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(54) Title: METHOD AND APPARATUS FOR TREATING AN OBJECT

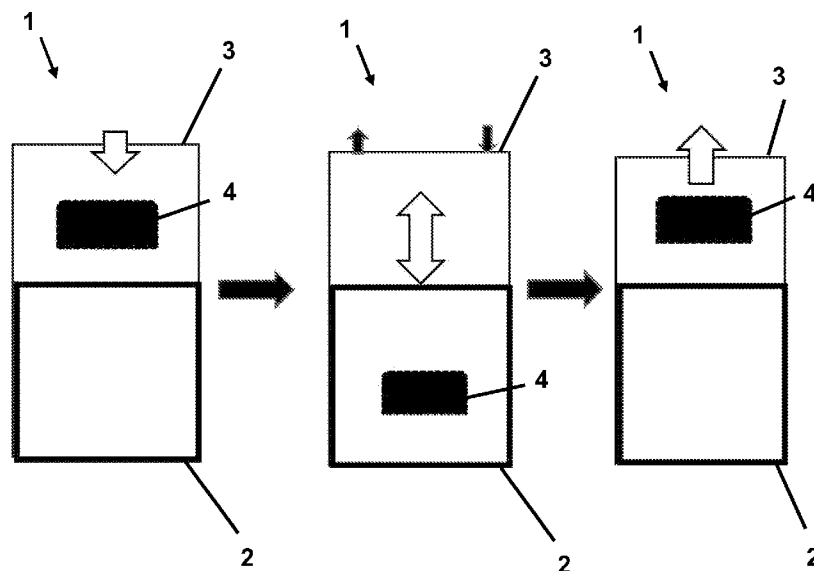


Fig. 1

(57) Abstract: The invention relates to a method and an apparatus for treating an object (4) comprising concrete, asphalt and/or porous metal such as galvanized iron. The method comprises at least the following steps: - subjecting the object (4) to underpressure and thereby removing water and other substances from pores, cracks and/or other openings of the object; - immersing the object (4) completely or partially in primer; - applying the primer to the pores, cracks, and/or other openings the object (4), thereby reducing porosity of the object to be treated. The invention is suitable for surface treatment of, for example, objects (4) of traffic environment, such as concrete street curbs (4) and road surfaces.



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METHOD AND APPARATUS FOR TREATING AN OBJECT

TECHNICAL FIELD OF THE INVENTION

The invention relates to a method and an apparatus for treating an object comprising
5 concrete, asphalt and/or porous metal such as galvanized iron, according to the
preambles of the independent claims below. For example, the invention relates to a
new way of surface treatment of a concrete street curb, road surface paving or a
metal fastening plate or a bolt of a highway railing.

10 PRIOR ART

Objects of traffic environment are exposed to high strain on climate, wear of traffic
and mechanical cleaning. For example, concrete is a partially porous material and
contains many types of cells, cracks and capillaries. Pores, cracks and other
openings reduce the mechanical resistance of a material. Porous material absorbs
15 water in moist conditions. In traffic environment, the temperature will typically vary,
resulting in decay when moisture in the pores expands when freezing and contracts
when melting. Traffic and cleaning wear the objects of traffic environment both
mechanically and chemically. Mechanical wear is caused e.g. by car tires, snow and
ice and snow ploughs. Chemical wear is caused e.g. by road ice removal chemicals
20 and traffic emissions.

Objects of traffic environment are usually coated with different kinds of paints to
protect them or to increase their visibility. There is a limited number of paints suitable
for e.g. concrete or asphalt. To increase visibility, paints that include a light reflecting
25 additive or a pigment having a luminescence effect are often used. For example, in
a concrete street curb, paint remains on or close to the surface of the object and
does not form good adhesion deeper than at the surface of the concrete.
Temperature variation combined with moisture stress reduces adhesion between a
porous material such as concrete and the coating painted on it. Especially in wet
30 objects, the paint coating is released quickly. The surface under the paint, such as
a grey concrete surface, is difficult to detect in rain and dark. This increases the risk
of a traffic accident. The unpainted surface will wear out and decay faster than
before. The need for maintenance painting is considerable.

US 2009176020 A1 discloses a cover to be placed against a porous surface, under which a vacuum can be provided. Liquid primer can be led under the lid, against the surface, which primer then penetrates the pores of the surface.

