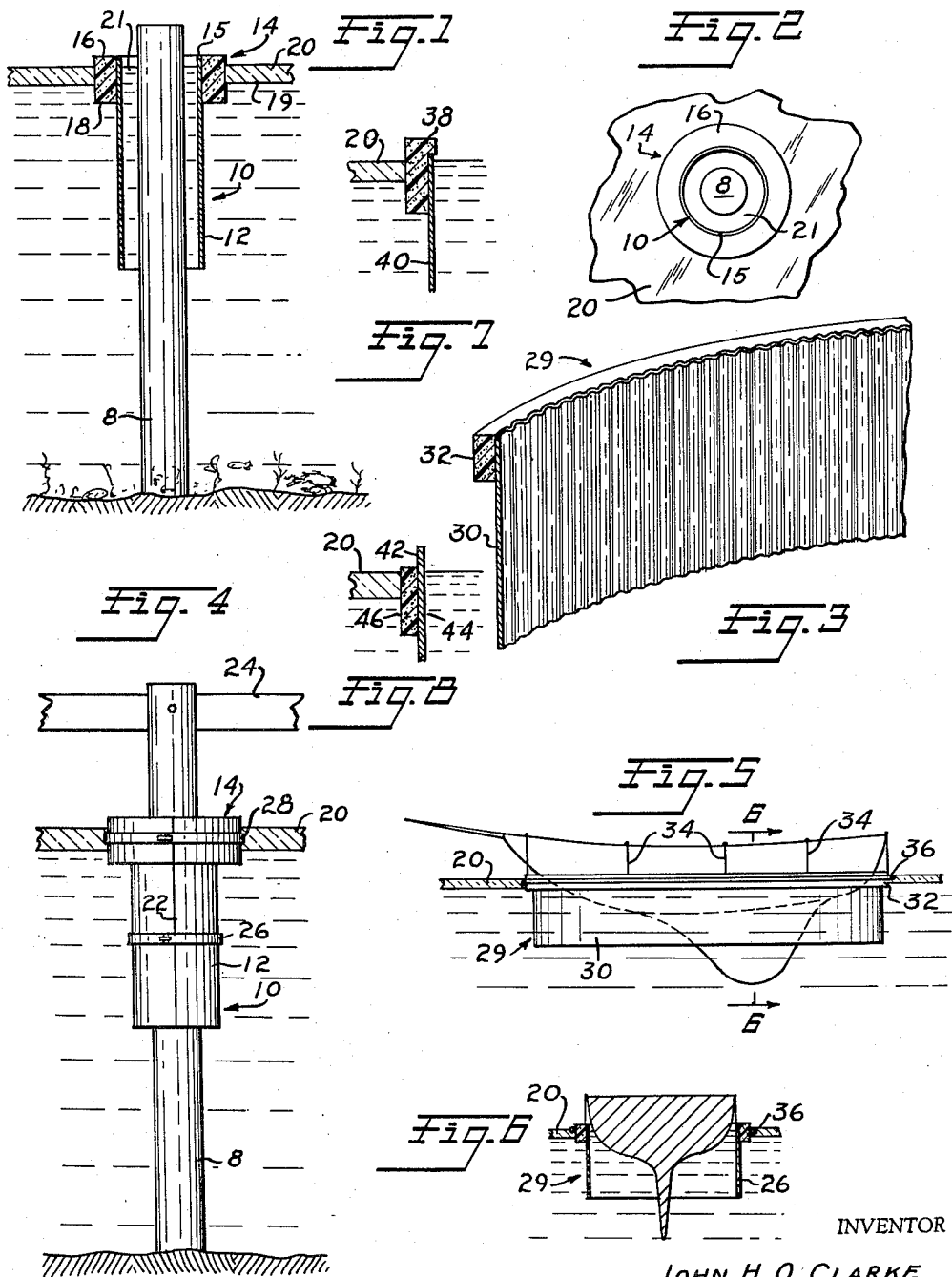


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MEANS FOR PREVENTION OF ICE DAMAGE TO
BOATS, PIERS AND THE LIKE
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MEANS FOR PREVENTION OF ICE DAMAGE TO BOATS, PIERS AND THE LIKE

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This invention relates to ice protection and more particularly to improved method and apparatus for preventing the formation of damaging ice on piles, boats and other partially immersed objects normally exposed to damaging natural icing conditions.

Where boats, piers and the like are subjected to severe ice conditions costly damage can result unless suitable precautions are taken before the onset of the ice period. In tidal areas, when ice forms tightly about piles, on each rise of the tide the ice clamped about the piles raises them an increment and while they are thus suspended by the ice partly out of their original holes in the bottom, sand or mud fills in the holes beneath the piles so that when the tide falls the piles cannot return to their original position. Thus, the piles are, in effect, jacked upwardly by each rising tide until they are entirely free whereupon any structure supported on the piles collapses.

