(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 243 989**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **87200396.7**

(22) Date of filing: **04.03.87**

(51) Int. Cl.³: **E 04 H 3/19**
E 04 H 15/00, E 04 H 3/18
A 63 C 19/12

(30) Priority: **13.03.86 NL 8600650**

(43) Date of publication of application:
04.11.87 Bulletin 87/45

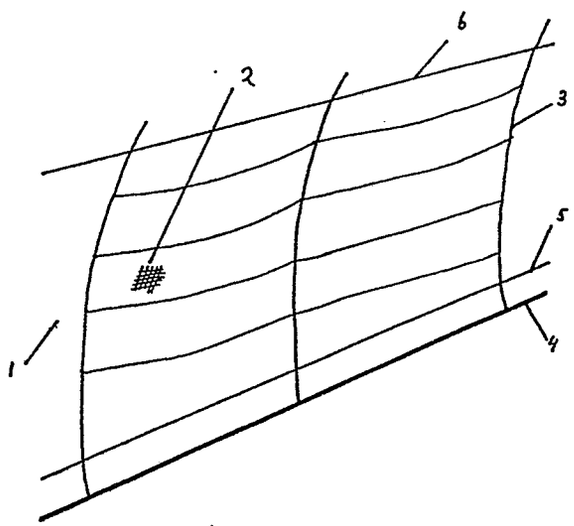
(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: **Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO**
P.O. Box 297
NL-2501 BD Den Haag(NL)

(72) Inventor: **Mennink, Bernhard Diedrich**
Coehoornsingel 76
NL-7201 AE Zutphen(NL)

(54) **Method and device for keeping constant the temperature of an out-door liquid or frozen surface.**

(57) Method for keeping constant as much as possible the temperature of a surface of a liquid or solid medium, like water or ice, situated in the open air used with outdoor swimming-pools, cooling ponds and outdoor artificial skating-rinks respectively. Use is made of a fine mesh net (2) being for 50% previous to air, to be spanned at some distance above the surface. For use with swimming-pools, the net is transparent for sunlight and impervious to heat radiation. For use with skating-rinks, the net is transparent for heat radiation. Preferably the net is supported by a stream of arch profiles (3) being mobile along the surface via a rail (4).



Figuur 1

EP 0 243 989 A1

Method for keeping constant as much as possible the temperature of a surface situated in the open-air and means for carrying out the method.

The invention concerns keeping constant as much as possible the temperature of a horizontal surface of a liquid or solid medium like water or ice situated in the open-air.

When the temperature of a surface of a solid or liquid medium in the open-air, which is to be kept at a certain level differing from that of the temperature of the air, the quantity of energy needed is highly dependent on the interaction between the medium and the atmosphere. This interaction concernsto the convection of heat via air-flow or moist present, the incident solar radiation and the radiation of heat into the atmosphere.

Examples of surfaces which are to be kept at constant a temperature, are surfaces of outdoor artificial skating-rinks, the surface of the water in outdoor swimming-pools and cooling-ponds.

Ice-floors of e.g. outdoor artificial skating-rinks, are kept at a temperature below 0°C, owing to convection via airflows with temperatures above 0°C and via rain, cold is lost. Incident sunbeams result in loss of cold too. The radiation towards the atmosphere positively contributes however, averaged over a winter season, especially in the case of a clear sky, the atmosphere behaves as a source of cold.

Outdoor swimming-pools for instance are kept at a temperature being higher for long periods than the outside temperature. Owing to convection as well as radiation, in the case of a clear sky heat is lost, whereas solar radiation contributes positively.

E.g. the temperature of water in cooling-ponds is preferably kept constant; such ponds are used for cooling via evaporation, convection and heat radiation. If no additional measures are taken, the contribution of the evaporation at the inlet of the hot water will increase disproportionately, giving rise to an impermissible mist.

For maintaining ice-floors and for keeping the water of swimming-pools at the temperature desired, energy is needed for cooling and heating-up respectively and for maintaining the ice-floor and the water of the swimming-pool in a given cooled and heated

respectively condition. Both when cooling and heating-up, the phenomenon of convection considerably increases the amount of energy needed. To minimize this amount of energy as much as possible, the convection losses have consequently to be kept down as much as possible. This may be obtained by minimizing the flow of air and the presence of moist.