5

OBJECT OF THE INVENTION

It is an object of the present invention to reduce or even eliminate the abovementioned problems appearing in prior art.

10 It is an object of the present invention to provide a way in which traffic environment objects are protected from climate stress and mechanical and chemical wear.

It is an object of the present invention to provide a new and more effective way of surface treatment of a porous object, such as an object comprising concrete, asphalt
15 and/or galvanized iron.

It is an object of the present invention to improve durability of concrete, asphalt, and other porous materials used in traffic environment and at the same time improve their visibility.

20

It is an object of the present invention to provide a coating method that enables and facilitates widespread use of reflective material, material with luminescence effect, and various contrast colours in traffic environment objects.

25 It is an object of the present invention to provide a concrete street curb, concrete curb support system of a pedestrian crossing, a precast concrete element for road construction site, road surface paving, a metal highway railing, a metal bolt of a highway railing, a metal fastening plate of a bolt of highway railing, a metal lighting pole or a traffic sign that has been surface-treated more durably and/or visibly than
30 before.

SUMMARY OF THE INVENTION

In order to achieve the above-mentioned purposes, among others, the method and apparatus according to the invention and other objects of the invention are characterized by what is stated in the attached independent claims.

5

The examples and advantages mentioned in this text apply, where applicable, to the method as well as to the apparatus according to the invention, although not always mentioned separately.

10 In a method according to the invention an object comprising concrete, asphalt and/or porous metal such as galvanized iron is treated. The method comprises at least the following steps:

- subjecting the object to underpressure and thereby removing air, water and other substances from pores, cracks and/or other openings of the object;
- 15 – applying primer to the pores, cracks, and/or other openings of the object, thereby reducing porosity of the object to be treated.

Apparatus according to the invention is meant for treating an object comprising concrete, asphalt and/or porous metal such as galvanized iron. The apparatus
20 comprises:

- a vacuum chamber for subjecting the object to underpressure using an underpressure device, in order to remove water and other substances from pores, cracks and/or other openings of the object;
- a primer applicator for applying primer to the pores, cracks, and/or other
25 openings of the object.

According to the invention, the application of the primer is carried out by immersing the object in whole or in part in the primer. Apparatus according to the invention comprises a primer basin. The apparatus may also comprise means for immersing
30 the object in the primer basin and means for removing the object from the basin. This kind of means may be e.g. an elevator device, such as an electric crane or a lever solution hand-operated from outside the apparatus. The immersing of the

object in the primer ensures a guaranteed and plentiful contact between the primer and the object.

5 The object to be treated may be only part of an article or a thing, for example a part of a piece made of concrete or the part of road surface where road markings are painted.

Production of underpressure, vacuum chambers and other equipment and structures required therein are known per se and are therefore not discussed further
10 herein. The underpressure device may, for example, be a displacement pump.

The porous metal may be, for example, iron, galvanized iron, aluminium or bronze. Depending on the situation, different amounts of different substances, such as water, air and other gases, are removed by underpressure from the pores, cracks
15 and openings.

The primer is selected to suit each situation. The product type can be, for example, water- or solvent-soluble epoxy, polyurethane, acrylic, vinyl ester, elastomer and polyurea, or any combination of these binders.
20

Thus, it has now been discovered that an object made of concrete, asphalt or porous metal can be coated more effectively by subjecting the object to an underpressure before coating with a primer. The idea is to prevent water from penetrating into the pores, cells and cracks of the object by filling them with primer or sealer paint or
25 equivalent suitable for concrete, asphalt or porous metal.

In one embodiment of the invention, the porous object, such as a concrete block, is underpressurized to a pressure lower than normal air pressure (101 kPa). For example, a pressure of less than 50 kPa, less than 25 kPa, less than 10 kPa, less
30 than 5 kPa or less than 3 kPa may be used for underpressure. Thus, unwanted substances in the pores and cracks, such as water become gasified and leave the pores to at least some extent.

The underpressure can be maintained for a time suitable for each situation, for example, over 10 seconds, over one minute, 1 to 10 minutes, or more than 5 minutes.

- 5 When the pores, cracks and other openings in the object are filled with a primer, the porosity of the object to be treated is reduced. The possibilities of water to penetrate into the object at a later stage are greatly slowed down or completely prevented, and thus the decay of the object is also reduced. For example, frost resistance of concrete and corrosion resistance of reinforcement bars are improved. Primer
10 penetrated into concrete or other porous material also acts as a binder within the porous material, thereby improving mechanical wear resistance and strength of the object.

