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(21) International Application Number: PCT/NO88/00036 (22) International Filing Date: 4 May 1988 (04.05.88) (71)(72) Applicant and Inventor: HEGSTAD, Björn [NO/NO]; Alf Godagers vei 16, N-7081 Sjetnhaugan (NO). (74) Agent: FOLVEN, Reiel; Curo AS, N-7094 Lundamo (NO). (81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK, FI, FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent), SU, US.		Published <i>With international search report.</i> <i>In English translation (filed in Norwegian).</i>
(54) Title: SURFACE COATING (57) Abstract A surface coating with heater cable, for the heating of surface structures such as ships' decks, or floors. The coating consists of a foundation layer of a plastic material which forms a base for the heater cable (2), a conducting layer (4) of a plastic material where particles of metal or similar thermically-conducting particles (5) are sealed inside, and a covering layer (6) of a material with significantly lower thermic conductivity, than the conducting layer.		

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SURFACE COATING

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The invention concerns a surface coating of the type indicated in the introduction to Claim of Patent 1 for heating surfaces and similar structures such as ship decks, floors, particularly areas where there is danger of icing. The coating is also designed for indoor surfaces which require heating such as floors.

Surface coatings exist which have heater cables covered by a plastic material which is polymerized in situ. The plastic material has metal particles sealed inside to help lead the heat towards the exposed surface.

Nevertheless, such coatings result in uneven surface heating, with local heating along the heater cable and lower temperatures in the areas between the cables.

The main objective of the present invention is to find a means of surface heating, particularly for outdoor applications, which maintains a more even temperature than any known surface coating, and which simultaneously provides the mechanical and other advantages of heater cables compared with heating elements made of foil or plates. Among the subsidiary objectives are being able to reduce the energy supply to the surface coating to a level which is sufficient to complete the task at hand, for example: de-icing an oil platform by the heat from the heater cable. Another

objective is to find means of rapidly conducting the heat away from the cable so that the latter can have a smaller diameter than any other heater cables.

5 The surface coating is also to have adequate mechanical characteristics, it should also be durable and easy to lay. As one application is for rehabilitating buildings with normal door sill heights, a further objective has been to design a thin coating.

10 All these objectives can be met by designing a surface coating in accordance with the characterizing part of Claim of Patent 1. Other advantageous features of the invention are indicated in the subsidiary claims of patent.

15 The present invention will firstly reduce the heat loss towards the inner side of the surface. Then it will rapidly conduct the heat from the heater cable without any local overheating of the exposed surface. The result will be temperature equalization which makes it possible to reduce the maximum surface temperature
20 to the minimal temperature to maintain the required operating conditions. This naturally results in energy savings, which can be sizeable given large surface areas such as offshore platforms, drilling rigs and ships.

25 The figure shows a section through a surface which has been covered by a coating designed in accordance with the invention.

The under-surface 1 in the example is a steel plate, but this could also be made of other types of
30 metal sheeting or materials such as chipboard, laminate, concrete or similar. An important functional specification for the coating is that it must reduce the heat transfer towards the under-surface 1, as this can mean a loss of heat and in the worst case lead to
35 the overheating of sensitive components.

The under-surface is prepared for the laying of a

heater cable 2 by applying an alkaline coating 3 of an electrically insulating substance that preferably has low thermic conductivity. An example of such could be a plastic material that is polymerized in situ. Some kind of reinforcement could also be incorporated into the plastic, such as a glassfibre matting. Another possibility is laying an alkaline coating 3 on a layer of thermically-insulating material such as porous plastic plate.

10 An alternative to a heating cable is using string-like heating elements, such as ribbon heating foils.

 The heating cable 2 may be of the conventional, known type, which is laid with suitable density for the particular application and cable power. The cable can be secured during polymerization by an adhesive or other appropriate means. The invention makes it possible to reduce the cable diameter by using less insulation than has been normal to date.

20 Above the heater cable 2 the first covering layer, or heat conducting layer 4 is composed of a plastic composite, such as an acrylic material. This layer contains and seals bits or particles 5 of a material with high heat conductivity. Suitable materials for this purpose include steel swarf, or chips of other metals or ceramics. Though the content of such particles can exceed 10 - 40 %, it will normally be around 5 - 10 %.

 A covering layer 6 of plastic is then laid on top of the conducting layer 4. The covering layer 6 does not have any metal swarf or thermically-conducting materials added. As this layer has the function of a heat equalization layer, it has considerably lower conductivity than the conducting layer 4, in quantitative terms this will be between 20-60% less conductive. Layer 6 could have particles added to improve its

durability, or it could have an outer covering layer on top (not illustrated) which could be of a durable material that could have different thermic characteristics than layer 6.

