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(54) **SOLAR COLLECTOR AND METHOD FOR MANUFACTURING SUCH A SOLAR COLLECTOR**

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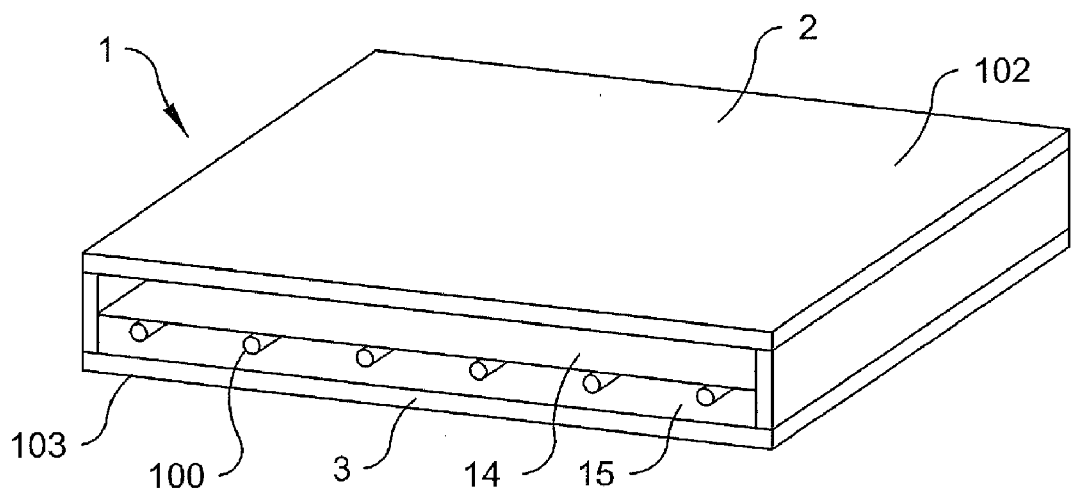
(57) **ABSTRACT**

A solar collector is provided having an absorber (**100**), which has a front side (**102**) facing toward the solar radiation during use and a back side (**103**) facing away from the solar radiation during use, a transparent cover (**200**) arranged essentially plane-parallel opposite the front side (**102**) of the absorber (**100**), and a back wall (**300**) arranged opposite the back side (**103**) of the absorber (**100**). The solar collector distinguishes itself in that the back wall (**300**) is constructed as a transparent pane, in particular a glass pane or plastic pane, and contains, at least in some regions, a medium which reflects infrared radiation and is reflective in the direction of the back side (**103**) of the absorber (**100**). Further, a composite pane is provided, in particular a composite glass pane (**1**), an absorber (**100**), and a use of such an absorber (**100**) in solar collectors and composite panes. This absorber can also have a coating for the reduction of heat emission (low-e).



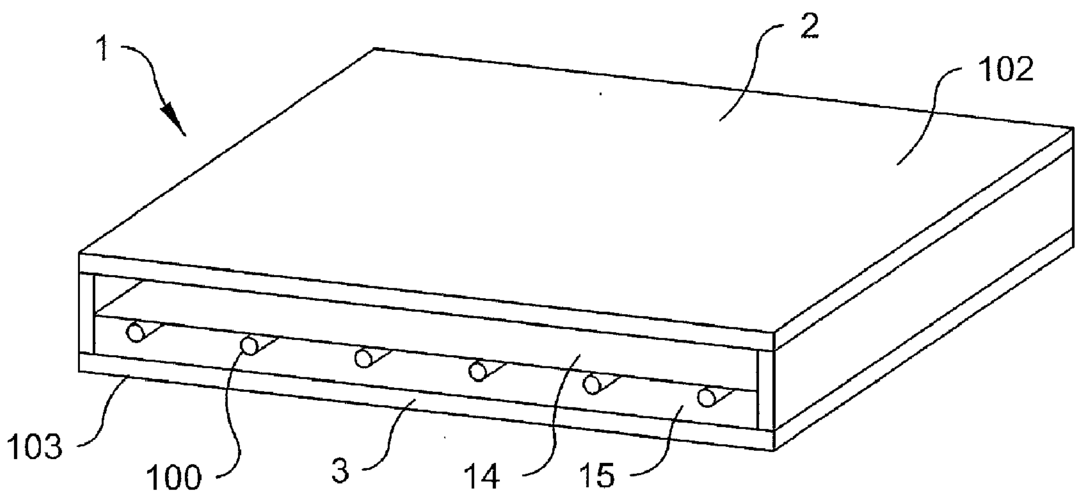


Fig. 1

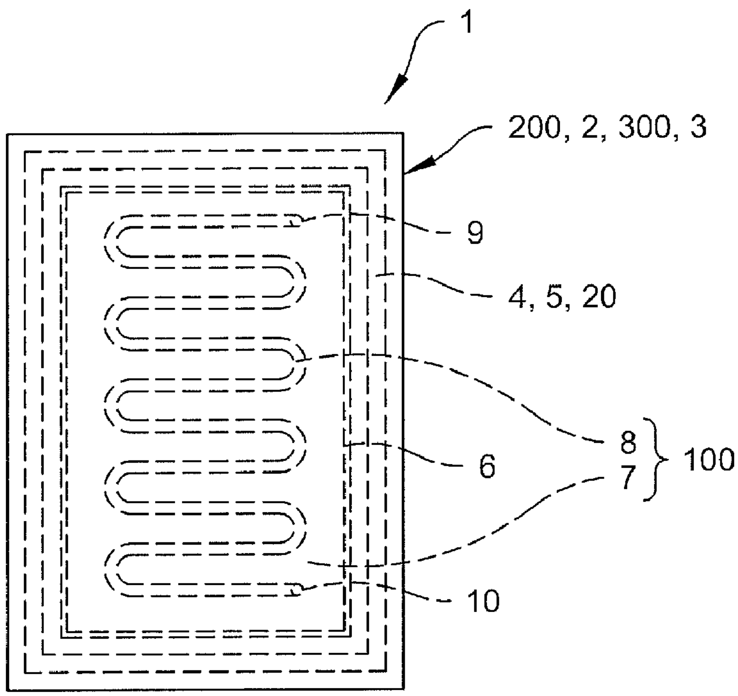

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Fig. 2

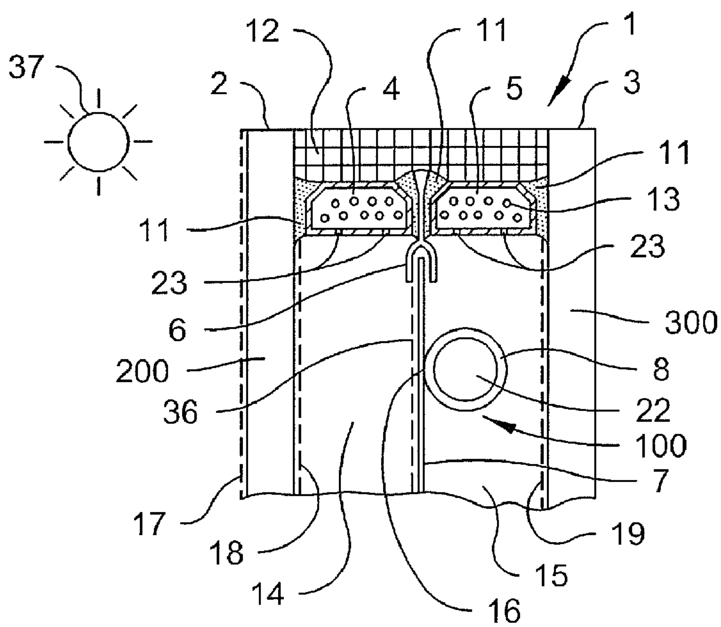
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Fig. 3

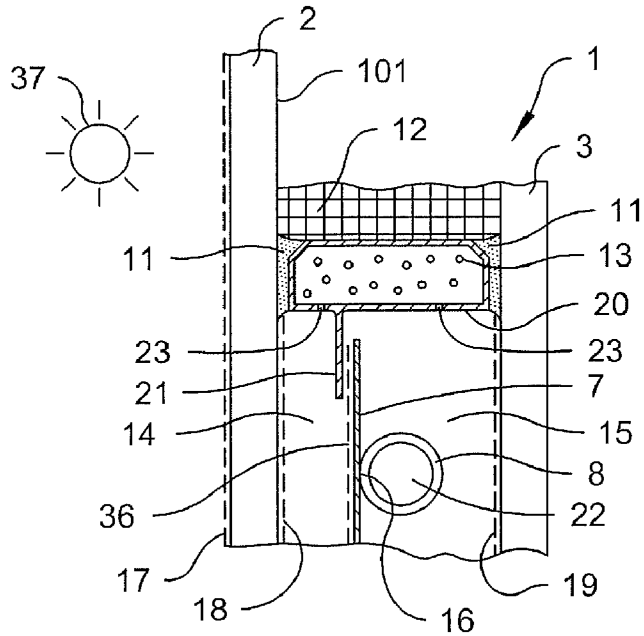
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Fig. 4

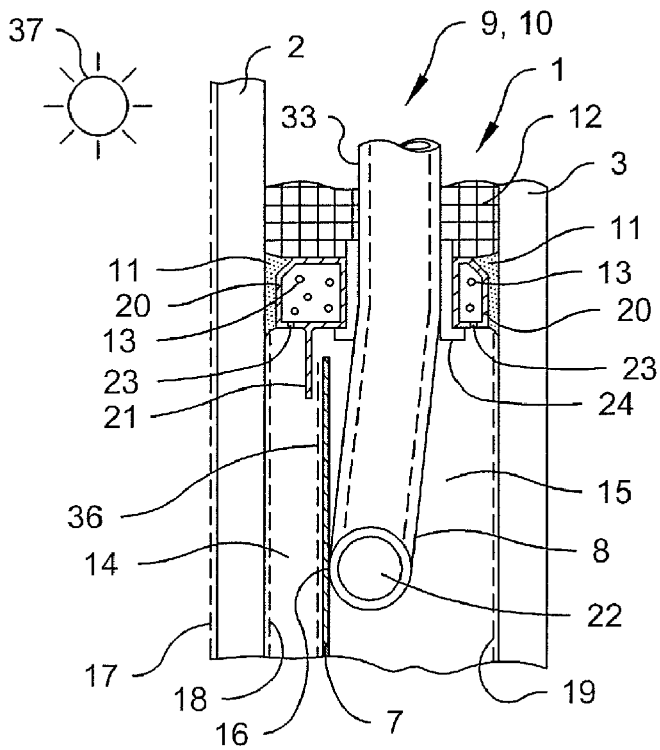
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Fig. 5