- A particular advantage is achieved by the fact that the surface formed by the primer
15 acts as a good substrate for the next coating treatment. Adhesion is good because the object, such as concrete or asphalt, no longer has water or easily separable material, such as concrete adhesive on its surface.

- Coating of concrete and other porous materials such as galvanized iron can be done
20 already in production stage at the factory. Products made in this way are ready to be installed e.g. in a traffic environment, already when coming out of the factory, and, for example, after the installation of curbs, no separate painting is required. The coating at the production stage can be easily done on different sides of the object. Thus, for example, concrete curbs can be easily at least partly painted on
25 their parts meant hidden, for example on parts meant to be situated underground. This further increases the durability of the products.

- The quality of the coating according to the invention is better than usual. This brings economic benefits as the painting of objects afterwards and the need for long-term
30 maintenance painting are reduced.

Because coating, such as paint, remains better at the object, the invention improves the visibility of, for example, objects in the traffic environment and the colours used therein, even in poor driving conditions. This increases safety.

- 5 In one embodiment of the invention, the subject of the traffic environment is discussed. The object of the traffic environment can be, for example, a concrete street curb, a concrete curb support system of a pedestrian crossing, a precast concrete element for road construction site, road surface paving, highway metal railing, metal bolt of a highway railing, metal fastening plate of a bolt of highway
- 10 railing, metal lighting pole, traffic sign. The advantages of the invention are particularly emphasized in traffic objects. For example, bolts and base or fastening plates of bolts used in highway railings are usually made of galvanized iron, which is susceptible to corrosion. By means of the invention, the bolts or the base or fixing plates of the bolts can be durably painted with a paint having a light reflecting
- 15 additive and/or a pigment having a luminescence effect. In this way, road bridges can be seen by road users even in bad conditions.

- In one embodiment of the invention, the object is dried with a dryer such as an infrared and/or air dryer before subjecting the object to underpressure. An infrared
- 20 dryer is well suited for drying porous materials. There the heat output is evenly distributed over a wide surface, accelerating the drying process. By means of a dryer, at least some of the water in the pores of the object can be effectively removed even before the underpressure treatment.

- 25 In one embodiment of the invention, the primer applicator may comprise, for example, a device that pours, sprays or mists small droplets of primer on the surface of an object.

- In one embodiment of the invention, the transferring of the primer to the pores, cracks and/or other openings of the object is enhanced by raising ambient pressure
- 30 when the primer is applied to the object. Thus, the pressure pushes the primer deep into the pores, cracks and/or other openings. The pressure can be raised to normal atmospheric pressure, 1 bar i.e. about 101 kPa. The pressure can also be increased

with the help of a pressurizing device, for example over 5 bar, or up to over 10 bar. For example, if the object is immersed in a liquid primer as the pressure is increased, the pressure will cause a hydrostatic pressure in the coating agent, which effectively causes it to fill the pores and cracks of the object. It is even possible that the pores
5 and cracks are filled or closed completely.

In one embodiment of the invention the primer-treated object is treated with a second surface treatment. In the second surface treatment a second surface treatment agent can be applied to the primer, the second surface treatment agent
10 comprising at least one of: polyurethane, light reflecting additive, pigment with luminescence effect, reflective fabric or reflective thermoplastic plastic. Other coatings and paint types than those suitable for the surface of the object being treated may be used as a second coating treatment, since the coatings are not in direct contact with the object. For example, acrylates are well suited for surface
15 treatment of concrete, but they have a tendency for chalking, thus losing their reflectivity and visibility. As a second coating treatment agent can now be used e.g. polyurethanes, which have better weather resistance and resistance of colour than acrylates alone. In the second coating treatment, the primer may be coated with a material comprising a light reflecting additive and/or a pigment having a
20 luminescence effect. This way, for example, tinted concrete structures in traffic environment are made more durable and better visible.

In one embodiment, a reflective fabric or a reflective thermoplastic plastic is attached to the surface or part of the surface of the porous object. The fabric or plastic may
25 be of, or it may be coloured with, an approved safety colour or reflective colour. Under the effect of the underpressure according to the invention, the fabric or plastic can be firmly adhered to the material to be coated. The entire porous object and/or said fabric or plastic can be surface treated, for example with a durable lacquer. The surface treatment can be done, for example, with polyurethane lacquer.

