Abstract: The present invention relates to a roof-covering element, with an upper surface and a lower surface, whereby for roof covering a plurality of elements is juxtaposed in a particular way such that neighboring elements are interconnected by means of an interlocking arrangement, and whereby the roof-covering element comprises means for exchanging heat with the environment, where at least one of the surfaces of the element is at least partially made of a metal alloy. The particular roof-covering element can in particular be made of an alloy comprising any combination of copper (Cu), zinc (Zn), manganese (Mn) and iron (Fe), i.e., the alloy CuZn, Mn, Fe. The roof-covering element according to the present invention can also comprise a cavity, provided inside the element (10), in which a fluid is circulable for heat exchange with the environment. The roof-covering elements according to the present invention can be interconnected by means of a tubing system for the circulation of the fluid between different elements.
Roof-covering element

Technical Field

The present invention relates to a roof-covering element, having an upper surface, a lower surface and an interlocking arrangement for interconnecting neighbouring elements, whereby a plurality of elements is juxtaposed in a particular way for roof covering. The present inventions relates in particular to such a roof-covering element which comprises means for heat exchange with the environment.

Background Art

The roof, i.e. the top covering of a building, can essentially be found on each and every building in the world. On one hand, the purpose of a roof is to shed rain water off the building and to prevent it from accumulating on top of the building. On the other hand, roofs have a more and more important decorative function. To realise these objectives, roofs can be built with different forms and shapes and using many different materials. With respect to the form, roofs can be highly pitched (sloped) or low sloped in form. While pitched roofs are in general found on industrial or commercial type structures, low sloped roofs are the primary design found on residential homes. As roofs are fully faced toward the sky, they must resist to all weather conditions. In particular, they have to be watertight, secure, durable, attractive and elastic enough to withstand important temperature shifts without cracking. Subsequently, roof-building techniques and roofing materials have been refined continuously for centuries to bear roofs of considerable strength and durability.

Over the millennia, people have surfaced their homes with just about anything that would hold the weather out, from animal skins to tree bark. Today, there are many roofing options with respect to the material, colour, shapes etc.. The use of different roofing materials depend largely on particular weather conditions, but also and aesthetic criteria. Traditional roof coverings - slate and wood shakes - have remained virtually unchanged for centuries. On
the other hand, new materials such as asphalt/fibreglass composites, lightweight concrete and metal tiles are products of the technological revolution. Each of these materials has slightly different durability, appearance, cost and ease of application. Furthermore, contemporary roofs are complex systems, made up of a variety of components that work together.

In the last decades, the so called solar roofing systems have increasingly been used for roof covering. These systems are designed in such a way to be able to generate electricity and/or to produce hot water or hot air, in addition to act as a roof covering. Typically, these systems make use of the so called solar cells. A solar (or photovoltaic) cell is a piece of equipment that is capable of converting the solar energy into another kind of energy. An assembly of solar cells is generally referred to as a solar panel. Historically, solar cells and panels have been used in cases where electrical power from the grid were unavailable. Recently, solar cells have though been more and more used as a source of "clean" or alternative energy, in contrast to "dirty" power from nuclear power plants.

Solar systems can be built-in in roofs in many different ways. On the one hand, solar cells can be directly integrated in the covering of pitched roofs. These systems are usually referred to as solar shingles. Essentially, solar shingles are solar cells shaped like a conventional (slate or ceramic) shingle. They are designed to fit nicely onto many different types roofs and to be compatible with regular shingles. Nevertheless, solar systems can also be mounted on an existing roof, e.g. solar panel on a tile roof, or integrated in a flat roof.

