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(54) METHOD AND SYSTEM FOR COOLING A POROUS PAVING LAYER

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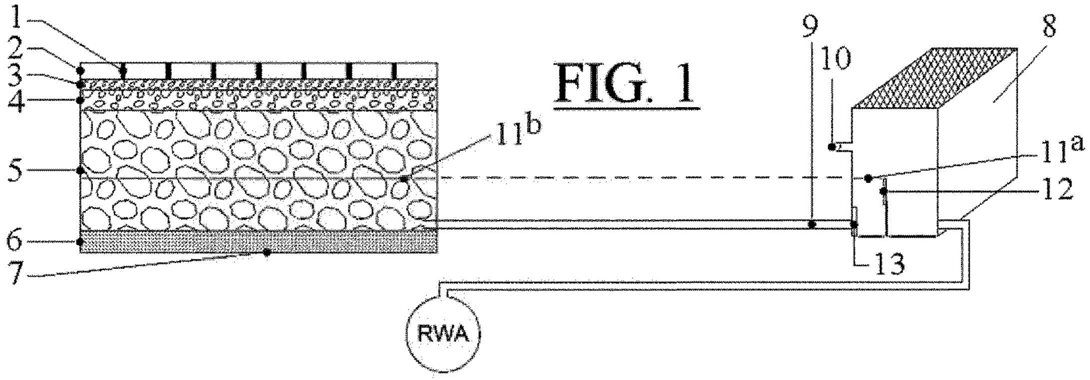

FIG. 1

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Description

[0001] The invention relates to a method and a system for cooling a porous paving surface (paving layer).

[0002] It is an object of the present invention to provide a method and system, respectively, for cooling a porous paved (for example cobbled) surface and thus cooling the environment of that paving surface, in particular in urban areas. Cooling the paving may reduce the temperature on squares and roads, thus producing a more liveable climate for humans and animals alike.

[0003] To this end, the invention provides a method for cooling a porous paving surface, comprising the following steps:

- providing a paving bed of material having capillary properties which is intended and configured both to support the paving surface and to absorb the water which has permeated the paving surface, in particular precipitation;
- providing a water buffer reservoir and communicatively connecting the latter to the paving bed.

[0004] The present invention also comprises a system for cooling a porous paving surface, comprising:

- a paving bed of material having capillary properties which is intended and configured both to support the paving surface and to absorb the water which has permeated the paving surface, in particular precipitation (rainwater);
- a water buffer reservoir which is communicatively connected to the paving bed.

[0005] The invention is based on the insight that a porous paving surface is not only suitable to allow water to pass through in a downward direction and to carry it away, but that, if the discharged water is stored, the stored water simply flows back to the porous paving surface when the weather is dry and hot (since the water buffer reservoir is communicatively connected to the paving bed), where it will evaporate due to the relatively hot porous surface and the paving surface cools down as a result of that evaporation, which consequently also cools down the environment of that paving surface. Due to the capillary properties of the material of the paving bed, during the evaporation process on the paving surface water is brought up from the capillary paving bed which is situated underneath, as a result of which the evaporation of water via the paving surface continues. This process lasts for as long as there is water present in the paving bed and is replenished from the communicating water buffer reservoir. Due to the communicating configuration of the paving bed and the water buffer reservoir and due to the capillary action of the material of the paving bed, the evaporation process and the accompanying cooling down take place without the supply of external energy.

[0006] The invention will now be discussed in greater detail by means of the following description of the figures.

Fig. 1 shows an exemplary embodiment of a system according to the invention, intended for squares, traffic-calmed streets, etc.;
Fig. 2 shows an exemplary embodiment of a system according to the invention, intended for suburban access roads, etc.