30

In one embodiment of the invention, the object treated with the primer and the second surface treatment is treated with a third surface treatment. In the third surface treatment, e.g. at least some of the second surface treatment agent can be

applied with a high gloss lacquer. This provides a paint coating that is protected by a durable high gloss lacquer. A third surface treatment, in particular with a high gloss lacquer, provides a water-repellent and dirt-repellent coating e.g. for a traffic environment object. Thus, for example, when a tire hits the object, rubber traces do not stay on it as easily as in existing coatings. The third surface treatment can be done, for example, with polyurethane lacquer.

The apparatus and method according to the invention can be used for many different objects. For example, the invention is suitable for objects in outdoor or otherwise challenging conditions, such as surface treatment of well rings, swimming pools, shipyard pools and road paintings.

The invention provides several advantages. Applying the primer is fast, as each submerged spot of the object is immediately covered with a sufficiently thick primer layer. The primer coverage is smooth, as openings and or poorly applied areas can be minimized or completely avoided. The amount of impurities, such as debris, entering the primer can be minimized. Application can be controlled precisely because it is easy to apply exactly desired pressure to the liquid and it is easy to control the immersion time as desired. By immersing in a liquid, it is possible to limit the application precisely just at the liquid surface without any special limiter walls, tapes, etc. By immersion in a fluid, the primer can be applied to many different objects, all materials, different shapes, large and small objects.

BRIEF DESCRIPTION OF THE FIGURES

The invention is described in more detail below with reference to the enclosed schematic drawing, in which
Figure 1 shows an apparatus according to the invention in three different situations.

DETAILED DESCRIPTION OF THE EXAMPLES OF THE FIGURES

Figure 1 shows a device 1 according to the invention in three different stages of the method according to the invention. The lower part 2 of the device forms a basin, which in the situation of the pictures is filled with a primer, so-called primer coating.

The upper part 3 of the device has an empty space. The upper and lower parts together form a tight pressure vessel. Fig. 1 shows no pressure control means such as pumps and valves.

- 5 Figure 1 schematically illustrates the movement of a curb with white arrows, black small arrows illustrate movement of gases between the device and its environment, and black large arrows illustrate change of process steps.

10 In the left figure of Figure 1, a street curb 4 made of concrete is brought to the top of the device from a door or the like. The figure does not show a door, or an elevator mechanism included in the device to which the curb is supported. Air is now sucked out of the device and underpressure is accomplished in the device. This way air and other gases are removed from the pores of the curb 4. The water and any other substances in the pores are gasified. Gaseous substances are released from the
15 device by pressure control means.

In the situation of the centre view of Figure 1, the underpressure treatment has lasted for a desired time, and the curb 4 is lowered by the elevator device into the basin 2. Thus, the curb is completely embedded in the primer. After a desired time,
20 the pressure in the device is started to be raised by releasing air to the top part of the device 3. The pressure is allowed to return to normal atmospheric pressure, or it can even be raised to a considerably high overpressure. The pressure effectively pushes the primer into the pores of the curb 4, at least partially filling them. The edge stone is kept in the primer and a desired pressure is maintained in the device
25 1 for a desired time.

In the situation of the right-hand image of Figure 1, the curb 4 is lifted by the elevator device back to the upper part 2 of the device, away from the primer basin. Any overpressure in the device is lowered to normal atmospheric pressure and the
30 treated curb 4 is removed from the device 1.

After drying, the curb 4 may be treated with, for example, a yellow or white paint comprising a light reflecting additive. The painted curb can still be lacquered.

The invention is not meant to be limited to the described examples, but the scope of protection is defined by the independent claims. The dependent claims present some advantageous embodiments of the invention.