The invention provides for a method to achieve this object in a simple and inexpensive way and is thereto characterized in that the surface is spanned at some distance upwards by a fine-mesh net with a few millimetres wide meshes and a surface being 50% pervious to air.

By the net used, between the net and the surface no or hardly any flow of air is present: a kind of isolating stationary air blanket is formed. In case of rainfall, the net will at least partly become impervious, owing to the capillary effect of the meshes of the net as a result of which water is kept away from the blanket. A decrease of the convective load with a factor 3 to 5 can be thus obtained. When this method is applied to cooling-ponds, above the warm part at the inlet of the cooling-water apart from the reduction of the evaporation and so of the formation of mist, still another advantage is obtained as by condensation on the net of water vapour rising from the pond, the formation of mist is still further reduced.

When the method according to the invention is used to diminish the loss of heat of the water of outdoor swimming-pools or for decreasing the loss of cold of the ice-floor of an outdoor artificial skating-rink, the net should be spanned at a height of at least ten times the width of the meshes, but not higher than about 150 cm above the surface of the water and the ice respectively. At a certain minimum height, the maximum height of the net is determined by the demand that for a minimizing of wind the net-surface should be as flat as possible. For artificial skating-rinks of 12 m wide e.g., a sag of the net of 1 m for a span of 12 m may be selected. At a minimum height of 10 cm e.g. the resulting maximum height is 1,10 m.

As not only the convection influences the temperature and so the energy-balance, but the incident sunbeams and the outward radiation as well, a net used should be adapted to its object with respect to these effects. This means that for use in swimming-pools e.g. in a preferred embodiment, the net is made of a material being transparent for sunlight and impervious for heat-radiation. In this respect

polyvinylchloride (PVC) is particularly suited.

In case the method is put into practice for cooling or keeping cool an ice-floor of an outdoor artificial skating-rink, the net should on the contrary for that very reason be transparent for heat-radiation. In that case polyethylene is very suited as net-material. To make the net retain the sunbeams as well, it is preferably made of sunlight reflecting material. Thereto polyethylene with a small amount of the whitener titaniumdioxide is satisfactory.

For carrying out the method according to the invention, measures should be taken to make spanning of the surface concerned possible. The invention therefore includes a device containing a net as described before and a supporting structure for the net to be spanned over the surface. Preferably such a structure can be moved, so that thus the net can be spanned over the surface on one hand and can be removed from the surface on the other hand. For instance, the net over the ice-floor may be mobile.

A preferred embodiment of such a supporting structure is provided with parallel arranged arch profiles over the surface to be covered. These arch profiles rest on both sides of the surface on the firm stationary lower edge and are fixed in a rail on one side according to a further preferred embodiment. The other side can adjust itself during the covered condition by means of castors, such that the sag of the arch profiles provide sufficient a supporting force for the weight of the net and the arched sections themselves. For removing the covering to start with, the net is drawn off the arch profiles and stored on the spot along the rail. Subsequently the arch profiles are grouped by means of the rail to be then removed from the surface by displacing them parallel to themselves and rotating them about an axis vertically positioned with respect to the rails respectively.

The invention also comprises outdoor swimming-pools and outdoor artificial skating-rinks provided with a net and with a device as described before.

It has been proved that when nets as described before are used for outdoor artificial skating-rinks, the nets apart from their heat convection minimizing effect, may have a further function to wit in applying or maintaining an ice-floor.

An ice-floor is laid in the usual way by applying water on a

foundation, kept at a temperature below 0°C. To obtain a smooth ice-floor, the water should be supplied thereto in small quantities and uniformly spread. It is usual to do this by dispersing water above the rink. The time needed for applying an ice-floor is for example 7 days under non-extreme weather conditions. It will be clear that much sunshine, high temperature of the air, rain and/or wind prolongs the time needed, owing to a decrease of the cooling-capacity available for making ice. A big part of the cooling capacity of the equipment namely has to be used under extreme weather conditions for draining off heat (absorbed solar radiation and the convective load). For applying an ice-floor ultimately more energy is needed. So when during making ice, the load as a result of solar radiation and convection of the rink can be reduced, an ice-floor can be applied in less time and at the cost of less energy. This proves to be possible by making use of the presence of a net above the rink during application of the water.