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Example:

After degreasing the steel plates on a platform deck a foundation layer of an acrylic material was laid, this was between 2-4 mm thick. After this had hardened, a heater cable was laid on top and temporarily held in position by an adhesive gun. The heater cable was arranged so that it covered the deck at about 10 cm intervals. The cable was then covered by an acrylic mass mixed with steel swarf (25 % of the mixture being steel swarf). This layer was about 15 mm thick. A further layer of 1-2 mm of acrylic plastic was then applied. Measurements showed that the temperature variation on the surface was about + 0.1°C, when the cable output was 400 W/m².

In a second example, 1 litre of plastic mass "Silikal 1061 FR" was mixed together with 3 kg of quartz sand, 0.6 kg of aluminium pins and an accelerator, this was then used as the conducting layer 4. Then, a second layer composed of the same substances except the aluminium pins was laid in a 2-4 mm thick strata on top as the covering layer. This also resulted in a satisfactory surface coating.

There are a number of modifications that can be made within the framework of the invention. Though acrylic plastic has proved to be particularly suitable, other plastics that can be applied in a molten state are also feasible.

The thermically-conducting particles can have a number of forms. These include fibres, chips or granular particles. They can be made of steel, aluminium or other metals, composites or ceramic

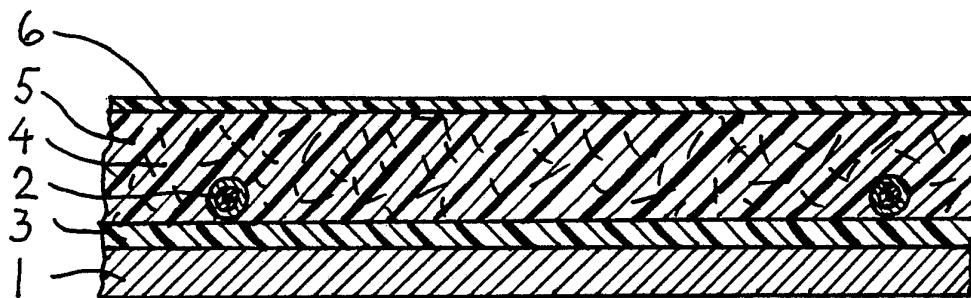
materials with high thermal conductivity. The covering layer 6 can also be composed of ceramic tiles.

The surface coating in accordance with the invention can be used for other purposes than heating exposed surfaces. These applications include tanks and supportive structures.

Claim of Patent:

1. A surface coating with heater cable or a corresponding heating element, for the heating of surface structures such as ships' decks, particularly for the purpose of hindering icing, where a coating of a plastic mass seals a heater cable or a similar elongated heating source, characterized by the coating consisting of:
- a foundation layer of a plastic material which forms a base for the heater cable (2),
 - a layer (4) of a plastic material which covers the heater cable and where particles of metal or similar thermally-conducting particles (5) are sealed inside,
 - a covering layer (6) of a material with significantly lower thermic conductivity, i.e., about a half the conductivity of the conducting layer (4) containing the sealed particles.
2. A surface coating in accordance with Claim of Patent 1, characterized by the covering layer (6) having the addition or a finishing of a particularly durable material, such as quartz grain.
3. A surface coating in accordance with Claim of Patent 1, characterized by the covering layer (6) consisting of a plastic material, such as an acrylic plastic, which is polymerized in situ.
4. A surface coating in accordance with Claim of Patent 1, characterized by the covering layer (6) consisting of a ceramic tiles.

I/I



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO88/00036

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC ⁴		
H 05 B 3/20, F 24 D 13/02		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC 4 US C1	F 24 D 13/00-/02; H 05 B 3/10-/22, 3/26-/28, 3/34-/36, 3/56 219:213, 522, 528, 531, 538-540, 542, 546, 548-549	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁸		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	NO, B, 157 730 (SKIPNES) 1 January 1988 See page 3, line 17 - page 4, line 3 and fig. 1.	1-4
Y	US, A, 1 349 136 (LILLARD) 10 August 1920 See page 1, line 64 - page 2, line 22 and fig. 1.	1-4
Y	US, A, 4 220 848 (MC MULLAN ET AL) 2 September 1980 See col. 7, lines 19-24, col. 9, lines 55-64 and fig. 9.	1-4
A	US, A, 3 694 622 (BENTLEY) 26 September 1972	
A	FR, A, 1 509 157 (LECOLE) 22 March 1968	
Y	AT, B, 326 788 (WINDISCH) 29 December 1975 See page 3, lines 13-22 and figure.	1-4
¹⁰ Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "A" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1988-10-18	1988 -12- 0	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	 Roland Landström	