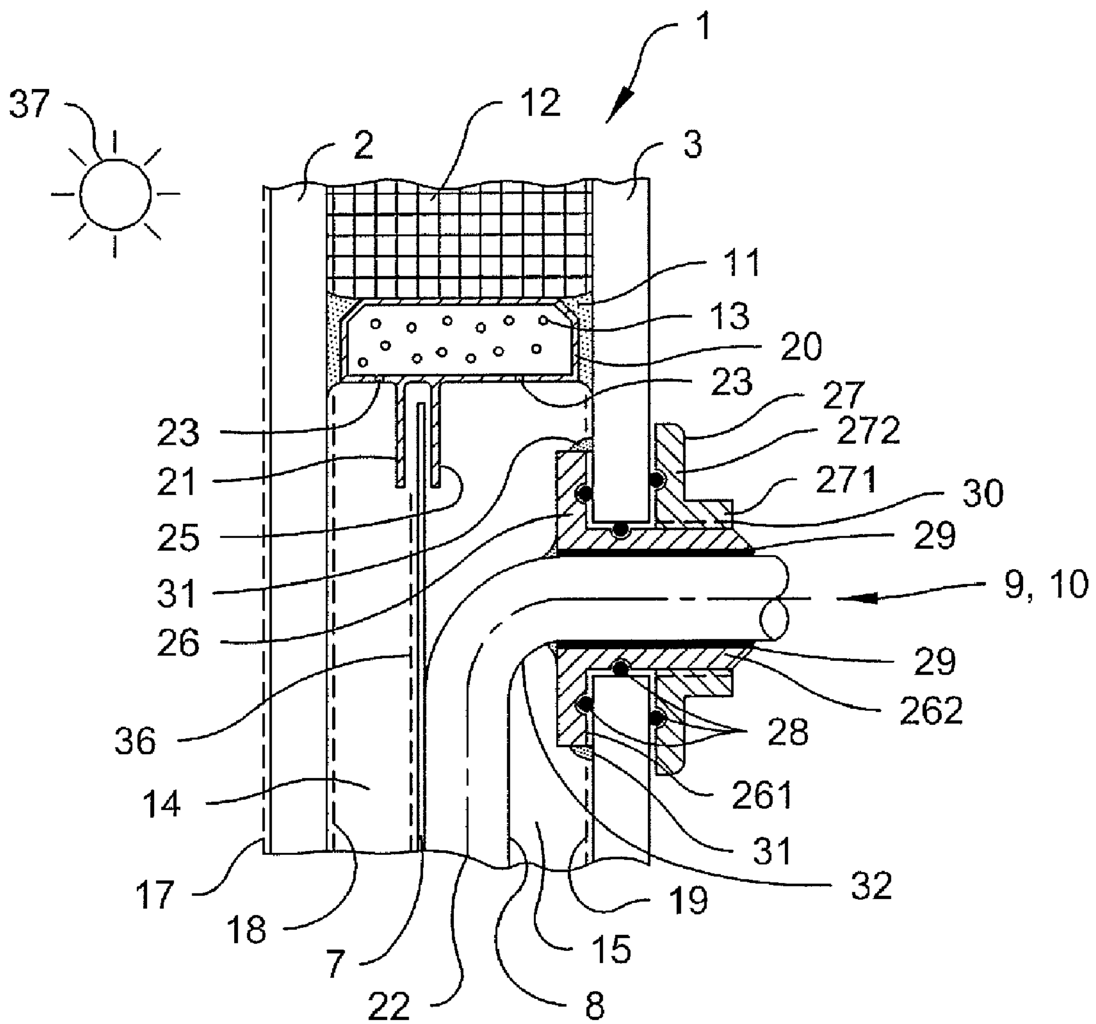
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Fig. 6

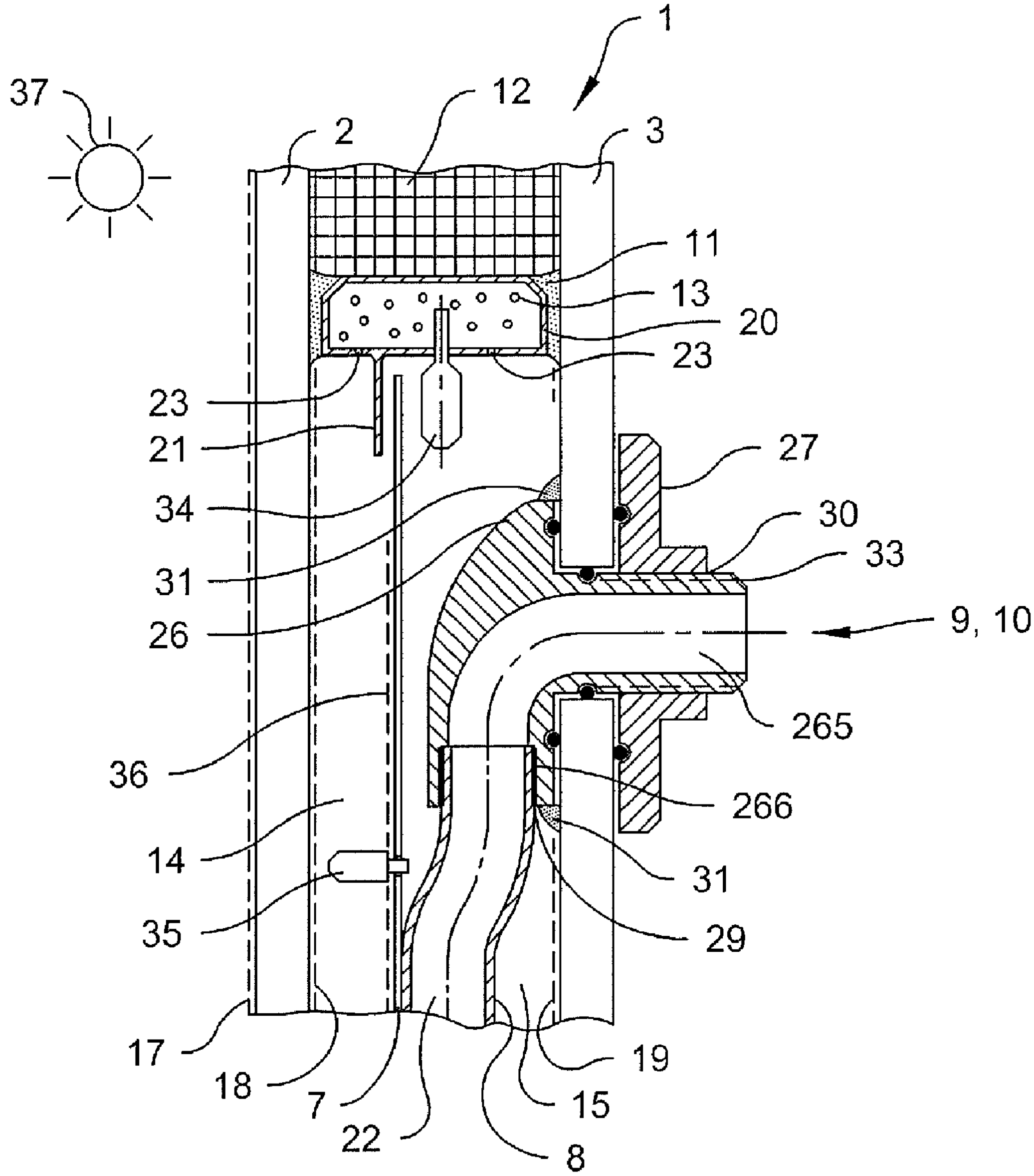
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Fig. 7