CLAIMS

1. Method for treating an object (4) comprising concrete, asphalt and/or porous metal such as galvanized iron, where the method comprises at least the following steps:
- 5 – subjecting the object (4) to underpressure and thereby removing water and other substances from pores, cracks and/or other openings of the object;
- applying primer to the pores, cracks, and/or other openings of the object (4), thereby reducing porosity of the object to be treated;
- 10 **characterised** by that
- when applied, the object (4) is completely or partially immersed in the primer.
2. A method according to claim 1, **characterised** by treating an object (4) of traffic environment.
- 15 3. A method according to claim 2, **characterised** by treating at least one of the following: concrete street curb (4), concrete curb support system of a pedestrian crossing, precast concrete element for road construction site, road surface paving, highway metal railing, metal bolt of a highway railing, metal fastening plate of a bolt
- 20 of highway railing, metal lighting pole, traffic sign.
4. A method according any previous claim, **characterised** by drying the object (4) with a dryer before subjecting it to underpressure.
- 25 5. A method according any previous claim, **characterised** by enhancing transferring of the primer to the pores, cracks and/or other openings of the object (4) by increasing ambient pressure on the object when the primer is applied to the object.
- 30 6. A method according claim 5, **characterised** by increasing ambient pressure to normal atmospheric pressure of 1 bar i.e. approximately 101 kPa.

7. A method according to claim 5 or 6, **characterised** by increasing ambient pressure with a pressurizing device to higher than normal atmospheric pressure, e.g. to over 5 bar or over 10 bar.
- 5 8. A method according to claim 5, 6 or 7, **characterised** by that during the increasing of ambient pressure the object (4) is immersed in a liquid primer.
9. A method according to any previous claim, **characterised** by treating the primer treated object (4) with a second surface treatment, wherein a second surface treatment agent is applied to the primer, the second surface treatment agent comprising at least one of: polyurethane, light reflecting additive, pigment with luminescence effect, reflective fabric or reflective thermoplastic plastic.
- 10 10. A method according to claim 9, **characterised** by treating the object (4) with primer and second surface treatment with a third surface treatment, wherein high gloss lacquer is applied on at least part of the second surface treatment.
- 15 11. Apparatus (1) for treating an object (4) comprising concrete, asphalt and/or porous metal such as galvanized iron, the apparatus comprising
- 20 – a vacuum chamber (3) for subjecting the object (4) to underpressure using an underpressure device, in order to remove water and other substances from pores, cracks and/or other openings of the object (4);
- a primer applicator (2) for applying primer to the pores, cracks, and/or other openings of the object (4),
- 25 **characterised** by that the primer applicator comprises a primer basin (2) and means for immersing the object in the primer basin completely or partially.
12. An apparatus according to claim 11, **characterised** by that it comprises a dryer for drying the object (4) before subjecting it to underpressure.
- 30 13. An apparatus according to claim 11 or 12, **characterised** by that it comprises a pressurizing device in order to increase ambient pressure to higher than the normal atmospheric pressure, e.g. to over 5 bar or over 10 bar, in order to enhance

transferring of the primer to the pores, cracks and/or other openings of the object (4).

14. An apparatus according to any claim 11 to 13, **characterised** by that the means
5 for immersing the object in the primer basin comprises an elevator device.

15. An apparatus according to claim 14, **characterised** by that the elevator device is an electric crane or a lever solution hand-operated from outside the apparatus.