[0007] Figs. 1 and 2 each show an exemplary embodiment of a system according to the invention for cooling a porous paving surface (1-2), comprising:

- a (multi-layered) paving bed (3-7 and 14-19, respectively) which is intended and configured both to support the paving surface (1-2) and to absorb the water which has permeated the paving surface (1-2), in particular precipitation (rainwater);
- a water buffer reservoir (8) which is communicatively connected to the paving bed (3-7 and 14-19, respectively) via a connecting duct (9), so that the water level (11b) in the paving bed (3-7 and 14-19, respectively) and the water level (11a) in the water buffer reservoir (8) are always substantially equal with respect to each other.

[0008] Key to Fig. 1:

1 Lava rock (crushed volcanic rock) 0/1 (mm)
2 Water-permeable/porous paving stones and/or (bound) road paving
3 Lava rock (crushed volcanic rock) 0/3 (mm)
4 Infill lava rock (crushed volcanic rock) 0/16 (mm)
5 Lava rock (crushed volcanic rock) 16/31.5 (mm)
6 Filling sand (protection)
7 Film (surround)
8 Water buffer (storm drain)
9 Connecting duct
10 Storm drain discharge
11 Water level
12 Slide for summer and winter level
13 Filter

[0009] Key for Fig. 2:

1 Lava rock (crushed volcanic rock) 0/3 (mm)
2 Water-permeable/porous paving stones and/or (bound) road paving
8 Water buffer (storm drain)
9 Connecting duct
10 Storm drain discharge
11 Water level
12 Slide for summer and winter level
13 Filter
14 Laying bed
15 Foundation layer: Hard stone 8/32 (mm), Lava rock (crushed volcanic rock) 0/8 (mm)
16 Infill Lava rock (crushed volcanic rock) 0/16 (mm)

17 Lava rock (crushed volcanic rock) 16/31.5 (mm)
18 Filling sand (protection)
19 Film (surround)

[0010] List of advantages:

- No use of groundwater or surface water;
- No additional risk of slipperiness at all due to summer and winter setting;
- Underground cooling results in cooling aboveground without this resulting in any inconvenience;
- The system works in an entirely inconspicuous and unattended way;
- 100% sustainable solution;
- The construction may, if desired, also be made CO_2 neutral;
- Due to the buffer being situated under the paving, it is possible to reduce the dimensions of the clean water sewer, since the peak water discharge will be smaller.

[0011] Thus, the present invention provides a method and system, respectively, for cooling a porous paving surface and thereby cooling the environment of said paving surface, in particular in urban areas, resulting in a more liveable climate for humans and animals alike.

[0012] With regard to the publications D1 (CN109594446A) and D2 (CN110144789A) mentioned in the Netherlands novelty report which has meanwhile been published, the following may be remarked.

[0013] D1 relates to horizontal, tubular heat exchangers 4 which are supplied from heat-exchanging chambers 41 alongside the road which are in turn fed from a water tank 44 under the road which is filled with drainage water which has permeated the road/roadbed. D1 does not mention the use of capillary action provided by the capillary properties of the material of the paving bed, in which during the evaporation process on the paving surface water is brought up from the capillary paving bed which is situated underneath, as a result of which the evaporation of water via the paving surface continues as long as there is water present in the paving bed and is replenished from the water buffer reservoir. By means of the connecting duct 9, the water buffer reservoir 8 is communicatively connected to the paving bed 3-7 and 14-19, respectively, that is to say connected ("communicatively") in such a way that the water level 11b in the paving bed 3-7 and 14-19, respectively, and the water level 11a in the water buffer reservoir 8 are always substantially equal with respect to each other. Due to the communicative configuration of the paving bed and the water buffer reservoir in combination with the capillary action of the material of the paving bed, the evaporating process and the associated cooling takes place without external energy having to be supplied.

[0014] Already a comparison of the figures of D1 with those of the present patent application shows that the configuration of the present device is significantly simpler than the configuration of D1, which also uses, inter alia, pressure-regulating means, heat exchangers, microprocessors, etc.