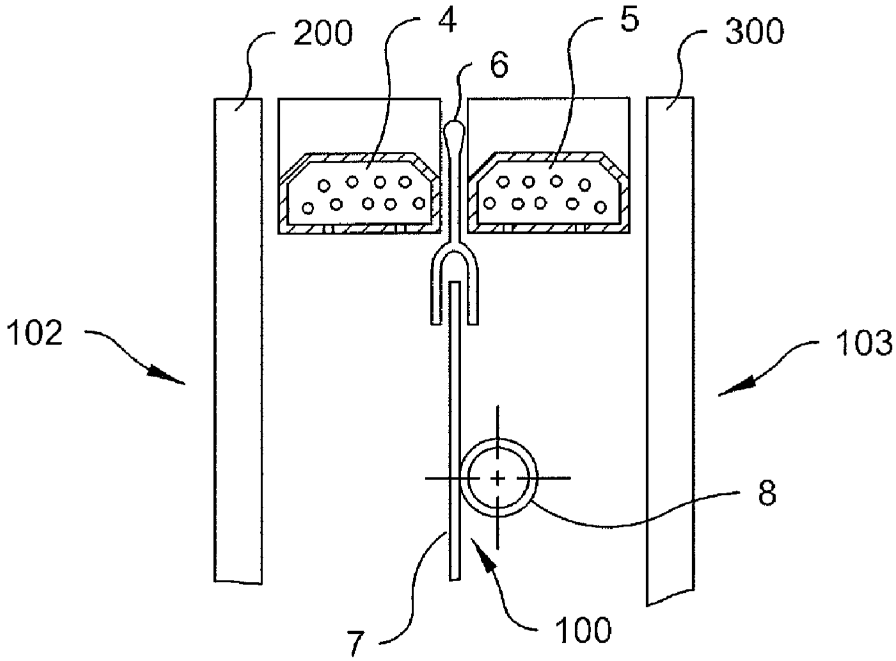

Fig. 8

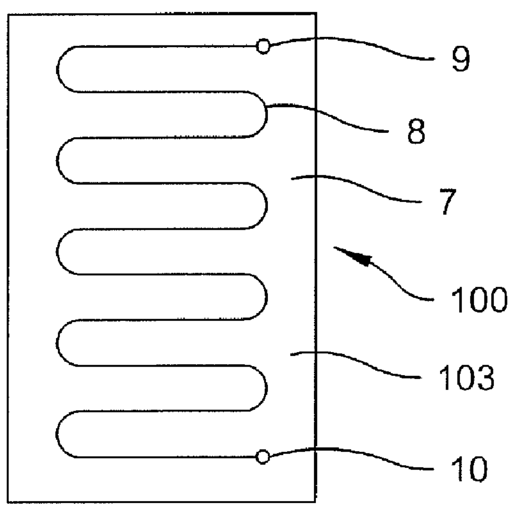

Fig. 9

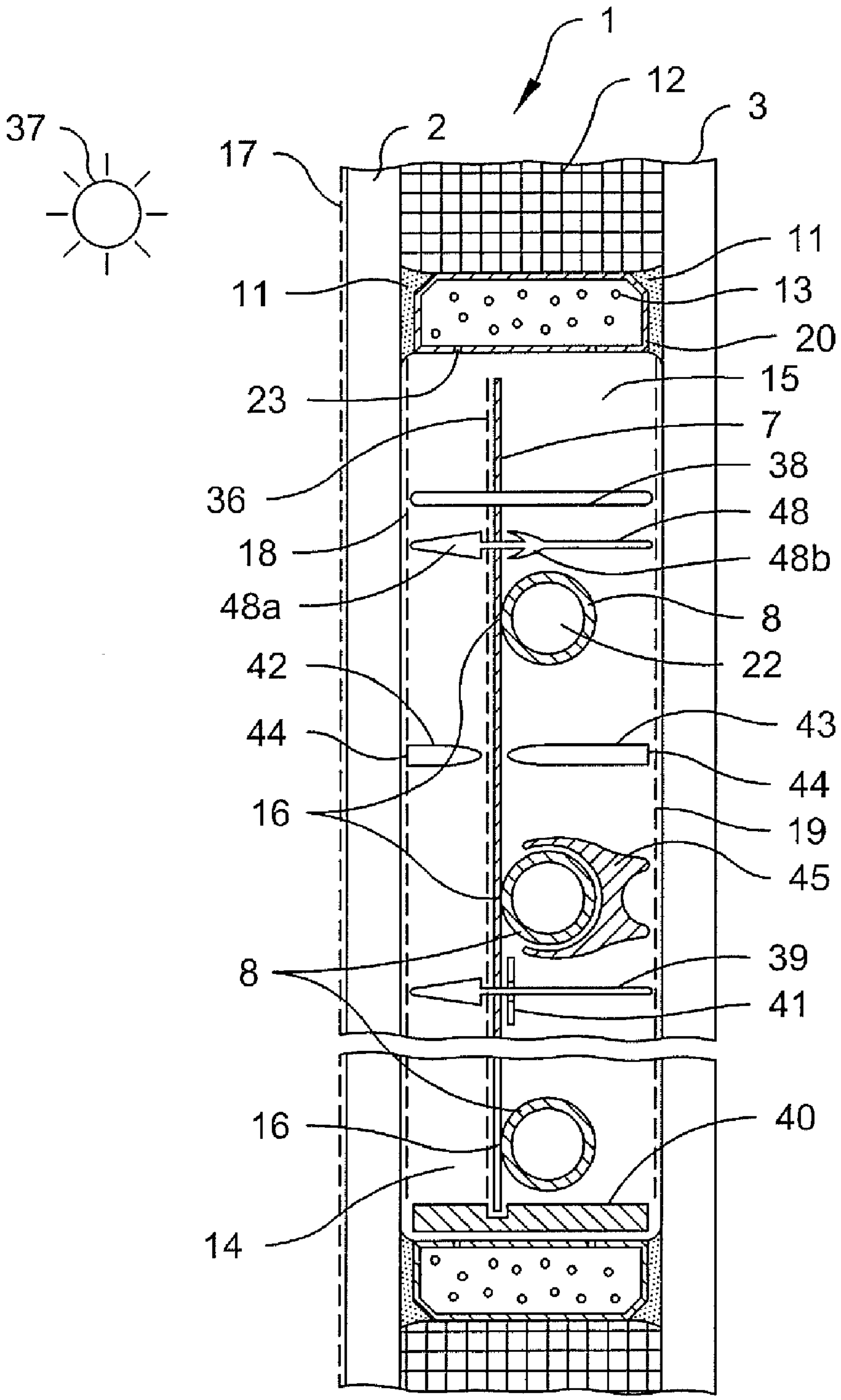
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Fig. 10