However, all known solar roofing systems present a number of huge disadvantages compared with regular roofs. To start with, all solar panels have a deep, dark, purplish-blue colour, such that roofs covered with the solar roofing systems look completely different than other roofs. Moreover, the installation of solar roofing systems is prohibited in different circumstances, i.e. in particularly old buildings or buildings of a particular historical relevance. Moreover, the majority of solar cells has an important dazzling effect, which can be a source for important inconvenience in the entire neighbourhood. An additional
problem of conventional solar systems arise in connection with the integration of these solar systems in existing roofs. As solar roofing systems become increasingly popular, more and more house proprietors wants to replace existing roofs by solar roofs. Nevertheless, solar panels represent an additional weight for the underlying roof constructions, such that installing solar panels is often possible only after a thorough renovation of the whole roof structure. Similar problems arise with solar shingles, where the replacement of conventional shingles usually requires a new static calculations and an important modification of the roof support.

On the other hand, the so called geothermal exchange heat pumps or ground source heat pumps (GSHP) become also a more and more popular source of energy for heating buildings. These ground sorce heat pumps use the Earth as either a heat source, when operating in heating mode, or a heat sink when operating in cooling mode. Geothermal heat pumps have an external loop containing water or a water/antifreeze mixture, and a much smaller internal loop containing a refrigerant. Both loops pass through the heat exchanger. There are also the so called air source heat pumps (ASHP), which use the same principle but extract the heat from the air, rather than the ground. Thus, the installation of these pumps is simpler and cheaper.

However, these air source heat pumps present the drawback that, in the cooling mode, the evacuation of the superfluous heat is sometimes difficult. Some systems using air source heat pumps employ therefore additional cooling devices, such as ventilators, in order to draw off the heat. These ventilators are an additional annoyance for the neighbours and contribute also to the high costs of these systems.

Disclosure of Invention

It is thus an objective of this invention to propose a new and improved roof-covering element that does not present the above-mentioned inconveniences and disadvantages of the prior art.
According to the present invention, these and other objectives are achieved in particular through the features of the independent claims. In addition, further advantageous embodiments follow from the dependent claims and the description.

In particular, this objective is achieved through the invention in that, in a roof-covering element, having an upper surface and a lower surface, whereby for roof covering a plurality of elements is juxtaposed in a particular way such that neighbouring elements are interconnected by means of an interlocking arrangement, and whereby the roof-covering element comprises means for exchanging heat with the environment, at least one of the surfaces of the element is at least partially made of a metal alloy. The advantage of such a device is, among other things, that the roof-covering element can be produced of a natural material. A metal alloy is a particularly suitable material for this purpose, as the kind of alloy and the mixing ratio of the different compounds can be chosen to satisfy all different requirements of the particular roof. In particular, an iron or aluminium alloy can be used in connexion with modern buildings, where the silvery shine of these materials can be particularly advantageous. In addition, a particular metal alloy to be used can be chosen in function of its thermal or mechanical characteristics for an optimal protection against atmospheric conditions and environmental influences.

In an embodiment variant, the metal alloy comprises any combination of copper (Cu), zinc (Zn), manganese (Mn) and iron (Fe). This embodiment variant has the particular advantage, among other things, that the metal alloy comprising a combination of these components has a particularly advantageous proprieties with respect to the thermal, mechanical and chemical aspect. Thus, a roof-covering device made of this kind of metal alloy is particularly suitable for the realisation of the present invention.

In another embodiment variant, the metal alloy comprises the alloy CuZn\textsubscript{40}Mn\textsubscript{2}FeI. The alloy CuZn\textsubscript{40}Mn\textsubscript{2}FeI has the particular mechanical characteristics, that make it very suitable for the present invention. In particular, this alloy, known also under the trademark DORNA-A® has a particular surface colour that is not substantially different from the colour of the conventional tiles.
or other similar roof-covering elements. Thus, a roof-covering element according to this embodiment of the present invention has the advantage of being very easily interchangeable with the conventional roof-covering elements.