The invention therefore comprises a method for applying and maintaining an ice-floor of an outdoor artificial skating-rink, provided with a net as described earlier, water being sprayed on the net, said water flowing through the net and forming ice on the cooled surface below.

If by means of this method an ice-floor is made, in general 50% in time may be easily saved, which is important in connection with the operation.

The invention will be explained more fully with reference to the drawing, which shows schematically and in a perspective view part of a surface to be kept at a constant temperature, e.g. an ice-floor of an outdoor artificial skating-rink provided with a net and a supporting structure according to the invention.

The surface 1 with edges 5 and 6 is roofed-in with a net 2, spanned over it by means of arch profiles 3. The arch profiles 3 may be grouped via rails 4 at the inner edge. Spanning of the net occurs e.g. by means of one or more cables to be tensioned via winches.

Claims

1. Method for keeping constant as much as possible the temperature of a surface of a liquid or solid medium in the open air, characterized in that the surface is spanned at some distance upwards by a fine mesh net with a few millimetres wide meshes and a surface being 50% pervious to air.

2. Method according to claim 2 for diminishing the loss of heat of the water of outdoor swimming-pools or for decreasing the loss of cold of the ice-floor of outdoor artificial skating-rinks, characterized in that the net is spanned at a height of at least ten times the width of the meshes, but not higher than about 150 cm above the surface of the water and ice respectively.

3. Fine mesh net for carrying out the method according to claim 2 for outdoor swimming-pools, characterized in that it is made of a material being transparent for sunlight and impervious to heat radiation.

4. Net according to claim 3, characterized in that it is made of P.V.C.

5. Fine mesh net for carrying out the method according to claim 2 for outdoor artificial skating-rinks, characterized in that it is made of material being transparent for heat radiation.

6. Net according to claim 5, characterized in that it is made of polyethylene.

7. Net according to claim 5 or 6, characterized in that the material is sunlight reflectant.

8. Net according to claim 7, characterized in that it is made of polyethylene with a small quantity of titaniumoxide added thereto.

9. Device for carrying out the method according to claim 1 or 2, characterized in that it contains a fine mesh net according to one of the claims 3-8 and a supporting structure for the net to span this over the surface concerned.

10. Device according to claim 9, characterized in that the supporting construction is movable in such a way that the net can be spanned over the surface and can be removed from the surface again respectively.

11. Device according to claim 9 or 10, characterized in that the supporting structure consists of parallel arranged arch profiles, which can be provided over the surface and are supported next to the surface.