[0015] The configuration known from D2 involves a water buffer which is situated below the level of the road/roadbed and contains a water pump 11 which pumps up the drainage water. This configuration is also more complicated than the device proposed in the present patent application. No mention is made anywhere in D2 about using the capillary properties of the material of the paving bed in order to bring up water from the capillary paving bed which is situated underneath, during the evaporation process on the paving surface. By contrast, D2 uses a water pump and the control elements required for this purpose, such as sensors, etc., and this water pump, etc. will also require a power supply, which is not the case with the configuration according to the invention.

Claims

1. Method for cooling a porous paving surface, comprising the following steps:

    - providing a paving bed of material having capillary properties which is intended and configured both to support the paving surface and to absorb the water which has permeated the paving surface, in particular precipitation;
    - providing a water buffer reservoir and communicatively connecting the latter to the paving bed.

2. System for cooling a porous paving surface (1-2), comprising:

    - a paving bed of material having capillary properties (3-7 and 14-19, respectively) which is intended and configured both to support the paving surface and to absorb the water which has permeated the paving surface, in particular precipitation;
    - a water buffer reservoir (8) which is communicatively connected (9) to the paving bed.

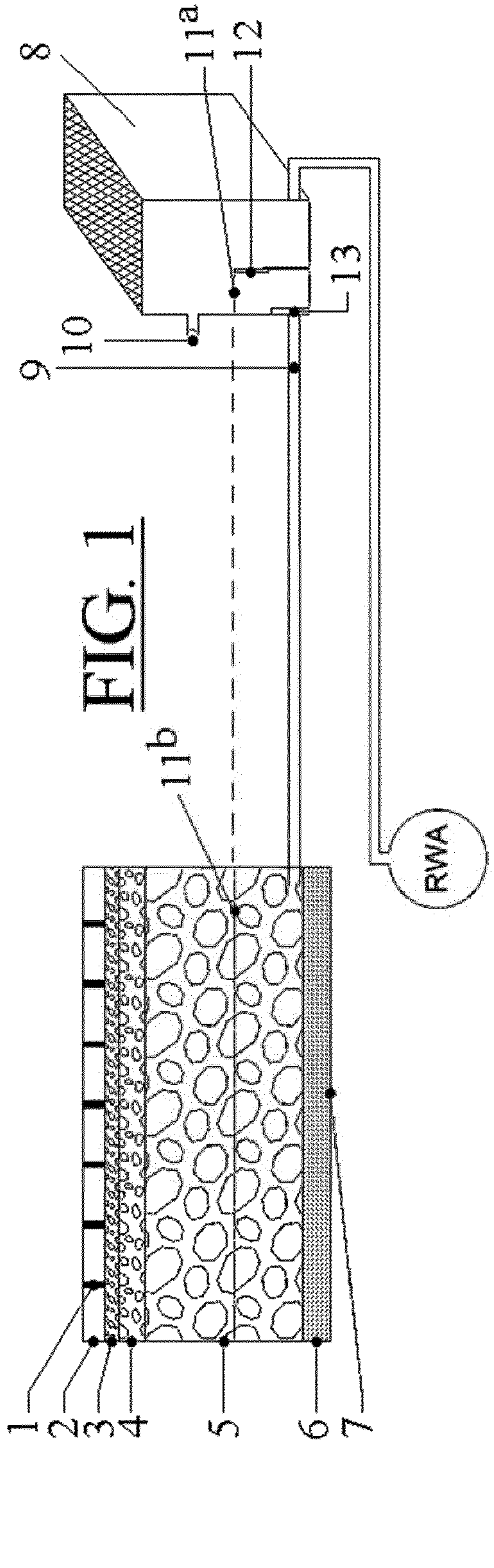
8
11a
12
13
10
9
11b
RWA
1
2
3
4
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FIG. 1