In another embodiment, a cavity is provided inside the element, between the upper surface and the lower surface of the element, whereby a fluid is circulable in the cavity for heat exchange with the environment. The advantage of this embodiment is, inter alia, that a fluid can be brought to circulation inside the roof-covering device for heat exchange with the environment. The roof-covering element offers a good platform for heat exchange between the fluid and the outside air, through natural convection. Moreover, the sun light can heat the fluid inside the cavity of the roof-covering element such that the heat exchange can work in both directions (i.e. cooling or heating of the fluid). In this way, the building with the roof made of roof-covering elements according to this embodiment of the present invention can be heated or cooled, depending on the needs. Moreover, this particular embodiment of the present invention allow a good collaboration with air source heat pump systems, where the superfluous heat can easily be dissipated in the environment.

In a further embodiment, at least one nipple with an opening is provided in at least one surface of the element, whereby the opening of the nipple is connected with the cavity. This embodiment has the advantage, among other things, that the fluid can easily be filled in the cavity, or extracted from the cavity of the roof-covering element. The nipple has in addition the advantage that a tube or another similar device can be easily attached to it and thus to the roof-covering element, for circulating the fluid.

In a further embodiment, the cavity comprises a channelling system. The advantage of this embodiment is, among other things, that the internal surface of the cavity of the roof-covering element can be increased, such that the heat exchange with the environment can be facilitated. Using an appropriate channelling system, the internal surface can be significantly increased, such that a much better heat exchange rate can be achieved in comparison with similar other devices without such a channelling system.
In another embodiment of the present invention, the upper surface and/or the lower surface of the element comprises a fin structure. The fin structure can in particular be formed similar to the structure of a radiator or a similar device. The advantage of this embodiment is, among other things, that the particular fin structure of the surface of the roof-covering element allows to render possible a very efficient heat exchange with the environment. As at least one of the surfaces of the roof-covering element in a preferred embodiment is at least partially made of a metal alloy, the heat exchange with the environment can be accelerated and expedited using the special fin structure with a larger surface.

In another embodiment, the fluid is water and/or an aqueous solution. Water is very suitable for heat exchange thanks to its advantageous thermal characteristic. In the same way, aqueous solutions, in particular solutions with an antifreeze matter help to achieve an even more important effect.

At this point, it should be stated that, besides the roof-covering element according to the particular embodiments of the invention, the present invention also relates to an assembly of roof covering elements, a heat exchange system in a building or similar structures, a method of manufacture of a roof-covering element and a method for roof covering using the roof-covering element according to the present invention.

Brief Description of Drawings

The present invention will be explained in more detail, by way of example, with reference to the drawings in which:

Figure 1 is a perspective representation of a conventional roof-covering element;

Figure 2 is a perspective representation of an assembly of conventional roof-covering elements of Figure 1, which are juxtaposed in rows and
columns and interconnected by means of an interlocking arrangement for covering one part of the roof;

Figures 3a and 3b are sectional representations of two embodiments of the roof-covering element according to the present invention;

Figure 4 are perspective representations of an assembly of roof-covering elements according to the present invention with the corresponding tubing arrangement; Figure 4a shows the tubing arrangement being attached to the roof-covering elements; Figure 4b shows the tubing arrangement being separated from the roof-covering elements;

Figure 5 is a view from below of an assembly of roof-covering elements according to the present invention with the corresponding tubing arrangement;

Figure 6 are sectional representations of the assembly of roof-covering devices according to the present invention of Figure 5; Figure 6a is the sectional representation taken along the line B-B of Figure 5; Figure 6b is the sectional representation taken along the line A-A of Figure 5.