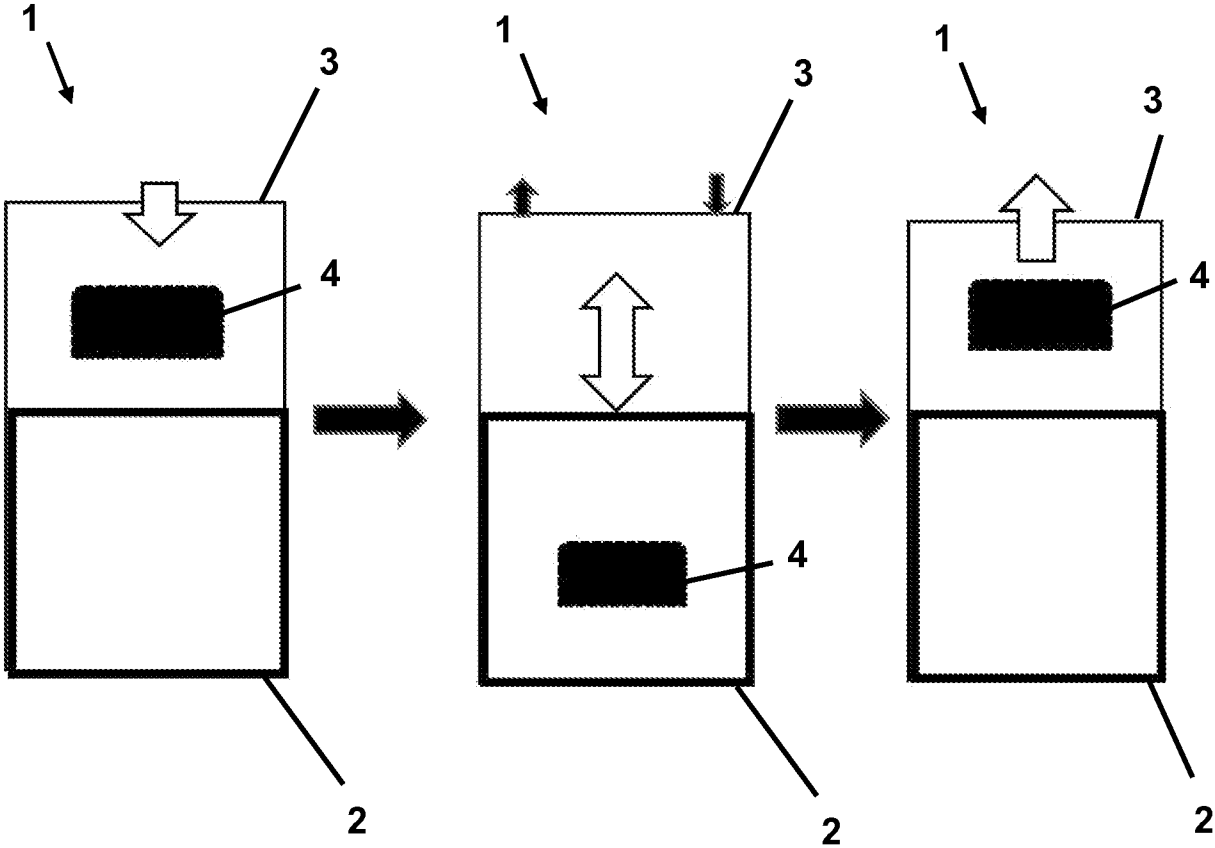


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2019/050001

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B03D, B05D, B28B, C04B, C09D, E01C, E01F, E04F, E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)

EPODOC, EPO-Internal full-text databases, Full-text translation databases from Asian languages, WPIAP

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009176020 A1 (VAEREWYCK GERARD J [US]) 09 July 2009 (09.07.2009) whole document, especially paragraphs [0005], [0009]-[0013], [0029], [0038]; figures 1, 2 and 10, cited in the application	1-8, 11-15
Y		9, 10
Y	WO 2010036522 A1 (DOW GLOBAL TECHNOLOGIES INC [US]) 01 April 2010 (01.04.2010) whole document	9, 10
A	WO 9400651 A1 (TECHSTONE KINNA AB [SE]) 06 January 1994 (06.01.1994) whole document, especially page 5, lines 4-18; figure 3	1-15
A	DE 3930281 A1 (TONCELLI DARIO [IT]) 15 March 1990 (15.03.1990) abstract [online] EPOQUENET EPODOC & WPI	1-15

☒ Further documents are listed in the continuation of Box C.
☒ See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2019/050001

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4169909 A (MILNE JAMES [GB]) 02 October 1979 (02.10.1979) whole document, especially column 1, lines 6-24; column 3, lines 12-64; figures 1-3	1-15
A	DE 2134811 A1 (LANGSTRAAT CORNELIA) 01 February 1973 (01.02.1973) whole document, especially figure & abstract [online] EPOQUENET EPODOC & WPI	1-15

INTERNATIONAL SEARCH REPORT
Information on Patent Family Members

International application No.
PCT/FI2019/050001

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CLASSIFICATION OF SUBJECT MATTER

IPC

B28B 11/04 (2006.01)**B28B 19/00** (2006.01)**E01C 5/06** (2006.01)**E01C 11/22** (2006.01)**E01C 11/24** (2006.01)**E01C 19/12** (2006.01)**E01C 23/02** (2006.01)**E01F 9/535** (2016.01)**E01F 9/541** (2016.01)**E01F 9/518** (2016.01)**E01F 9/60** (2016.01)**E04G 23/02** (2006.01)**C04B 41/45** (2006.01)**C09D 5/33** (2006.01)**B05D 3/00** (2006.01)**B05D 5/00** (2006.01)