In certain northern areas of the United States heavy icing conditions are normal events and in those areas, objects which would be exposed to damaging ice are generally removed bodily from the water; for example, boats are hauled clear of the water and structures, such as piers and the like which are supported by piles, are dismantled and the piles jettied out and placed in storage for replacement after the icing season. In more temperate parts of the United States severe icing conditions occur at intervals of several years and in these areas annual precautions against ice are not normally taken but when a severe icing condition does occur, damage to boats and destruction to piers can run into millions of dollars. One means for preventing ice damage in both northern and temperate areas has been by the use of a network of tubes which lay on the bottom and are supplied with compressed air to create air bubbles throughout the area to be maintained ice-free. The air bubbles as they ascend towards the surface act to drive upwardly warmer water which commingles with cold water at the surface to elevate its temperature to a level above its normal freezing temperature. The so-called bubble system is effective but it is also very expensive and subject to corrosion and other derangements resulting from prolonged submergence, particularly in highly saline waters.

It is known that as water cools its density decreases until it reaches 4° C. whereupon as cooling continues the water expands so that the colder water floats above the warmer strata below and it is this well recognized phenomenon which causes water to freeze from the surface downwardly. Obviously, the water in the lower strata must be at all times above freezing or otherwise this water would freeze in the same manner as the surface water, and it is a recognition of the relative warmth of the lower strata which is made use of in the above mentioned bubble system of ice prevention.

It is the broad object of the present invention to provide novel method and means for preventing ice formation against partially immersed objects without requiring the use of expensive, derangeable mechanical equipment.

It is a more specific object of the present invention to provide novel method and means for the prevention of ice formation on water immersed objects, such as piles, boats and the like, which means takes advantage of the higher temperature of water below the freezing layer and conducts the heat thereof into the surface zone immediately surrounding the object, thereby continuously main-

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taining the temperature of this surface zone above the freezing temperature thereof.

More particularly it is the object of the invention to provide means which accomplishes the foregoing object while at the same time it insulates the aforementioned zone which is to be maintained ice free.

Still another object of the invention is to provide method and means of the foregoing nature wherein the insulating means in addition serves as a float for the heat conducting unit so that the entire ice preventing structure maintains the same relative position with respect to the water surface regardless of the rise and fall of tide.

Still another object of the invention is to provide ice prevention means which accomplishes all of the foregoing objects by a structure formed of elongated, heat conducting material having a length capable of extending from the surface of a body of water well downwardly into the strata of warmer waters with the surface end of the material having bonded to the outer side thereof flotation material which serves not only to support the heat conducting material but also serves as an insulator against ice formed outside of the zone to be protected.

Yet another object of the invention is to provide structure of the foregoing nature which may be either prefabricated in sleeve-like form so as to slide over the upper end of individual piles and the like or may be fabricated in substantially flat sheets which are capable of being cut to the proper size and formed as a sleeve around piles or other structures whose upper ends are not free.

Other objects and their attendant advantages will become apparent as the following detailed description is read in conjunction with the accompanying drawings wherein:

FIG. 1 is a vertical cross-sectional view illustrating one form of the invention as it may be applied to an individual pile having a free upper end;

FIG. 2 is a top plan view of the arrangement of FIG. 1;

FIG. 3 is a perspective view showing one manner whereby the invention may be constructed in elongated sheet-like form;

FIG. 4 is a vertical cross-sectional view showing one manner in which the structure of FIG. 3 may be arranged for the protection of a pile whose upper end is not free;

FIG. 5 is a schematic side elevation showing how the structure of FIG. 3 may be utilized for the protection of a boat;

FIG. 6 is a vertical cross-sectional view taken substantially on the line 6-6 of FIG. 5;

FIG. 7 is a partial vertical cross-sectional view showing a modified construction of the invention; and

FIG. 8 is a view similar to FIG. 7 showing yet another modified construction of the invention.

Referring now to the drawings and particularly to FIG. 1, the numeral 8 designates a conventionally driven pile located in waters subjected to destructive icing conditions. Ice protecting means constructed in accordance with the invention is designated by the numeral 10 and comprises a tubular sleeve 12 slightly larger in diameter than the pile 8. Bonded to the upper outer end part of the sleeve 12 is an annular ring 14 of water impervious heat insulating, buoyant material such as a foam of polystyrene, polyethylene, rubber having closed, gasified cells, or other suitable substance. The ring 14 is bonded to the sleeve 12 in such a position with respect to the upper end of the latter that when the assembly is floating in water the upper edge 15 of the sleeve is disposed at or slightly above the surface of the water for reasons that will become apparent. Further, the ring 14 of insulating material should have a vertical dimension such that when the assembly is in the water the upper and lower sides 16, 18 of the ring are respectively disposed at least slightly above the surface of the water and at a depth beyond the

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expected lower surface 19 of the ice 20; that is to say, when the protector assembly is in its position of use the ring should extend above and below the ice layer sufficiently far so as to prevent exterior ice from touching any part of the sleeve 12. The sleeve 12 should be of a material having high thermal conductivity, such as copper or aluminum, and should extend freely below the lower edge of the ring and well into the warmer strata of water beneath the ice layer.