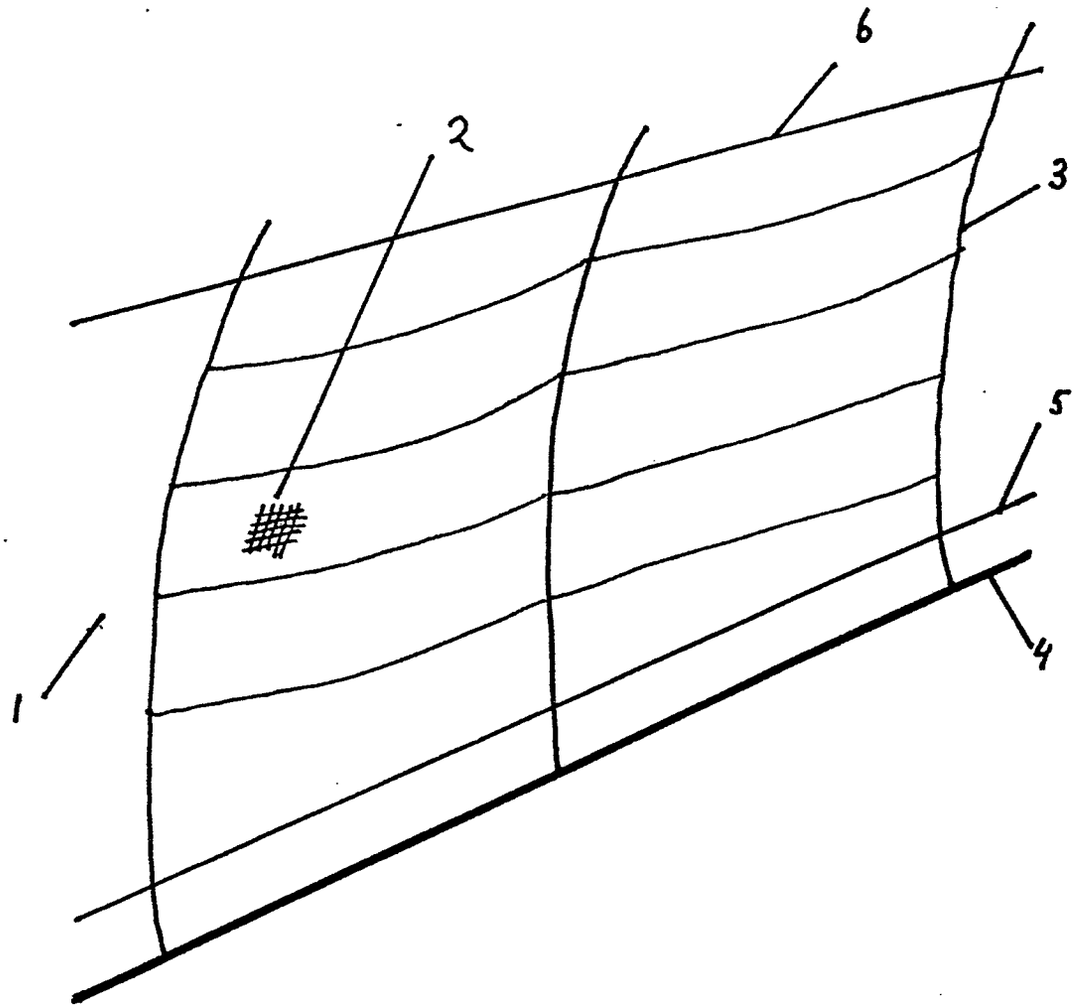
12. Device according to claim 11, characterized in that the arch profiles are fixed with a foot in a rail following the edge of the surface such, that they are mobile and rotatable about an axis, vertically positioned with reflect to the rails, or can be displaced parallel to themselves.

13. Outdoor swimming-pool provided with a net according to claim 3 or 4, provided with a device according to one of the claims 9-12.

14. Outdoor artificial skating-rink provided with a net according to one of the claims 5-8 and provided with a device according to one of the claims 9-12.

15. Method for applying and maintaining respectively an ice-floor for an outdoor artificial skating-rink, provided with a net according to one of the claims 5-8, water being sprayed onto the net, said water flowing through the net and forming ice on the cooled underground below.

16. Method according to claim 15, characterized in that use is made of a device according to one of the claims 9-11.



Figuur 1

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 20 0396

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	FR-A-2 536 105 (POUSSY) * Page 2, lines 26-29; page 3, lines 1-35; page 4, lines 1-26; page 6, lines 1-4; figures 1-4 *	1,4,6	E 04 H 3/19 E 04 H 15/00B E 04 H 9/18 A 63 C 19/12
A	DE-A-3 123 117 (STORK) * Page 8, lines 30-37; page 9, lines 1-32; figures 1,2,3 *	1	
A	US-A-3 174 493 (GRUENBERG) * Column 2, lines 51-71; column 3, lines 1-61; figures 1-5 *	1,11	
A	US-A-3 840 118 (WHITMORE) * Column 2, lines 26-57; figures 1-5 *	9,10	
A	GB-A-2 064 289 (PREMIER)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 04 H
A 63 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-06-1987	SCHOLS W.L.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03.82