**Description of Specific Embodiments of the Invention**

Figure 1 illustrates a conventional roof-covering element 10, generally referred to as a tile. In Figure 1, the reference numeral 11 refers to an upper surface of the roof-covering element 10. The upper surface of the roof-covering element 10 can have different forms and profiles, and can also present different patterns, colours or structures. The upper surface 11 of the roof-covering element 10 can in particular be treated by mechanical or chemical means in order to achieve a particular optical, mechanical or thermic effect. The upper surface 11 of the roof-covering element 10 can also have a particular glaze or similar coating. In addition, the roof-covering element 10 in Figure 1 possesses an interlocking arrangement 13, 14, 15, which is used for interconnecting adjacent roof-covering elements 10 when they are used in roof covering.
This interlocking arrangement 13, 14, 15 is basically built-up of both horizontal and vertical beads 13, 14 and grooves 15 in the peripheries of the roof-covering element 10 which work together to interconnect safely neighbouring elements 10 into a continuous assembly. It is well understood that the interlocking arrangement 13, 14, 15 can comprise additional interlocking, fastening and/or binding means (such as clamps or nails) for a safe and stable interconnecting, fastening and binding of neighbouring elements 10 on the roof.

An assembly of conventional roof-covering elements 10 of Figure 1, which are juxtaposed in rows and columns and interconnected by means of the interlocking arrangement 13, 14, 15 for covering one part of the roof is shown in Figure 2. The reference numeral 20 in Figure 2 refers to framework bars which function as support for the roof-covering elements 10. Typically, the framework bars 20 are made of wood. However, the framework bars 20 could also be made of any other suitable material. The roof-covering elements 10 are hung from the framework bars 20 in a number of parallel rows, whereby each row overlaps the row below it to exclude rainwater. As mentioned above, additional fastening means could be used in order to safely fasten the roof-covering elements 10 to the roof. The particular arrangement of the roof-covering elements 10 therefore also allows to hide the fastening means (i.e. nails or hooks) that sustain the row situated immediately below. As a matter of course, different other ways of covering roofs using the roof-covering elements 10 are imaginable, particularly with respect to the way in which the roof-covering elements 10 are arranged and/or interconnected.

Examples of the roof-covering element 10 according to different embodiments of the present invention are shown in Figure 3: Figure 3a illustrates a sectional representation of the roof-covering element 10 according to a first embodiment of the present invention, and Figure 3b illustrates a sectional representation of the roof-covering element 10 according to a second embodiment of the present invention. In Figure 3a, the reference numeral 11 refers again to an upper surface of the roof-covering element 10 and the reference numeral 12 to a lower surface of the roof-covering element 10. As it can be seen in Figure 3a, the upper surface 11 of the roof-covering element 10 can have a particular shape or profile, which can be chosen based on aesthetic, functional, architec-
tural or any other criteria. Although the upper surface 11 of the roof-covering element 10 in Figure 3a has a concave profile, the profile or shape of the upper surface 11 of the roof-covering element 10 can have any other form, including a convex or flat profiles. The lower surface 12 of the roof-covering element 10 is basically flat, although other shapes of the lower surface 12 are possible. Nevertheless, as the lower surface of the roof-covering element 10 is basically not exposed to views, its shape can be chosen in any way, as soon as it does not limit the functionalities of the roof-covering element 10.

The roof-covering element 10 of the first embodiment of the present invention in Figure 3a also comprises the interlocking arrangement 13, 14, 15, consisting of beads 13, 14 and grooves 15. The beads 13, 14 and grooves 15 of the interlocking arrangement 13, 14, 15 are designed in such a manner that they are able of easily interconnecting neighbouring roof-covering elements 10. In particular, the bead 14 is designed to work together with the groove 15, while the bead 13 is designed to work together with the groove on the lower face of the bead 14. Moreover, the roof-covering element 10 comprises typically other beads and grooves extending in a direction perpendicular to the section plane in Figure 3a. It is however obvious, that the roof-covering element 10 can be provided with other means allowing an easy and reliably interconnection of adjacent elements 10. In this manner, any roof can be covered with continuous rows and columns or any other assembly consisting of individual roof-covering elements 10. The roof-covering element 10 of the first embodiment of the present invention in Figure 3a comprises a recess 14a in the bead 14. The recess 14a can in particular be used for deploying a fastening or binding means which can be used for a better hold between two roof-covering elements 10. In this manner, the interconnection between two elements 10 can be strengthened in order to achieve a particularly secure and resistant roofs, even under very bad weather conditions. Of course, fastening or binding means for reinforcing this interconnection can also be placed at a different place on the roof-covering element 10. On the other hand, the recess 14a can be used to adjust correspondingly the weight of the roof-covering element 10, when necessary.