As should be apparent from an inspection of FIG. 1, when the structure of the invention is in its position of use, the lower end of the metallic sleeve 12 is totally submerged in water all of which is at a temperature above freezing, thus heat from the lower strata will be conducted through the sleeve wall toward the region of lower temperature at the upper end of the sleeve in accordance with the well known law of heat conductivity. Because the exterior of the sleeve in the region of greatest cold is insulated by the ring 14 from ice or freezing surface water, the annular ring of water 21 within the sleeve surrounding the pile has its temperature raised to a level which may approximate the temperature level of the warmer strata beneath the ice but in any event the temperature is raised to a level above freezing.

FIG. 4 illustrates an arrangement particularly suited for the protection of piles which support structures preventing a prefabricated sleeve from being lowered over the top of the pile as in the embodiment of FIG. 1. The structure of FIG. 4 may be identical to the structure of FIG. 1 except that the user would be required to first cut the sleeve 12 and the plastic ring 14 along a line 22 whereupon the user would spread the sleeve to an open position so that it could, in effect, be snapped around the pile below a horizontal support member, such as the stringer 24 illustrated in FIG. 4. A suitable plastic which has a sufficient degree of resiliency to permit such spreading is polyethylene foam plastic which upon being released, elastically springs back to its original shape and aids in retaining the structure in its sleeve-like form around the pile. In addition metallic strapping 26, 28 of the same material as the sleeve 12 may be utilized to retain the structure in its proper shape. The strapping may be of a construction substantially similar to strapping used to retain insulating material around pipes, that is to say, one end of the strap may be provided with a buckle or bail through which the free end of the strap is passed and merely bent back upon itself.

In lieu of slitting the structure of FIG. 1 to provide protection for piles of the type illustrated in FIG. 4, the ice protector of the invention is susceptible of fabrication in substantially flat elongated composite sheets 29 as illustrated in FIG. 3. As shown the metallic part 30 of the sheet 29 may be corrugated, and preferably of aluminum or copper, to which there is bonded or cast at the upper end of the outer side thereof a continuous strip 32 of flotation plastic material which is desirably flexible, as for example, foam rubber of the type having closed gasified cells.

With the above arrangement it will be apparent that the user would cut off lengths as necessary for the intended use. For example, if a pile is to be protected the user would measure the circumference of the pile and would cut off a length of the composite sheet 30 which is somewhat greater than the measured circumference and he would then bend the sheeting around the pile and apply suitable fasteners such as the strapping 26, 28 to produce a structure which has an appearance similar to that shown in FIG. 4.

Boats which are subjected to ice are vulnerable for a variety of reasons but primarily because the ice freezes on any, almost imperceptible, projecting fibres or caulking material and starts a chain reaction which may ultimately cause a substantial part of the caulking being withdrawn from underwater seams resulting frequently in the unexpected sinking of a vessel as the ice retreats in the spring

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time. The structure of FIG. 3 is particularly suited for the protection of boats against losses of the foregoing nature as well as against other damage produced by ice. As illustrated in FIGS. 5 and 6 an elongated composite sheet 29 of the type illustrated in FIG. 3 is placed around the entire vessel as close inwardly to the water line as can be arranged. The surrounding sheet may be supported from the vessel by the means of lines 34 as illustrated and if necessary in order to draw the material into the sides of the vessel as closely as possible a suitable fore and aft line 36 may be wrapped around the entire periphery of the sheeting material to insure that only a minimum marginal band of water contacting the sides of the vessel need be raised to an above freezing temperature as explained herein before.

Where the sheeting of FIG. 3 is to be used primarily for the protection of vessels, it may be desirable to construct the plastic material as shown in FIG. 7 wherein the upper edge 38 thereof extends over the upper edge of the metallic member 40. With this arrangement it will be noted that the extending edge part 38 of the plastic material serves as a fender to prevent the upper edge of the metallic member from scarring the sides of the vessel.

In FIG. 8 a further modification of the invention is shown wherein the upper edge 42 of the heat conducting member 44 extends slightly above the upper edge of the plastic material 46. This arrangement may be useful for taking advantage of the heat of the sun as an aid in retaining an area ice free.