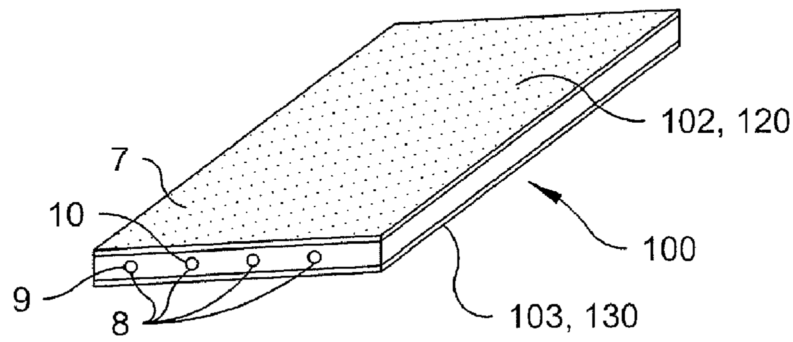

Fig. 11

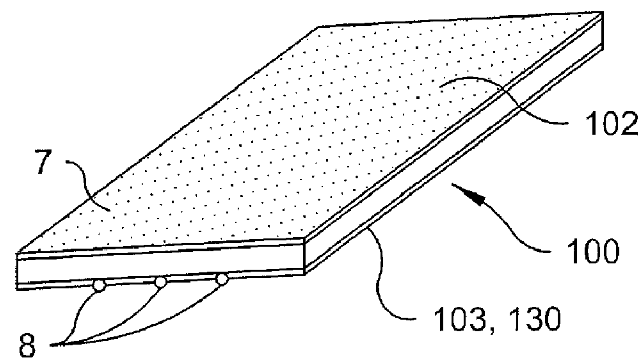

Fig. 12

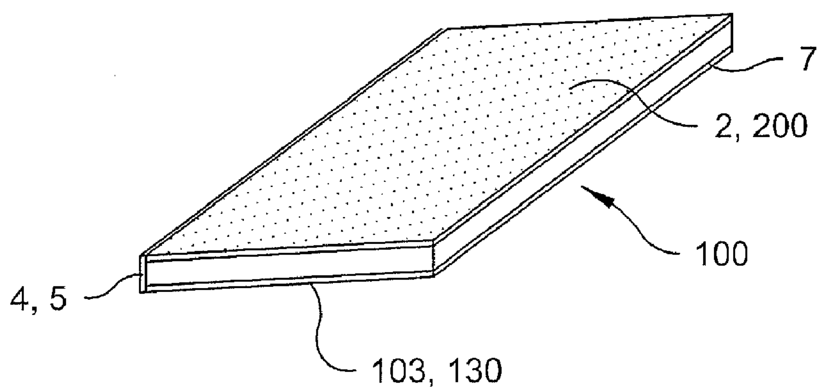

Fig. 13

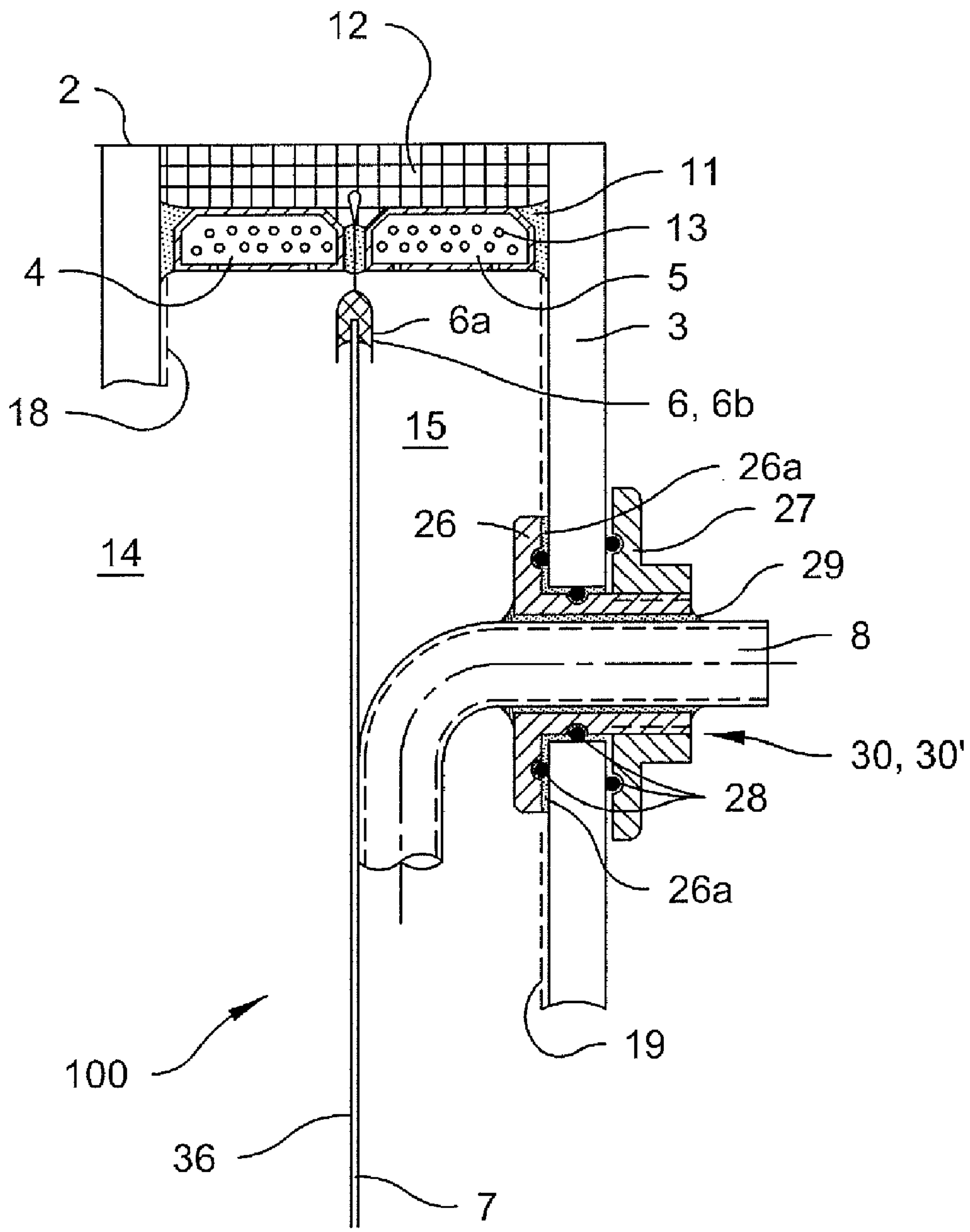

Fig. 14

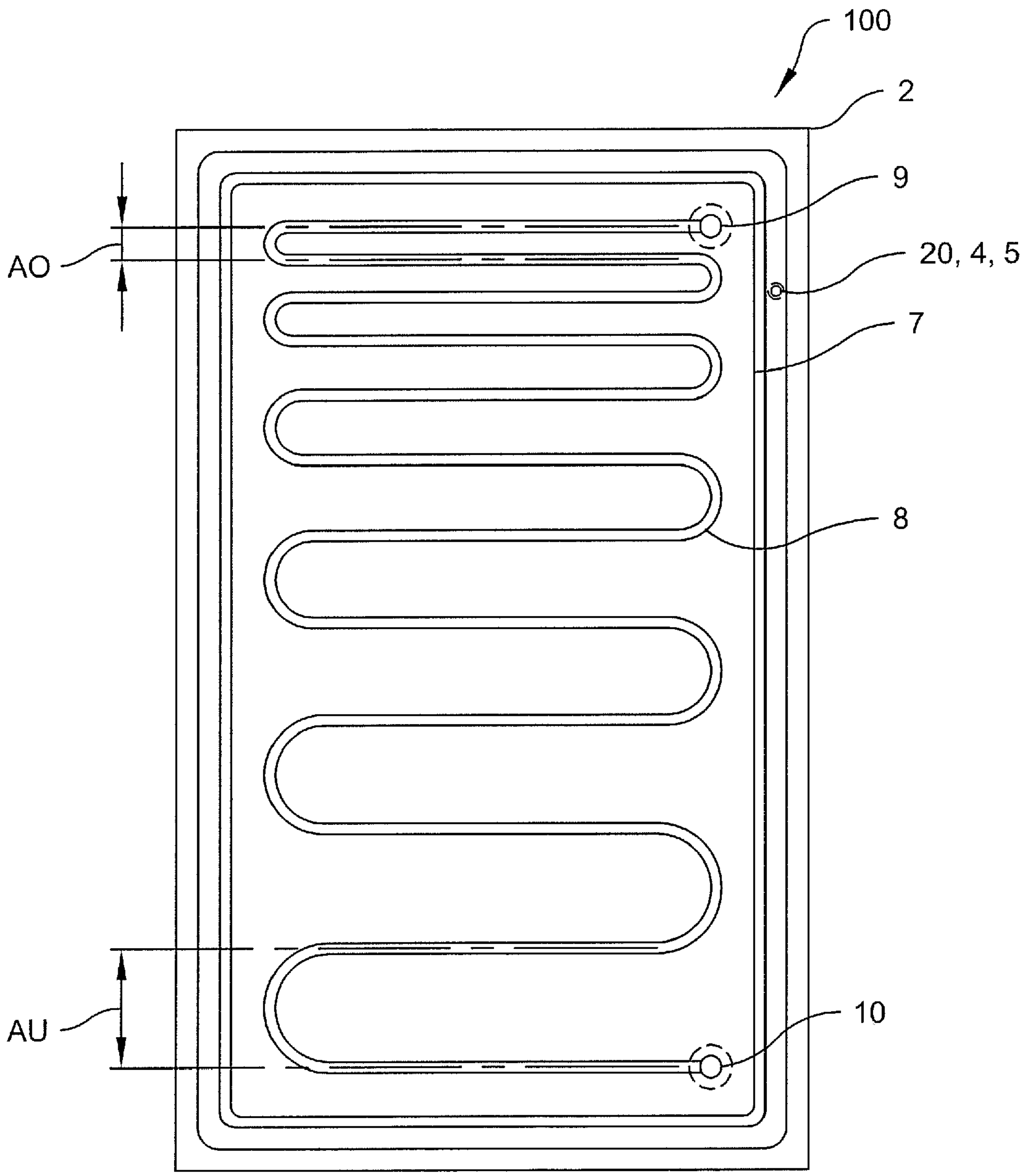

Fig. 15

SOLAR COLLECTOR AND METHOD FOR MANUFACTURING SUCH A SOLAR COLLECTOR

BACKGROUND OF THE INVENTION

[0001] The invention relates to a solar collector comprising an absorber, which has a front side facing toward the solar radiation during use, and a back side facing away from the solar radiation during use, and having a transparent cover arranged essentially plane-parallel opposite the front side of the absorber. The invention further relates to a composite pane, an absorber, as well as a use of such an absorber. A solar collector of the type mentioned above is known, for example, from German Patent DE 10 2006 006 718 B4.

[0002] The invention explained in detail below relates, in special embodiments, to thermal solar collectors and here especially to the construction of the pane, in particular glass pane or glass tube, bounding the collector on the outside.

[0003] From the field of solar collector technology, it is basically known to provide an absorber in the region underneath a glass-like cover pane, wherein this absorber transmits the energy contained in the solar radiation to the heat carrier medium and thus heats this medium. Here, solar collectors are constructed predominantly as flat collectors or as tube collectors.

[0004] Flat collectors distinguish themselves in that the cover pane, made predominantly of glass, has a planar construction and is arranged, in general, plane-parallel to the absorber element. In this context, special embodiments provide that, instead of glass-like cover panes, transparent cover panes containing plastic are provided. In each case, care must be taken that the cover panes of solar collectors are transparent, that is, permeable, for radiation in the wavelength range of the solar radiation in the largest possible area.

[0005] In addition to the previously described flat collectors, tube collectors are known in which an absorber element is provided within the tube. Such tube collectors selectively carry a flow of a heat carrier fluid, which leads the heat to a building heating system. Alternative embodiments provide that the individual tubes of a tube collector are decoupled hydraulically from this heat carrier fluid.

[0006] The solar collectors currently used the most often are flat collectors, which usually have available a collector box made predominantly from a metallic material or sheet, in which a cover pane is inserted with the help of corresponding sealing elements. The absorber carrying a flow of heat carrier fluid is arranged in the interior of the solar collector box, which also has available at least two connection elements as an inlet and an outlet through which a heat carrier fluid can be guided from outside of the solar collector into the absorber and then back out from this absorber. Here, it is likewise known that the efficiency of a solar collector will be higher, in principle, the higher the quality of the glass cover is, so that, in some parts, the use of insulating glass for thermal solar collectors has been proposed.

[0007] In addition, from DE 10 2006 006 718 B4 cited above, a solar collector is known in which the support element is formed by the cover pane constructed as a glass pane. On the bottom side of this glass pane and at a distance from this glass pane there is an absorber, which is mounted on the absorber pane with suitable fastening means. In addition, on the bottom side of the cover pane there are additional fastening means, which allow an attachment of the solar collector on a roof and/or in the region of a building façade. The essential technical feature of a solar collector constructed in this way consists in that the use of a collector box is eliminated and the cover pane and all of the components of the solar collector, for example, also the connections for the inlet and outlet of the heat carrier fluid are covered by the glass pane. Such a solar collector thus allows a very compact construction and also a relatively simple and visually appealing integration into the structure provided for the collector.

BRIEF SUMMARY OF THE INVENTION

[0008] The object of the present invention consists in providing a solar collector, which features, on one hand, a compact construction and simultaneously a satisfactory, in particular improved, efficiency. Furthermore, the invention is based on the object of providing a composite pane, which is suitable for energy conversion from solar energy, as well as an absorber and a use of such an absorber.

[0009] According to the invention, these objects are achieved by a solar collector of the type described at the outset, wherein a medium which reflects infrared radiation and is reflective in the direction of the absorber is allocated to the back side of the absorber. These objects are further achieved by a composite pane, in particular a composite glass pane, having a frame, which connects at least two transparent panes spaced from each other and arranged plane-parallel to each other in a gas-tight manner, wherein the transparent panes each have a medium reflecting infrared radiation inward, and wherein at least one absorber for solar energy is arranged between the transparent panes. These objects are still further achieved by an absorber, in particular for the above solar collector, having a front side, a back side, and at least one fluid channel for a heat-exchanger medium arranged between the front side and the back side, wherein the back side has, at least in some regions, a medium reflecting infrared radiation, in particular a coating which reflects infrared radiation and is reflective in the direction of the fluid channel. Finally, these objects are achieved by the use of the above absorber in the above solar collector or the above composite pane.

[0010] The invention involves the idea of providing a solar collector having an absorber, which has a front side facing toward the solar radiation during use and a back side facing away from the solar radiation during use, wherein a transparent cover is provided, which is arranged essentially plane-parallel lying opposite the front side of the absorber. Here, a medium which reflects infrared radiation and is reflective in the direction of the absorber is allocated to the back side of the absorber. In the sense of the present application, reflection in the direction of the absorber means that a reflective coating or surface is provided on the side of the absorber facing away from the sun—either set apart or deposited on the back side of the absorber.

[0011] The invention is based on the idea of allocating a medium, which reflects infrared radiation and at least partially reflects the heat radiation emitted by the absorber, in particular infrared radiation, to the back side or back surface of the absorber. Energy losses via the back side of the absorber or the side of the absorber facing away from the solar radiation are thus reduced. Here, the medium reflecting infrared radiation can be arranged in the back side, i.e., in the back surface of the absorber or can form the back surface of the absorber. The medium reflecting infrared radiation can also be arranged with a spacing from the back side of the absorber.

[0012] Preferably, the medium reflecting infrared radiation comprises a coating reflecting infrared radiation and/or additives reflecting infrared radiation. The coating reflecting infrared radiation can be arranged directly on the back side of the absorber or the back surface of the absorber. This means that the back surface or back side of the absorber is preferably provided with the coating reflecting infrared radiation. Alternatively, the back side of the absorber can have reflective additives. The coating reflecting infrared radiation or the additives reflecting infrared radiation can also be arranged in other components of the solar collector, which are arranged spaced apart from the back side of the absorber. Here, it is essential that the coating reflecting infrared radiation or the additives reflecting infrared radiation are allocated to the back side of the absorber. The coating reflecting infrared radiation or the additives reflecting infrared radiation, in general the medium reflecting infrared radiation, is arranged on the side of the absorber facing away from the solar radiation. Here, it is not excluded that a medium reflecting infrared radiation is also allocated to the front side of the absorber or that the front side of the absorber comprises a medium which reflects infrared radiation and reflects infrared radiation toward the absorber.

[0013] According to one preferred embodiment, the solar collector can have a back wall which is arranged lying opposite the back side of the absorber. Here, the back wall can be constructed as a transparent pane, in particular a glass pane or plastic pane, and can comprise, at least in some regions, the medium which reflects infrared radiation and is reflective in the direction of the back side of the absorber.

[0014] This embodiment involves the idea of using the cover or back wall, in particular glass, of a solar collector forming the outer boundary not only with respect to its transparency for sunlight, but also to use it in addition or as a supplement for heat insulation of the collector in a suitable way.

[0015] In this context it is preferred that the cover and the back wall each comprise a glass, in particular a glass pane, which forms the outer boundary of the solar collector. The glass pane allocated to the back wall can have the medium reflecting infrared radiation. In addition, the back side of the absorber can be provided with a medium reflecting infrared radiation or a medium that reduces the emission of radiation in the direction toward the back side, so that overall at least two components reflecting infrared radiation, in particular coatings, are allocated to the back side of the absorber.

[0016] It is also possible that instead of the back wall, a back mechanical protection or a corresponding protective coating is provided for the absorber. For example, the solar collector according to the invention can be bounded in one possible embodiment on the side facing away from the solar radiation by the back side of the absorber or the back surface of the absorber. For such an embodiment no component, actually no back wall, is needed which is arranged with a spacing from the back side of the absorber. The solar collector can instead comprise a cover on the front side of the absorber, wherein the back wall of the solar collector is formed essentially by the absorber itself. The smallest structural unit according to an actual embodiment of the present invention therefore consists of an absorber, which has a transparent cover facing toward the solar radiation during use, wherein simultaneously a medium which reflects infrared radiation and is reflective in the direction of the absorber is allocated to the back side of the absorber directly or spatially at a distance. Such a structural unit can be used or integrated at different positions of installation and use, for example in a roof or façade construction of a building. In this respect, an especially compact construction of the solar collector can be achieved. At actual mounting locations, additional insulating materials can be allocated to the back side of the absorber, wherein it is not excluded that the damping materials are fixed on the building side. The damping materials can also be connected to the back side of the absorber.