The upper surface 11 and the lower surface 12 of the roof-covering element 10, as well as the interlocking arrangement 13, 14, 15 and other parts
of the roof-covering element 10 can be made of a same material. One or vari-
ous parts can however be made of a material which is different than the mate-
rial of the other parts. In particular, at least the upper surface 11 of the roof-co-
vering element 10 can at least partially be made of a metal alloy. This metal
alloy can in particular comprise a combination of copper (Cu), zinc (Zn), man-
ganese (Mn) and iron (Fe). However, this metal alloy can also comprise any
other combination of these or other metals. This metal alloy can also contain
non-metal substances, which are particularly necessary or advantageous for
achieving special properties of the alloy. At the same time, the other parts of
the roof-covering element 10 can be made of another material, in particular of
another metal or metal alloy, but also of non-metal materials such as clay, ce-
ramic, glass, plastics or other synthetic materials. For example, the upper sur-
face 11 of the roof-covering element 10 can be made of a first metal alloy, the
lower surface 12 of the roof-covering element 10 of a second metal alloy, and
the interlocking arrangement 13, 14, 15 of a third metal alloy. It can be appre-
ciated that any other combination of materials is possible, without leaving the
general inventive concept of the present invention.

The reference numeral 16 in Figure 3a refers to a cavity, formed in-
side the roof-covering element 10, between the upper surface 11 and the lower
surface 12. The size, shape and dimensions of the cavity 16 can vary without
changing the fundamental idea of the present invention. In particular, this cav-
ity 16 can extend over the whole area of the roof-covering element 10, but also
comprise just a small area compared with the overall area of the roof-covering
element 10. The cavity 16 is formed in such a way that a fluid can circulate
inside the cavity 16. The fluid can in particular be water or a particular aque-
ous solution, but can basically be any other suitable fluid. The used fluid can in
particular also be an water/antifreeze solution, which can be used in a very im-
portant temperature range without any difficulties caused by low temperatures.
In particular suitable antifreezes are propylene glycol, denatured alcohol and/or
methanol). As fluid is confined in the cavity 16 inside the roof-covering element
10 between the upper surface 11 and the lower surface 12, the heat exchange
between the fluid and the environment can easily be realised. In particular, the
upper surface 11 of the roof-covering element 10 stands in an continuous con-
tact with the outside air, such that the temperature difference between these
two media can lead to the heating or cooling of the fluid inside the roof-covering element 10 without any additional action or mechanism. Moreover, metal alloys in general and particularly alloys containing copper have very advantageous thermal characteristics, such that the heat exchange with the environment can be realised in an optimal way. In addition, being exposed to the sun, the upper surface 11 of the roof-covering element 10 is particularly subject to a very important heating up, in the way that the fluid inside the cavity 16 of the roof-covering element 10 can easily achieve very high temperatures.

Furthermore, the roof-covering element 10 according to the first embodiment of the present invention in Figure 3a comprises a nipple 17, which on its own comprises an opening 17a. The nipple 17 in Figure 3a is formed in the lower surface 12 of the roof-covering element 10. It is however evident that the nipple 17 can be formed in any other place on the roof-covering element 10, including in particular the upper surface 11, the interlocking arrangement 13, 14, 15, or side surfaces of the roof-covering element 10. Of course, the roof-covering element 10 can comprise more than one nipple 17, if required. The opening 17a of the nipple 17 is connected with the cavity 16 in such a way that the fluid can enter and/or leave the cavity 16 through the opening 17a of the nipple 17. The roof-covering element 10 can i.e. comprise a tap for closing the opening 17a of the nipple 17, once the fluid has been filled in or evacuated from the cavity 16. In this way, the cavity 16 of the roof-covering element 10 can be filled with the fluid for heat exchange with the environment and emptied after the fluid has reached the desired temperature.