In addition to utilizing the conductivity of the metallic sleeve to maintain an ice-free zone about immersed objects, in tidal areas it is believed that the sleeve may also serve as a fluid conduit to direct flowing, warmer waters up into the sleeve where it co-mingles with the cooler surface water. Also as the sleeve ascends and descends with the tide there may be an action somewhat similar to pumping whereby as the sleeve moves vertically there is a degree of turbulence set up within the confines of the sleeve which causes a certain amount of mixing of cold and warmer waters.

The use of the invention should be apparent from the foregoing description. It is contemplated that the ice protecting means of the invention will be placed in its position of use only just before the onset of icing conditions and will be removed as early as possible after the danger of ice is over. During the winter months marine growth is dormant and the structure will remain in a maximum heat-conducting condition free of growth if timely placement and removal is adhered to.

It will be apparent from the foregoing description that the method and apparatus of the invention provides a relatively inexpensive, continuously re-usable, non-derangeable means for protecting partially immersed objects from ice damage. Tests during icing conditions utilizing polystyrene foam, which is a crumbly, quite brittle substance, established that the invention is effective to accomplish its intended purpose. It was particularly noted that even though the polystyrene was firmly locked in a thick ice layer which presumably expanded radially inwardly during periods of extreme cold, after the ice had departed no deterioration of the foam could be detected, and during icing conditions there was no apparent tendency of the test model to be collapsed inwardly by the pressure of the ice.

It will be apparent to those skilled in the art that the structure of the invention is subject to a variety of modifications suited to prevailing conditions. For example, the metallic member may be pleated or corrugated so as to afford a maximum heat conducting area exposed to the warm strata of water. The plastic material may be bonded to the metallic material in any of a variety of ways; for example, foam rubber might be vulcanized directly to the upper side of the metallic sheet material and other plastics may be bonded by the use of suitable adhesives as for example, epoxy adhesive and the like. These

and other materials may be utilized and other changes may be resorted to without departing from the scope and spirit of the appended claims.

What is claimed is:

1. Means preventing the formation of ice upon an object partially immersed in a body of water subject to natural icing conditions comprising metallic sheet material continuously surrounding said object in closely spaced relationship with ice-free water therebetween, water impervious, heat insulating material extending continuously around the outer face of said metallic sheet material and fixedly secured in heat insulating relationship therewith, said heat insulating material having continuous closing upper and lower terminal edges with the vertical dimension therebetween being greater than the thickness of ice resulting from said natural icing conditions, the lower end of said metallic sheet material extending substantially beyond the lower edge of said insulating material, and means supporting said metallic sheet material in said water with its upper edge at least at the surface of the water in its ice-free condition and its lower end depending into heat conducting relationship in a lower strata of warm water beneath a layer of ice resulting from said natural icing conditions, said insulating material being so positioned on said metallic sheet material that with the latter in said supported position the upper edge of said insulating material is at least not below the surface of the water in its ice-free condition and the lower edge thereof terminates at a depth no less than the bottom surface of the layer of ice resulting from said natural icing conditions, said insulating material completely covering the sheet material when it passes through said ice layer.

2. Means maintaining an ice-free zone in a body of water subject to natural icing conditions comprising a metallic heat conducting member marginally and continuously surrounding said zone, water impervious, heat insulating material extending continuously around the outer face of said heat conducting member and fixedly connected in heat insulating relationship therewith, said heat insulating material having continuous closing upper and lower terminal edges with the vertical dimension therebetween being greater than the thickness of ice resulting from said natural icing conditions, the lower end of said heat conducting member extending substantially beyond the lower edge of said insulating material, and means supporting said heat conducting member in said water with its upper edge at least at the surface of the water in its ice-free condition and its lower end depending into heat conducting relationship in a lower strata of warm water beneath a layer of ice resulting from said natural icing conditions, said insulating material being so positioned on said heat conducting member that with the latter in its supported position the upper edge of said insulating material is at least not below the surface of the water in its ice-free condition and the lower edge

thereof terminates at a depth no less than the bottom surface of the layer of ice resulting from said natural icing conditions, said insulating material completely covering the sheet material when it passes through said ice layer.

3. The means according to claim 2 wherein said insulating material and said support means are combined in a unitary flotatable substance having high heat insulating properties.

4. The means according to claim 3 wherein said insulating material comprises flotation plastic foam material.

5. The means according to claim 4 wherein the upper side edge of said plastic foam material overlaps the upper horizontal edge of said sheet material to serve as a fender for the edge of said heat conducting member.

6. The means according to claim 2 wherein the upper horizontal edge part of said sheet material projects above the adjacent edge of said heat insulating material so as to be exposed in heat conducting relationship with the atmosphere.

7. The means according to claim 2, wherein said sheet material is in substantially tubular form, said material being flexible so as to enable it to be folded into said form.

8. The means according to claim 7 including fastening means for retaining said sheet material in said tubular form upon folding thereof.

9. The means according to claim 7 wherein said sheet material is corrugated.

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