[0017] In one especially advantageous embodiment, the cover and/or the back wall, in particular the medium reflecting infrared radiation, comprises a heat insulating glass. In particular here it is proposed to use a heat insulating glass which ensures that infrared radiation emitted by the absorber is reflected from the side of the corresponding glass opposite the absorber, so that the heat resulting from the energy of the infrared radiation is likewise fed to the absorber and then transmitted to the heat carrier fluid flowing through the absorber.

[0018] According to this description, heat insulating glass is understood to be a glass that is suitable, at least on one side, for reflecting infrared radiation to a high degree. The heat insulating glass or, in general the medium reflecting infrared radiation, thus features increased reflection properties with reference to long wavelength light, in particular infrared radiation, in comparison with typical glass, in particular window glass. Preferably, the degree of reflection of the heat insulating glass or the medium reflecting infrared radiation with respect to infrared light equals more than 20%, in particular more than 30%, in particular more than 40%, in particular more than 50%, in particular more than 60%, in particular more than 70%, in particular more than 80%, in particular more than 90%. For this purpose, the glass can be provided and/or coated with suitable additives.

[0019] It is explicitly noted that, in principle, it is insignificant how the solar collector is shaped by its structural configuration. In particular the technical solution proposed here can be used both for tube collectors and also for flat collectors. Likewise, it is insignificant to what extent the heat-insulating glass is used. What is essential for the realization of the inventive solution is merely that a medium, for example a heat-insulating glass that reflects infrared radiation and reflects the infrared radiation emitted by the absorber, is provided opposite the absorber, so that the energy resulting from the radiation energy is not lost, but instead can be fed to the absorber and thus to the heat carrier fluid.

[0020] In this context, a very especially suitable embodiment of the invention realizes a solar collector of especially compact configuration in that a composite glass construction is provided in a sandwich configuration, wherein the absorber is arranged between two glass panes, which form a cover and the back wall, respectively. In particular the solar collector is constructed in this embodiment, according to type, of a composite glass construction in a sandwich configuration. Here, an absorber is provided that can be constructed as a sheet with corresponding channels or in the form of tube lines between two glass panes. At least one of the panes, in particular both panes between which the absorber is located, has available the medium, in particular heat-insulating glass reflecting infrared radiation. The solid-material glass pane thus contains particles and/or is provided with a coating, which allows at least a partial reflection of the infrared radiation emitted by the absorber.

[0021] The medium reflecting infrared radiation can comprise pigment-like bodies, in particular glass beads, which are arranged on the side of the back wall facing toward the back side of the absorber. In particular, another embodiment of the invention provides that a filling of pigment-like bodies, in particular glass beads, is provided at least in some sections opposite the absorber, preferably on the side facing away from the solar radiation, with these bodies having, in turn, the property of reflecting infrared radiation emitted by the absorber. For example, a corresponding glass-bead package, which reflects the infrared radiation emitted by the solar absorber, can be provided on the back side of an absorber of a plate-like solar collector.

[0022] The cover and the back wall can be arranged spaced apart from the absorber and can be connected by a frame. Another construction of the invention provides that the two panes, set at a spacing from the absorber and enclosing this absorber, are connected to each other with the help of a frame. In this way, a very compact composite-glass construction is created.

[0023] Between the cover and the back wall a pane interspace can be provided, which is closed gas-tight relative to the surroundings. Preferably, the region or pane interspace between the glass panes, in which the absorber is arranged, is sealed gas-tight relative to the surroundings, so that it is conceivable to establish a vacuum in this inner space of a composite glass solar collector to provide this space with a protective gas and/or to fill it with other materials, in particular damping materials. The pane interspace can have an essentially fixture-free construction. This means that the pane interspace forms a hollow space bounded by the absorber and the back wall. The pane interspace can be filled exclusively with a gas or evacuated. Analogous to a back pane interspace between the absorber and the back wall, a front pane interspace can be formed between the absorber and the cover. The front pane interspace preferably likewise has a fixture-free construction.

[0024] The solar collector can furthermore be constructed in the form of a composite glass pane, which has two glass panes arranged on the outside and forming the cover and the back wall and the absorber in the inside. In a very special embodiment of the invention, the solar collector is constructed in the form of a composite glass pane, which has available two glass panes on the outside and the mentioned absorber in the inside, in particular an absorber sheet. At least one of the two glass panes covering the absorber is here constructed such that infrared radiation emitted by the absorber is reflected.

[0025] The surfaces of the glass panes facing toward the absorber can comprise, at least in some sections, the medium reflecting infrared radiation. In a first special refinement of the composite glass solar collector mentioned above, in particular the solar collector according to Claim **9**, the sides facing toward the absorber, both the glass pane facing toward the solar radiation and also the glass pane located on the back side of the absorber, are constructed such that the surfaces of the panes facing toward the absorber reflect, at least in some sections, infrared radiation emitted by the absorber. In this context, it is conceivable to construct the corresponding panes as heat-insulating glass by enriching and/or coating the glass with suitable material, for example particles, accordingly. One essential idea here is that, in this way, infrared radiation emitted not only from the front side of the absorber, but simultaneously or additionally infrared radiation emitted from its back side is reflected from the corresponding panes opposite the absorber.

[0026] It is explicitly noted that the same principle can be used for tube collectors in that the corresponding tube is provided, at least in some sections, as heat-insulating glass with corresponding particles within the glass and/or with a coating that reflects infrared radiation.

[0027] Now, in the technical solutions described above, as soon as solar radiation is incident on the absorber through the side of the solar collector facing toward the sun, this radiation on the absorber, in particular on the absorber sheet, is converted into heat and transmitted to the heat carrier fluid flowing through the absorber. Preferably, for the structural configuration of a solar collector, in this context, it is provided that within the collector corresponding heat insulating materials and/or an absorber, in which the emission of infrared radiation on its back side is reduced, is provided that prevents a loss of heat of the heat carrier fluid resulting, in particular through the emission of heat radiation, that is, infrared radiation. In the case of collectors known from prior art, above all flat collectors, for this purpose insulating material, such as mineral wool or polymer foam, is used for insulation. According to one preferred aspect of the present invention, it is now possible to eliminate, at least partially, such materials for insulation which prevent, above all, a compact configuration of the solar collector. Thus, selectively for the use of heat insulating glass or a correspondingly coated glass, in particular in general a transparent back wall having a medium reflecting infrared radiation on the back side of the absorber, additional damping materials can be completely eliminated or at least the quantity of material being used can be limited.

[0028] Through the use of a back wall having a medium reflecting infrared radiation according to one embodiment of the present invention, in particular through the use of heat-insulating glass as is known from the insulating glazing of buildings, the insulating glass configuration is advantageously realized.

[0029] In this context it is noted that, according to this description, heat-insulating glass is understood to be a glass which is constructed by the use of special manufacturing techniques such that it has lowest possible heat permeability, above all low permeability for heat radiation, that is, infrared radiation. This is realized, for example, by a thin metal coating on the surface of such glasses, which are also designated low-e glasses or k glasses.

[0030] These so-called heat-insulating glasses, however, have reduced transparency, so that typically their transmission in the range of visible light equals merely 70-90% of glasses that are otherwise used. This leads, in turn, to the result that 10-30% of the solar radiation does not reach the absorber, as long as the glass pane facing toward the solar radiation is likewise constructed as heat-insulating glass. A reduction of the solar radiation through the glass pane facing toward the sunlight necessarily reduces the performance of a solar collector.

[0031] Due to this knowledge, a very especially suitable embodiment of the invention provides that the solar collector is constructed as a flat collector or tube collector, wherein a first glass region, in particular a first glass pane, is constructed on the side of the solar collector facing toward the solar radiation as a solar glass pane and a second glass region, in particular a second glass pane, is constructed on the side of the solar collector facing away from the solar radiation as heat-insulating glass. In other words, it is provided that the glass pane (for example flat collector) or the glass region (for example tube collector) on the side of the collector facing toward the solar radiation is constructed as a solar glass pane, that is, with low iron-oxide glass, while the glass pane or the glass region provided on the side of the collector facing away from the solar radiation is constructed as heat-insulating glass, which reflects infrared radiation emitted by the absorber. Thus, in this embodiment, as the glass pane, which is facing toward the solar radiation, no heat-insulating pane is used, but instead advantageously a solar glass pane that provides particular permeability for solar radiation. Solar glasses are glasses having a relatively low iron-oxide component, so that highest possible transmission can be achieved or is achieved.

[0032] In contrast to the glass pane on the side of the solar collector facing toward the sunlight, on the back side of such a collector the use of a glass pane constructed as heat-insulating glass or a pane which is constructed such that it provides increased reflective properties with respect to infrared radiation is realized. The latter pane preferably comprises the medium reflecting infrared radiation. As has already been mentioned, the insulating property of a corresponding glass pane can be supported by the additional use of mineral wool, polymer foam, or insulating granulate. As the insulating granulate, in this context in principle, bulk materials made from a glass material, in particular from glass beads, can also be used, which likewise provide increased heat-insulating properties, for example, through the use of the described heat-insulating glass.

[0033] According to one associated aspect, the invention involves the idea of providing a composite pane, in particular composite glass pane, having a frame which connects at least two transparent panes, which are spaced apart from each other and are arranged plane-parallel to each other, wherein the transparent panes each have a medium reflecting infrared radiation inward. Here, between the transparent panes there is at least one absorber for solar energy.

[0034] One very specially constructed refinement or associated variant of the invention thus provides for a solar collector which is constructed in the form of a composite glass pane. Such a composite pane is formed by two panes, preferably from a solid glass material, connected to each other with the help of a corresponding border or frame, wherein the inner space is sealed gas-tight. In the interior of this glass pane, that is, in the hollow space between the border or the frame and the two panes preferably comprising a solid glass material, there is an absorber which can carry a flow of a heat carrier fluid. Such a solar absorber can be constructed like a tube or in the form of a plate absorber. The connections of the absorber for feed lines and discharge lines of the heat carrier fluid are preferably led outward and likewise sealed gas-tight. The remaining hollow space in the inside of the glass-like collector can be either evacuated or filled with a protective gas, in an especially preferred way with argon. It is preferred here that condensation does not take place and thus the panes do not become damp in the inside of the pane, in particular the composite glass pane, due to temperature differences.

[0035] The described composite glass pane, in particular according to this preferred embodiment, provides a glass pane, which is facing toward the solar radiation and is manufactured from a low iron-oxide solar glass. In this case, the glass pane arranged on the back side of the absorber facing away from the solar radiation is constructed as heat-insulating glass, which reflects the infrared radiation emitted by the absorber, so that the energy of the infrared radiation can also be transmitted, at least to a large extent, to the heat carrier fluid flowing through the absorber. The configuration of the described solar collector thus distinguishes itself primarily in that the principle of a triple insulating composite glass is used, wherein the typical middle glass is replaced by an absorber sheet. Here, the distances between the panes or between the panes and the absorber as well as the corresponding seals must be adapted to the objective, namely the use of this composite glass solar collector for generating solar energy. In particular, the partially high temperature gradients, which are to be expected between the individual operating phases of the solar collector, are to be taken into consideration here.