A second embodiment of the roof-covering element 10 according to the present invention is illustrated in Figure 3b. The second embodiment of the roof-covering element 10 according to the second embodiment of the present invention has a very similar structure as the roof-covering element 10 according to the first embodiment of the present invention. The same reference numerals are again used to refer to the same components: the reference numeral 11 refers to the upper surface and the reference numeral 12 to the lower surface of the roof-covering element 10. The reference numerals 13, 14, 15 refer to the interlocking arrangement, and the reference numeral 16 to the cavity between the upper surface 11 and the lower surface 12 of the roof-covering ele-
merit 10. The reference numeral 17 refers to a first nipple with the opening 17a and the reference numeral 17' to a second nipple which has basically the same structure and function as the first nipple 17. The cavity 16 in this second embodiment of the present invention comprises a channelling system 18. The channelling system 18 comprises various furrows and twists which increase significantly the inner surface of the cavity 16. In such a way, the heat exchange between the fluid confined inside the cavity 16 and the environment can be particularly effective. As the walls of the channelling system 18 are directly connected with the upper surface 11 of the roof-covering element 10, the heat exchange between the upper surface 11 and the fluid inside the cavity 16 can also be realised in a very effective and easy way.

As it can be very much appreciated from Figure 3a and Figure 3b, the visual aspect of the roof-covering element 10 according to these two embodiments of the present invention do not differ whatsoever from the optical appearance of a conventional roof-covering element. Their shape, including the shape and function of the interlocking arrangement 13, 14, 15 of the roof-covering elements 10 are designed to reproduce in an exact manner the corresponding elements of a conventional roof-covering elements. Moreover, the use of a particular alloy (i.e. the copper alloy CuZn_{40}Mn_{2}Fe_{1} with its particular properties) allows the roof-covering element 10 according to an embodiment of the present invention to have significantly the same colour as conventional clay-made roof-covering elements but without the need for any additional mechanical or chemical treatment of the surface. Moreover, the roof-covering element 10 of the present invention can preferably be designed in such a way to exhibit also exactly the same weight as a conventional roof-covering element having the same shape. This particular feature allows an easy exchange of existing roof-covering elements and their replacement with the roof-covering elements according to the present invention without need for any additional changes on the roofing structure or other roof elements. On the other hand, the roof-covering element 10 according to these embodiments of the present invention does present the particular advantage of heat exchange, without the above-mentioned disadvantages of the conventional solutions.
Figure 4 shows an assembly of roof-covering elements 10 according to any one of the embodiments of the present invention on a portion of a roof with the corresponding tubing arrangement 25. Figure 4a shows the assembly with the tubing arrangement 25 being attached to the roof-covering elements 10 and Figure 4b shows the same assembly with the tubing arrangement separated from the roof-covering elements 10. As it can be seen, the individual tubes interconnect two elements 10. It is evident for any person skilled in the art that the arrangement of tubes and the choice of interconnection patterns can be varied without departing from the general inventive concept. The tubes are attached to the nipples 17, 17' of the corresponding roof-covering elements 10 and thus interconnect the cavities 16 of the elements 10. In this particular manner, all individual roof-covering elements 10 build a linked system in which the fluid can freely circulate throughout the system. In this system, it is in particular possible to create a fluid flow in a direction, where the fluid enters the system at a first roof-covering element 10 and leaves the system after having visited all roof-covering elements 10 in the assembly. This flow can in particular be supported by means of a pump (not shown) or any other similar device. In this way, an optimal heat exchange can be realised.

