Artificial Sea Ice. Each of the pentagonal sides has an embedded ring to attach a chain that is the means to turn a number of Arctic Buoys into the form of a corral enclosure (Fig. 1 and 2). The pentagonal sides of the Arctic Buoy provide a shape for the easier creation of a floating curved corral enclosure. The Arctic Buoy corral
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enclosure is anchored to terrestrial outcroppings on either side of the glacier. Each Arctic Buoy is also anchored to the ocean floor to increase the strength of the corral enclosure. The corral enclosure contains the icebergs calving off the glaciers. Each corral enclosure will contain one or more gates that can be opened in the spring when a sufficient number of icebergs have calved and are available for retrieval.

Retrieving the Arctic Buoy Corralled Icebergs:

A smaller corral of Arctic Buoys is strung within the larger corral to provide a method to separate small icebergs from the larger icebergs. A semi-submersible heavy-lift ship with modest polar capability enters the Arctic Buoy enclosure corral through an opened gate. Inside the corral, the ship floods its ballast tanks to lower its cargo deck below the surface of the ocean. This operation allows the cargo deck to receive an iceberg. After the iceberg or icebergs are secured, the ship's ballast is pumped out, causing the ship to rise and the sea water, Artificial Sea Ice, and sea ice to flow off the cargo deck. Freshwater that melts off the iceberg can be deck-channelled and saved. Alternatively, a heavy-lift cargo ship enters the corral and the onboard crane lifts smaller icebergs into large open containers on deck for later melting in transit. Both ships have a speed greater than 15 knots. It is likely on longer return voyages the icebergs will melt completely, and all the freshwater will be captured. These methods of retrieving icebergs is more efficient than using multiple tugboats to tow an iceberg at very low speeds (1.5-2 knots). Icebergs will melt with the tug system and all the freshwater will be lost to the surrounding ocean. The disclosed innovative system using Arctic Buoys and Artificial Sea Ice allows freshwater to travel to parts of the world where potable water is scarce.

Description of drawings:

The drawings illustrate an exemplary embodiment consisting of an Artificial Sea Ice fabrication, an Arctic Buoy fabrication, and the combination of a number of Artificial Sea Ice fabrications and Arctic Buoy fabrications to build a corral enclosure with the intended purpose to retrieve polar icebergs by the use of heavy-lift ships. Other corral enclosure embodiments may consist of Artificial Sea Ice fabrications and Arctic Buoy fabrications by different useful shapes. The manufacturing methodologies of the Artificial Sea Ice fabrication and the Arctic Buoy fabrication can be by concrete, ceramic or other casting materials or another construction assembly.

Fig. 1 shows a water level view of Artificial Sea Ice and icebergs pinned in a section of a corral built by Arctic Buoys.

Fig. 2 shows an aerial view of 26 Arctic Buoys chained together in corral enclosure to hold Artificial Sea Ice, sea ice, and icebergs in place prior to retrieving the icebergs. Four glaciers are supplying icebergs to the corral enclosure. A semi-submersible heavy-lift ship is positioned outside the corral ready to enter the enclosure to retrieve a cargo or icebergs.

Fig. 3 shows a water level view of Artificial Sea Ice from the side. Artificial Sea Ice has a 1/5<sup>th</sup> freeboard vs. 4/5<sup>th</sup> underwater depth. The contemplated diameter might vary from 1 meter to 5 meters.

Fig. 4 shows an underwater angle view of Artificial Sea Ice showing its octagonal sides. The waterline is indicated.

Fig. 5 shows a top view of Artificial Sea Ice.

Fig. 6 shows a bottom view of Artificial Sea Ice.
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Fig. 7 shows a water level view of an Arctic Buoy showing embedded rings in the pentagonal sides. The ring provides attachment point for one Arctic Buoy to be chained to another to form the corral enclosure wall. A waterline is indicated. The Arctic Buoy has approximately $1/50$th freeboard vs. a $49/50$th underwater depth. The ballast of buoy is in the cone shaped keel under the pentagonal sides. An anchor ring is embedded in bottom of the ballast to secure the Arctic Buoy to the ocean floor.

Fig. 8 shows an underwater angle view of an Arctic Buoy showing its pentagonal sides, embedded rings, ballast and anchor ring.

Fig. 9 shows a top view of the Arctic Buoy showing its pentagonal sides, each side with an embedded ring. The contemplated diameter might vary from 50 meters to 800 meters.

Fig. 10 shows a bottom view of the Arctic Buoy showing its pentagonal sides, each side with an embedded ring, ballast and anchor ring.
Drawings:

**Fig. 1**
- Artificial Sea Ice
- Arctic Buoy

**Fig. 2**
- Glaciers
- Icebergs
- Corral formed by arctic buoy wall
- Cross hatch shows Artificial Sea Ice mixed with sea ice holding icebergs in place
- Semi-submersible heavy-lift ship