[0036] Relative to the solar collectors which are known from the prior art and consist of a solar collector box or a correspondingly sealed, installed cover pane, the solution proposed here has, above all, the advantage that it allows, due to a possible elimination or at least a reduction of the insulating material being used, a significantly more compact construction, in particular a smaller overall height. Relative to the solar collector known from DE 10 2006 006 718 B4, which is cited above and completely eliminated a corresponding back-side border of the solar collector, the collector configuration proposed here distinguishes itself through a significantly increased efficiency.

[0037] One very special embodiment of the invention provides that the technical solution proposed here is used in the field of tube collectors. In this context, it is preferably provided to construct either the back side of the tube collector facing away from the solar radiation as heat-insulating glass or to provide here a corresponding coating, so that the infrared radiation emitted by the absorber located within the tube collector is reflected. In one special embodiment, it is further provided to have a coating and/or bulk material, which is loose or fixed to the glass pane and provides increased infrared reflection properties on the side of the absorber facing away from the solar radiation.

[0038] In each case, an idea arises to construct the glass surfaces actually provided for the radiation of the solar, at least in some regions, such that infrared radiation is reflected from the surface of the pane located within the solar collector. Here, a glass pane provided on the back side of the absorber is especially suitable, because this allows a compact construction as well as at least a reduction of the damping materials being used.

[0039] According to another associated aspect, the invention involves the idea of providing an absorber, in particular for a solar collector described above, wherein the absorber comprises a front side, a back side, and a fluid channel for a heat-exchanger medium. The fluid channel is arranged between the front side and the back side. The back side here has, at least in some region, a medium reflecting infrared radiation, in particular a coating that reflects infrared radiation and is reflective in the direction of the fluid channel. Due to the medium which reflects infrared radiation and is arranged on the back side of the absorber, the efficiency of the absorber is increased in that the emissions of heat energy are reduced.

[0040] Preferably, the front side of the absorber according to the invention has, at least in some regions, a coating absorbing infrared radiation. In this way it is ensured that the front side, that is, the side or surface of the absorber facing toward the solar radiation, offers high selectivity for heat radiation.

The efficiency of the absorber is therefore further increased. Overall it is thus advantageously proposed to provide the front side of the absorber with a coating that has highest possible absorption and comparatively low emissions for heat radiation, in particular infrared radiation. Preferably, this measure is combined with a construction of the absorber to the extent that support is also given on its back side for a reduction of the emissions of heat radiation.

[0041] The medium which reflects infrared radiation and is arranged on the back side of the absorber further allows the use of the absorber in an insulating glass configuration, wherein the back glass pane, in particular facing away from the solar radiation, can be eliminated. The configuration of a collector equipped with the absorber according to the invention thus can be realized more economically and more compactly. In particular, with the medium reflecting infrared radiation or the coating reflecting infrared radiation on the back side of the absorber, the heat emissions are reduced, in particular significantly reduced in the range of infrared radiation, so that the elimination of an insulating configuration on the back side is enabled behind the absorber, in particular between the absorber and a back wall of a solar collector.

[0042] Another associated aspect of the invention relates to the use of such an absorber in a solar collector described above or a composite pane described above.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0043] The foregoing summary, as well as the following detailed description of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there are shown in the drawings embodiments of a composite glass solar collector which are presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. Shown in the schematic drawings are:

[0044] FIG. **1** is a perspective cross-sectional view through a solar collector according to a preferred embodiment of the invention;

[0045] FIG. **2** is a plan view of the solar collector according to FIG. **1**;

[0046] FIGS. **3-7** are each cross-sectional views through a solar collector according to a preferred embodiment of the invention;

[0047] FIG. **8** is a cross-sectional partial view of a solar collector according to another preferred embodiment of the invention;

[0048] FIG. **9** is a longitudinal section through a solar collector according to a preferred embodiment of the invention;

[0049] FIG. **10** is a partial cross section through a solar collector according to another preferred embodiment of the invention;

[0050] FIG. **11** is a perspective representation of an absorber according to a preferred embodiment of the invention;

[0051] FIG. **12** is a perspective representation of an absorber according to another preferred embodiment of the invention;

[0052] FIG. **13** is a perspective representation of a solar collector configuration with an absorber according to FIG. **11**;

[0053] FIG. **14** is a cross-sectional partial view of the solar collector according to another preferred embodiment of the invention; and

[0054] FIG. **15** is a longitudinal section through a solar collector according to a preferred embodiment of the invention.

[0055] In particular all of the shown possibilities for absorber mounting, spacer design, as well as tube feed-throughs can be combined arbitrarily with each other, so that the invention is in no way limited to the actually shown embodiments according to FIGS. **1** to **15**.

DETAILED DESCRIPTION OF THE INVENTION

[0056] In FIG. **1** a composite glass solar collector according to one embodiment of the present invention is shown, which provides a solar glass pane on the front side **102**, a heat-insulating glass pane on the back side **103**, and an absorber **100** arranged in the inside space, which is sealed gas-tight. Within the inside space, that is, between the two glass panes **2**, **3** or between the front side **102** and the absorber **100** and also the back side **103** and the absorber **100**, argon is provided as protective gas for preventing the formation of condensation in the solar collector.

[0057] According to FIG. **2** the solar collector or the composite glass solar collector forms a composite glass pane **1**, which comprises a front glass pane **2** and a back glass pane **3**, wherein an absorber **100** is arranged between the front glass pane **2** and the back glass pane **3**. The absorber **100** comprises an absorber sheet **7** and an absorber tube **8**, wherein the absorber tube **8** is led across the absorber sheet **7** in the shape of a meander and is connected rigidly to the absorber sheet **7**, in particular in a thermally active way. In one edge region of the composite glass pane **1** there are, furthermore, spacers **4**, **5**, which are connected rigidly to the absorber sheet **7** and/or to the front or back glass pane **2**, **3**. The spacers **4**, **5** thus form connecting bars between the absorber **100** and the front cover **200** or front glass pane **2** and the back wall **300** or back glass pane **3**.

[0058] In this context it is noted that the terms "front" and "back" refer to the side of the composite glass pane **1** facing toward and away from the solar radiation, respectively. In particular, the front glass pane **2** designates the glass pane facing toward the solar radiation, while the back glass pane **3** is facing away from the solar radiation. Preferably, the back glass pane **3**, or in general the back wall **300** of the absorber **100**, is equipped with corresponding fastening means that allow an installation of the composite glass pane **1**, or in general the solar collector, on building facades or building roofs, in particular slanted roofs, awnings, or carport covers. Such fastening means are typically not provided on the front side **102** of the absorber **100** or on the front glass pane **2** or the cover **200**. However, it is not excluded that the cover **200** or the front side **102** also comprises fastening means.

[0059] As is further to be seen in FIG. **2**, the back wall **300** or the back glass pane **3** has openings for a feed line **9** and also a discharge line **10**, wherein the feed line **9** and the discharge line **10** form the open ends of the meander-shaped absorber tube **8**. The feed line **9** and the discharge line **10** can each be connected to a tube system with suitable connection means, so that a heat-exchanger medium **22** can be led through the absorber tube **8**, wherein the heat-exchanger medium **22** is heated by the heat energy absorbed from the solar radiation when passing through the absorber tube **8**.

[0060] For holding the absorber **100**, in particular the absorber sheet **7**, a Y-profile **6** is provided, which extends between the spacers **4**, **5** as shown in FIG. **3**. The forking of the Y-profile here encloses the absorber sheet **7**. In this respect the Y-profile **6** forms a frame or a groove for holding the absorber sheet **7**.

[0061] In FIG. **3** the cross-sectional configuration of a composite-glass pane **1** is shown according to a preferred embodiment. The composite glass pane **1** comprises a front glass pane **2** and a back glass pane **3**, which are arranged spaced apart from each other. The absorber sheet **7**, which is connected rigidly to the absorber tube **8** by a thermal connection **16**, is arranged between the front glass pane **2** and the back glass pane **3**. A front pane interspace **14** is arranged between the absorber sheet **7** and the front glass pane **2**. A back pane interspace **15** is provided between the absorber sheet **7** and the back glass pane **3**. The pane interspaces **14**, **15** are each sealed gas-tight relative to the surroundings. For this purpose, it is provided in particular that two spacers **4**, **5** are arranged in the region of the Y-profile **6**, which forms a holder for the absorber sheet **7**, wherein these spacers each extend between the front glass pane **2** and back glass pane **3**, respectively, and the Y-profile **6**. The spacers **4**, **5** are each fixed between the Y-profile **6** and the glass panes **2**, **3** by a primary bonding agent **11**. The primary bonding agent **11** preferably has a component based on butyl. A secondary bonding agent **12** is further provided above the spacers **4**, **5** and also above the Y-profile **6** between the front glass pane **2** and the back glass pane **3**. The secondary bonding agent **12** connects and thus fixes the front glass pane **2**, the back glass pane **3**, the Y-profile **6**, and also the spacers **4**, **5**. Preferably, the secondary bonding agent **12** contains silicon.

[0062] With respect to the spacers **4**, **5** it is provided that each of these has a hollow profile in which a drying agent **13** is arranged. The drying agent **13** can be executed as a molecular sieve or can comprise zeolite. The spacers **4**, **5** further have, in a wall facing toward the pane interspace **14**, **15**, break-throughs **23**, which allow a gas exchange between the pane interspaces **14**, **15** and the drying agent **13**.

[0063] The absorber sheet **7** preferably extends across the entire surface of the composite glass pane **1** minus the edge regions formed by the spacers **4**, **5**, the Y-profile **6**, and the bonding agents **11**, **12**. The absorber sheet **7** is coupled, at least on one side, with the absorber tube **8** by the thermal connection **16**. It is also possible that an absorber tube **8** is arranged on both sides of the absorber sheet **7**. Preferably, as shown in FIG. **3**, the absorber tube **8** is arranged on one side of the absorber sheet **7**, in particular the back side of the absorber sheet **7**. This means that the absorber tube **8** is arranged on the side of the absorber sheet **7** facing away from the solar radiation. On the side of the absorber sheet facing toward the sun **37**, a solar-selective coating **36** is further provided. The solar-selective coating **36** increases the efficiency of the absorber sheet **7**. Advantageously, the back side of the absorber sheet is also constructed such that, especially with such a coating, the emissions of heat radiation are significantly reduced.