Figure 5 is a view from below of an assembly of roof-covering elements 10 according to the present invention with the corresponding tubing arrangement 25. Figure 6 shows sectional representations of the assembly of roof-covering devices 10 according to the present invention, shown in Figure 5. Figure 6a is the sectional representation taken along the line B-B of Figure 5, while Figure 6b is the sectional representation taken along the line A-A of Figure 5. These Figures show one of the possible structures of an assembly of roof-covering elements 10 according to any one of the embodiments of the present invention. The same reference numerals are again used to refer to the same components, the structure and function of which, for simplicity, will not be exposed again.

Although the present disclosure has been described with reference to particular means, materials and embodiments, one skilled in the art can easily ascertain from the foregoing description the essential characteristics of the present disclosure, while various changes and modifications may be made to
adapt the various uses and characteristics without departing from the spirit and scope of the present invention as set forth in the following claims.
Claims

1. A roof-covering element (10), having an upper surface (11) and a lower surface (12), whereby for roof covering a plurality of elements (10) is juxtaponed in a particular way such that neighbouring elements (10) are interconnected by means of an interlocking arrangement (13, 14, 15), and whereby the roof-covering element (10) comprises means for exchanging heat with the environment, characterised in that at least one of the surfaces (11, 12) of the element (10) is at least partially made of a metal alloy.

2. The element (10) according to claim 1, characterised in that the metal alloy comprises any combination of copper (Cu), zinc (Zn), manganese (Mn) and iron (Fe).

3. The element (10) according to claims 1 or 2, characterised in that the metal alloy comprises CuZn_{40}Mn_{2}Fe-I.

4. The element (10) according to any one of the claims 1 to 3, characterised in that a cavity (16) is provided inside the element (10), between the upper surface (11) and the lower surface (12) of the element (10), whereby a fluid is circulable in the cavity (16) for heat exchange with the environment.

5. The element (10) according to any one of the claims 1 to 4, characterised in that at least one nipple (17) with an opening (17a) is provided in at least one surface (11, 12) of the element (10), whereby the opening (17a) of the nipple (17) is connected with the cavity (16).

6. The element (10) according to claim 4 or 5, characterised in that the cavity (16) comprises a channelling system (18).

7. The element (10) according to any one of the claims 1 to 6, characterised in that the upper surface (11) and/or the lower surface (12) of the element (10) comprises a fin structure.
8. The element (10) according to any one of the claims 4 to 7, characterised in that the fluid is water and/or an aqueous solution.

9. An assembly of roof-covering elements (10), comprising at least one roof-covering element (10) according to any one of the claims 1 to 7, characterised in that a tubing arrangement (25) is provided for interconnecting at least two roof-covering elements (10), whereby the fluid is circulable between the roof-covering elements (10) through the tubing arrangement (25).

10. The assembly according to claim 9, characterised in that a pump is provided for circulating the fluid between the roof-covering elements (10).

11. A heat exchange system in a building or a similar structure, using a fluid for heat exchange with the environment, comprising a storage device for storing the fluid, a pump for circulating the fluid in the system and a control device for regulating the heat exchange, characterised in that the heat exchange system comprises at least one roof-covering element (10) according to any one of the claims 1 to 8.

12. A method of manufacture of a roof-covering element (10) according to any one of the claims 1 to 8.

13. A method for roof covering using roof-covering elements (10) according to any one of the claims 1 to 8.
FIG. 1

State of the art
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24J2/04 F24J2/48

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)

F24J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>X</td>
<td>EP 0 335 261 A (YOSHIDA KOGYO KK [JP]) 4 October 1989 (1989-10-04) column 3, line 13 - column 4, line 44; figures</td>
<td>1,2,4-6, 9-13</td>
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<td>X</td>
<td>DE 32 47 029 A1 (WEBER HELGA [DE]) 20 June 1984 (1984-06-20) page 14, lines 4-34; figures 14,15</td>
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* Special categories of cited documents
   'A' document defining the general state of the art which is not considered to be of particular relevance
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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

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& document member of the same patent family

Date of the actual completion of the international search: 14 December 2007

Date of mailing of the international search report: 20/12/2007

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