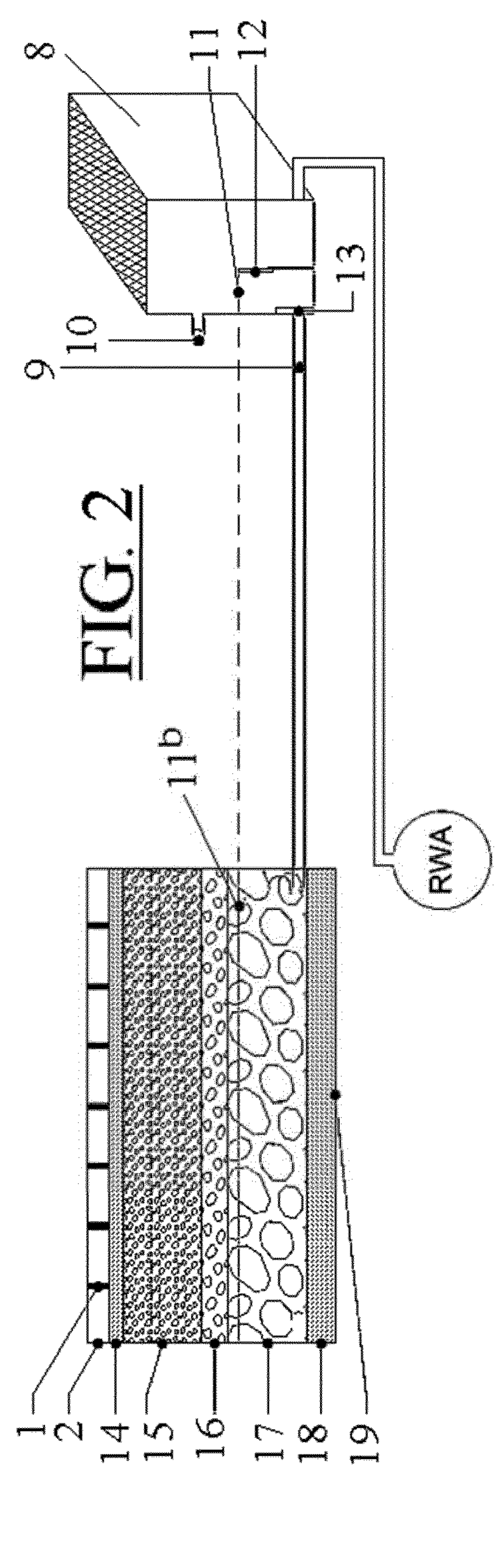
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FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 4744

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	JP 2005 068636 A (NICHIREKI CO LTD) 17 March 2005 (2005-03-17) * paragraphs [0001], [0006], [0007], [0011] - [0018], [0021] - [0026] * * figures 1,2 * -----	1,2 1,2	INV. E01C11/24
X	JP 2000 045206 A (OHBAYASHI CORP) 15 February 2000 (2000-02-15) * paragraphs [0001], [0004] - [0006], [0008] - [0013], [0015] - [0022], [0023] - [0027] * * figures 1-3 * -----	1,2	
X	JP 5 359178 B2 (OHBAYASHI CORP) 4 December 2013 (2013-12-04) * paragraphs [0001], [0006] - [0008], [0012] - [0015], [0019] - [0029]; figures 1-6 * -----	1,2	
X,D	CN 109 594 446 A (UNIV HUANGHUAI) 9 April 2019 (2019-04-09) * paragraphs [0008] - [0017], [0039] - [0041], [0043]; figures 1,2 * -----	1,2	TECHNICAL FIELDS SEARCHED (IPC) E01C
Y	CN 110 144 789 A (UNIV SOUTHEAST) 20 August 2019 (2019-08-20) * the whole document * -----	1,2	

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 February 2022	Kremsler, Stefan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons
& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 21 20 4744

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22-02-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2005068636 A	17-03-2005	JP 4147154 B2	10-09-2008
		JP 2005068636 A	17-03-2005
JP 2000045206 A	15-02-2000	JP 3589035 B2	17-11-2004
		JP 2000045206 A	15-02-2000
JP 5359178 B2	04-12-2013	JP 5359178 B2	04-12-2013
		JP 2010095903 A	30-04-2010
CN 109594446 A	09-04-2019	NONE	
CN 110144789 A	20-08-2019	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 109594446 A **[0012]**
- CN 110144789 A **[0012]**