[0064] With respect to the front and back glass panes **2**, **3**, it is preferably provided that the back glass pane **3** comprises, at least in some regions, a medium reflecting infrared radiation. The medium reflecting infrared radiation can form a reflection layer **19**, as provided, for example, in the embodiment according to FIG. **3**. The reflection layer **19** is arranged on the inside of the back glass pane **3** or the back wall **300**. The reflection layer **19** is thus arranged facing toward the absorber sheet **7**, or in general the absorber **100**. The reflection layer **19** preferably forms a reflective coating of the back glass pane **3**. The reflection layer **19** can comprise a low-e coating. In one especially advantageous construction, the reflection layer **19** has a reflective coating such that infrared radiation is especially or predominantly reflected. The reflection properties of the reflection layer **19** are thus advantageously set such that a reflection of wavelengths takes place, in particular takes place primarily in the infrared range or heat radiation wavelength range. For other wavelength ranges, especially visible light, the reflection layer **19** is preferably continuous. The reflection layer **19** can have a sputter-coated, sol-gel-coated, or aluminum-coated construction. The preferred manufacturing or coating methods thus comprise sputtering, sol-gel coating, or aluminum coating. Here, the reflection layer **19** is preferably deposited on the back glass pane **3** by roll-coating processes, curtain coating, spray-coating processes, screen printing, or similar coating methods.

[0065] In contrast to the back glass pane **3**, the front glass pane **2** is preferably constructed as a solar glass pane. This does not exclude, however, that the front glass pane **2** is also constructed as an insulating glass pane or heat-insulating glass, if needed. Here, in the scope of the application, heat-insulating glass is understood to be glass comprising a medium reflecting infrared radiation, in particular the mentioned reflection layer **19**.

[0066] The front glass pane **2** constructed as solar glass comprises, on both sides, an anti-reflection coating **17**, **18**, wherein a first anti-reflection coating **17** is arranged on the outside of the composite glass pane **1**, that is, on the side of the front glass pane **2** facing toward the sun **37**, and the second anti-reflection coating **18** is arranged on the back side of the front glass pane **2**, that is, the side of the front glass pane **2** facing toward the absorber sheet **7**. The anti-reflection coatings **17**, **18** are preferably connected to the front glass pane **2** with a material fit. The anti-reflection coatings **17**, **18** can be further made prismatic. Preferably, the back, second anti-reflection coating **18** is constructed as a low-e coating. In principle, it is advantageous if the front glass pane **2**, constructed as a solar glass pane, has at least one anti-reflection coating **17**, **18**, which is adjusted such that the highest possible permeability for light waves, in particular infrared radiation, is given. In this way it is achieved that a highest possible entry of energy into the composite glass pane **1** is provided, whereby the energy contribution introduced into the inside of the composite glass pane **1** can be converted into storable thermal energy, at least partially with the help of the absorber sheet **7** and the absorber tube **8**, or in general the absorber **100**.

[0067] In order to achieve the most constant possible efficiency of the composite glass pane **1** or the composite glass solar collector, it is advantageously provided to fill the front pane interspace **14** and the back pane interspace **15** with a protective gas, in particular argon. In this way, the formation of condensation is prevented. In addition, the drying agent **13** causes a reduction in the risk of condensation.

[0068] The absorber sheet **7** and the absorber tube **8** preferably have a material with a high heat transfer coefficient, in particular copper. The thermal connection **16** preferably comprises a metal, in particular a weld seam or a soldering joint, wherein the weld seam or the soldering joint can be deposited by a laser method or an ultrasonic method. This mechanical connection between the copper tube or absorber tube **8** and the copper sheet or absorber sheet **7** is thermally active. This means that the thermal connection **16** contributes to the transmission of heat energy from the absorber sheet **7** to the absorber tube **8**.

[0069] The front glass pane **2** and the back glass pane **3** each comprise preferably a single-pane safety glass or a heat-strengthened glass or a composite safety glass.

[0070] In FIG. **4** another embodiment of the solar collector according to the invention is shown, in which the front glass pane **2** projects past the back glass pane **3** and thus forms a support face **101**, with which the composite glass pane **1** can be placed on a building-side holding construction. By the front glass pane **2** projecting past the back glass pane **3**, a possibility is created to integrate the composite glass pane **1**, or in general the solar collector, flush with the building construction, for example a post-and-beam façade. Here, the front glass panes **2** of several composite glass panes **1** arranged one next to the other form a flush outer surface, in particular a continuous, essentially flat glass façade. Furthermore, in the embodiment according to FIG. **4**, in contrast to FIG. **3**, an individual spacer or a single sheet plating **20** is provided that replaces the spacer **4**, **5** according to FIG. **3**. The sheet plating **20** is arranged between the front glass pane **2** and the back glass pane **3** and is fixed by a primary bonding agent **11** and also a secondary bonding agent **12**, wherein the secondary bonding agent **12** forms an additional, insulating connection between the front glass pane **2** and the back glass pane **3**. The configuration of the sheet plating **20** corresponds essentially to the structural configuration of the spacer **4**, **5**, wherein, in addition, a first plating **21** is provided on the sheet plating **20**, with this first plating extending essentially at a right angle to a lower wall of the sheet plating **20** and forming a support for the absorber sheet **7**. The absorber sheet **7** here contacts, at least in some sections, in particular with an edge region, on the first plating **21**. Preferably, the absorber sheet **7** is connected rigidly to the first plating **21**, in particular welded, riveted, screwed, or bonded.

[0071] In another alternative construction according to FIG. **5** it is provided, based on the embodiment according to FIG. **4**, to lead the absorber tube **8** laterally, i.e., in a parallel plane to the front glass pane **2** and the back glass pane **3**, out from the composite glass pane **1** or the solar collector. For this purpose it is proposed to provide, in the edge region of the composite glass pane **1**, a feed-through **24**, which passes through the sheet plating **20**. The feed-through **24** preferably forms a sleeve, which is arranged in a heat-insulating manner in a recess of the sheet plating **20**. Preferably, the sleeve or the feed-through **24** has, at least on one axial end, a ring flange, which contacts a lower wall of the sheet plating **20** and prevents slippage of the feed-through **24** from the sheet plating **20**. The absorber tube **8** is arranged in the feed-through **24**, whereby the absorber tube **8** is led out from the composite glass pane **1**. The absorber tube **8** is further surrounded by the secondary bonding agent **12**, wherein the secondary bonding agent **12** creates an additional sealing of the absorber tube **8**. The piece of the absorber tube **8** led out from the composite glass pane **1** thus forms a feed line **9** or discharge line **10** for the heat exchanger medium **22**. For this purpose, a connection **33** is advantageously provided on the tube ends arranged outside of the composite glass pane **1**, so that the absorber tube **8** or the feed line **9** or discharge line **10** can be connected, for example, to the heating system of a building.

[0072] The embodiment according to FIG. **6** differs from the embodiment according to FIG. **5** essentially in that the feed line **9** or discharge line **10** of the absorber tube **8** is not led through a side surface of the composite glass pane **1**, but instead through the back glass pane **3** or back wall **300**. Here, the back glass pane **3** has an opening, in particular a drill hole in which an inner flange **26** is arranged. The inner flange **26** comprises a ring pane section **261** to which a sleeve section **262** connects essentially at a right angle. The sleeve section **262** passes through the back glass pane **3**. In contrast, the ring pane section **261** is arranged on the inside or front surface of the back glass pane **3**. In particular, the ring pane section **261** is arranged on the side of the back glass pane **3** facing toward the sun **37**, in particular on the surface of the back glass pane **3** provided with the reflection layer **19**. The inner flange **26** comprises ring-shaped recesses or ring grooves on the surfaces facing toward the back glass pane **3**, with sealing means, in particular ring-shaped sealing means or O-rings **28**, being arranged in these recesses or grooves. The O-rings **28** seal the inner flange **26** against the back glass pane **3**. Outside of the composite glass pane **1**, in particular on a side of the back glass pane **3** facing away from the sun **37**, an outer flange **27** is arranged, which has an essentially rotationally symmetric construction and comprises an L-shaped profile. The L-shaped profile of the outer flange **27** has a sleeve-shaped base **271**, which surrounds the inner flange **26**, in particular the sleeve section **262**, with a ring shape. A sealing pane **272**, which is constructed in one piece with the sleeve-shaped base **271**, is arranged at an essentially right angle to the sleeve-shaped base **271**. The sealing pane **272** comprises a ring groove or ring-shaped recess in which, analogous to the inner flange **26**, a sealing means or O-ring **28** is arranged, which seals the sealing pane **272** against the back glass pane **3**.

[0073] The absorber tube **8** guiding the heat exchanger medium **22** has an angle **32**, which is arranged essentially at the height of the inner flange **26**. By the angle **32** the absorber tube **8** is guided to the inner flange **26**, whereby the absorber tube **8** runs through the inner flange **26**, in particular the sleeve section **262**. The absorber tube **8** is connected rigidly to the inner flange **26**, in particular the sleeve section **262**. The connection is realized preferably by a soldering **29** or a weld seam.

[0074] The sleeve-shaped base **271** comprises, on one inner peripheral face, preferably a thread **30**, which engages in a corresponding counter thread **30'** of the inner flange **26**. The counter thread **30'** is here arranged preferably in the sleeve section **262** of the inner flange **26**. With the help of the thread **30** it is possible to brace the inner flange **26** against the outer flange **27**, so that the O-rings **28** arranged in the ring pane section of the inner flange **26** and the sealing pane **272** of the outer flange **27** are actively sealed against the back glass pane **3**.

[0075] The tube end of the absorber tube **8**, which is arranged outside of the composite glass pane **1** facing away from the sun **37**, comprises a connection **33** for connecting to the heating system of a building. The connection **33** can comprise a thread, a quick-acting closure or similar connection means.

[0076] The inner flange **26** is preferably connected to the back glass pane **3** by a temperature-resistant bonding agent **31** or is fixed to the back glass pane **3** by the temperature-resistant bonding agent **31**. The temperature-resistant bonding agent **31** can comprise a polymer or a polymer compound.

[0077] With respect to the sheet plating **20**, in the embodiment according to FIG. **6**, a refinement is provided that is different with respect to the embodiment according to FIG. **4**. In particular, the sheet plating **20** according to FIG. **6** has, also like that according to FIG. **4**, a first plating **21** on which the absorber sheet **7** is supported. In addition, however, in the embodiment according to FIG. **6**, a second plating **25** is to be arranged parallel to the first plating **21**, so that an apron is formed between the first plating **21** and the second plating **25**, wherein the absorber sheet **7** is received and held in this apron.

[0078] In this context it is noted that other embodiments of the sheet plating **20** or the spacers **4**, **5** can be combined with the feed-through of the absorber tube **8** on the back side through the back glass pane **3**. The same also applies essentially for the other embodiments mentioned in the application, which each allow and comprise any possible combination between spacers **4**, **5** or sheet plating **20** and absorber tube feed-through or arrangement of the feed line **9** and/or discharge line **10**.

[0079] In FIG. **7** another embodiment of the solar collector according to the invention or the composite glass pane **1** is shown, wherein, in particular the construction of the absorber tube feed-through through the back glass pane **3**, differs relative to the embodiment according to FIG. **6**. In particular, according to FIG. **7** it is provided to construct the inner flange **26** as a connection piece or as a feed line **9** or discharge line **10**. The inner flange **26** according to FIG. **7** has a passage line **265**, which is angled in the inside of the composite glass pane **1** and forms a coupling piece **266** on one end arranged in the inside of the composite glass pane **1**. The coupling piece **266** comprises essentially a larger cross-sectional diameter than the passage line **265**. The tube end of the absorber tube **8** opens into the coupling piece **266**. The absorber tube **8** is here preferably welded or soldered to the coupling piece **266**. In particular, the soldering **29** is arranged between the coupling piece **266** and the absorber tube end. The inner flange **26** is fixed with the temperature-resistant bonding agent **31** on the back glass pane **3**. Furthermore, the ring pane section **261** is constructed to become smaller above the curvature of the passage line **265**. In particular, the ring pane section **261** of the inner flange **26** forms a shark-fin-like profile above the curvature of the passage line **265**. The connection between the outer flange **27** and the inner flange **26** is constructed according to the embodiment of FIG. **6**.

[0080] Furthermore, in the embodiment according to FIG. **7**, it is proposed to provide, instead of the second plating **25** as can be seen in FIG. **6**, a fixing element **34**, which is connected or can be connected detachably to the sheet plating **20**. The fixing element **34** is preferably screw-connected or can be screw-connected to a lower wall of the sheet plating **20**. The fixing element **34** thus allows simple assembly, in particular a simple exchange of the absorber sheet **7** held between the first plating **21** and the fixing element **34**.

[0081] In addition, a spacer element **35** is provided, which is connected detachably to the absorber sheet **7**. The spacer element **35** essentially has a pin-like construction and extends perpendicular to the absorber sheet **7**. The spacer element **35** is here arranged between the front glass pane **2** and the absorber sheet **7** and ensures a constant spacing between the front glass pane **2** and the absorber sheet **7**. The spacer element **35** is preferably screwed with the absorber sheet **7**. This means that the absorber sheet **7** comprises a threaded drill hole in which a thread continuation of the spacer element **35** is arranged.

[0082] FIG. **8** shows clearly the basic configuration of a composite glass solar collector according to a preferred embodiment of the present invention. Accordingly, the solar collector according to the embodiment from FIG. **8** comprises an absorber **100**, which is preferably constructed as a combination of an absorber sheet **7** with an absorber tube **8**. A front side **102** and a back side **103** are allocated to the absorber **100**, wherein a cover **200** is arranged spaced apart from the absorber **100** on the front side **102** of the absorber **100**. On the back side **103** of the absorber **100** there is a back wall **300**, which has a spacing from the absorber **100**. The back wall **300** is constructed as heat-insulating glass or insulating glass. This means that the back wall **300** comprises a medium reflecting infrared radiation, in particular a coating reflecting infrared radiation. Furthermore, spacers **4**, **5** are provided which provide a sealed hollow space, in particular pane interspace **14**, **15** between the cover **200** and the absorber **100** and also between the back wall **300** and the absorber **100**. The absorber **100**, in particular the absorber sheet **7**, is fixed by a Y-profile **6** in the interspace between the back wall **300** and the cover **200**.

[0083] In FIG. **9** it is shown how the absorber **100** is preferably constructed. The absorber **100** comprises according to FIG. **9** an absorber sheet **7**, which is connected to an absorber tube **8**, wherein the absorber tube **8** extends in the shape of a meander across the back side **103** of the absorber sheet **7**. Here, the distances between the meander-like windings can vary. Preferably, the distances between the windings increase from a lower end to an upper end of the absorber **100**.

[0084] Especially for the integration of the composite glass solar collector in a building façade, it has been shown that the temperatures in the upper region of the absorber **100** are higher than those in the lower region. This effect can be used for increasing the efficiency of the solar collector, in that the meander-shaped windings of the absorber tube **8** have a smaller distance from each other in the upper region of the absorber **100** than in the lower region. For example, the distance between adjacent windings of the absorber tube **8** varies from at most 5 cm in the upper region to at most 15 cm, in particular at most 10 cm, in the lower region.

[0085] The absorber tube **8** has two tube ends, wherein an upper or first tube end is constructed as a feed line **9** and a second or lower tube end is constructed as a discharge line **10**. The feed line **9** and the discharge line **10** are preferably arranged at a right angle to the absorber sheet **7**. If the absorber **100** according to FIG. **9** is part of a composite glass solar collector, then the feed line **9** and the discharge line **10** are preferably guided through the back wall **300** at a right angle to the absorber sheet **7**. Preferably, during operation of the solar collector, the heat-exchanger medium **22** is fed through the feed line **9** into the absorber tube **8** and discharged from the absorber tube through the discharge line **10**. The heat-exchanger medium **22** thus flows through the absorber tube **8** starting from the feed line **9** up to the discharge line **10**.

[0086] In FIG. **10** different embodiments of the spacer element are shown in arrangement with the composite glass pane **1**. First of all, the spacer elements **35**, **38**, **39**, **40**, **42**, **43**, **45**, **48** shown in FIG. **10** are used not only in combination with each other, but also separately in the solar collector, and thus any combination of one of the shown spacer elements **35**, **38**, **39**, **40**, **42**, **43**, **45**, **48** with the composite glass pane **1** or the solar collector is disclosed and claimed.

[0087] The first spacer element **38** has a pin-like construction and passes through the front pane interspace **14**, the absorber sheet **7**, and the back pane interspace **15**. The first spacer element **38** thus extends from the front glass pane **2** up to the back glass pane **3**. Preferably, the first spacer element

38 is connected detachably to the absorber sheet **7**, in particular screw-connected. A different connection, in particular rigid connection, is possible.

[0088] One refinement of the first spacer element **38** is implemented with the second spacer element **48**. The second spacer element **48** essentially has a pin-like construction and further comprises positioning aids **48***a*, **48***b*. Here, a front positioning aid **48***a* has a cone-like construction, wherein the cone base is arranged in the region of the absorber sheet **7**. A back positioning aid **48***b*, which is arranged on the back side **103** of the absorber sheet has a vane-like construction, wherein the vanes of the back positioning aid **48***b* are flexible. The back positioning aid **48***b* thus forms a kind of snap closure or barbed hook. In this way, the second spacer element **48** can be guided through a drill hole in the absorber sheet **7**, whereby the second spacer element **48** automatically fixes itself as soon as the back positioning aid **48***b* is guided through the absorber sheet **7**.

[0089] A third spacer element **43** has a pin-like construction, wherein the third spacer element **43** extends from the back wall **300** or the back glass pane **3** up to the absorber sheet **7**. The third spacer element **43** is connected to the back glass pane **3** by a joint **44** or is bonded to the back glass pane **3**. The third spacer element **43** thus forms a back spacer element. A fourth, front spacer element **42** is allocated to the back spacer element or to the third spacer element **43**, wherein this fourth, front spacer element is bonded with the front glass pane **2** corresponding to the third spacer element **43** and extends like a pin up to the absorber sheet **7**. For this purpose, a joint **44** is provided between the front glass pane **2** and the front, fourth spacer element **42**. The absorber sheet **7** is thus held between the third and the fourth spacer element **43**, **42**.

[0090] It is likewise possible to provide a spacer element, which can be plug-connected to the absorber tube **8**. The fifth spacer element **45** shows such a spacer element. The fifth spacer element **45** has a front, C-shaped profile, which surrounds the absorber tube **8** for the purpose of the plug connection. The fifth spacer element **45** is further arranged on the back side **103** of the absorber sheet **7** and comprises two peaks, which extend in the direction of the back glass pane **3** and preferably contact the back glass pane **3** and support the absorber **100** or the absorber sheet **7** and the absorber tube **8** against the back glass pane **3**. A different number of peaks extending in the direction of the back glass pane **3** is possible.

[0091] A sixth spacer element **39** has an essentially pin-shaped form, wherein the sixth spacer element **39** forms, in the front pane interspace **14**, a shape corresponding to the front positioning aid **48***a* of the second spacer element **48**. In contrast to the second spacer element **48**, the sixth spacer element **39** has a securing disk **41** on the back side **103** of the absorber sheet **7** or on the side of the absorber sheet **7** facing toward the back glass pane **3**. The securing disk **41** can be screwed with the pin-like sixth spacer element **39**. The securing disk **41** forms a clamping fixture for the absorber sheet **7** with the front, cone-like section of the sixth spacer element **39**.

[0092] A seventh spacer element **40** has a profile-like construction and is arranged in the region of the sheet plating **20**. In particular the spacer element **40** is connected to the sheet plating **20** and has, on the side facing toward the absorber sheet **7**, a groove in which the absorber sheet **7** engages. In contrast to the other spacer elements, it is therefore not required in the seventh spacer element **40** that the seventh spacer element **40** form a contact to the front glass pane **2** or the back glass pane **3**. In this context, it is noted that the seventh spacer element **40** can be formed by the sheet plating **20** itself, in which the wall of the sheet plating **20** facing toward the absorber sheet **7** has a corresponding groove for holding the absorber sheet **7**.

[0093] It is noted that each of the mentioned spacer elements **35**, **38**, **39**, **40**, **42**, **43**, **45**, **48** can be arranged in a solar collector taken individually or in multiple arrangement. It is likewise possible that the mentioned spacer elements **35**, **38**, **39**, **40**, **42**, **43**, **45**, **48** be used in a solar collector in multiple combinations with each other. For example, several first spacer elements **38** can be provided in a composite glass solar collector. Alternatively or additionally, several second spacer elements **48**, third spacer elements **43**, fourth spacer elements **42**, fifth spacer elements **45**, sixth spacer elements **39**, or seventh spacer elements **40** can be provided. Preferably, several identical spacer elements **35**, **38**, **39**, **40**, **42**, **43**, **45**, **48** are to be provided.

[0094] FIGS. **11** and **12** show, in perspective representation, two other alternative embodiments of the absorber **100** according to the invention. The absorber **100** comprises, in general, an absorber sheet **7** and an absorber tube **8**. In the embodiment according to FIG. **11**, the absorber tube **8** is integrated into the absorber sheet **7**. This means that the absorber sheet **7** is penetrated by a fluid channel or a fluid channel is integrated into the absorber sheet **7**, with this channel comprising at least two outlet openings, which form the feed line **9** and the discharge line **10**. The absorber **100** or the integrated absorber sheet **7** comprises a front side **102** and a back side **103**. The back side **103** has a coating **130** reflecting infrared radiation. The reflective coating **130** is here adapted such that the reflection is active in the direction of the absorber tube **8** or the fluid channel. This means that heat energy or infrared radiation emitted by the absorber tube **8** or the fluid channel is reflected by the reflective coating **130**. The reflective coating **130** can be further adapted such that infrared radiation is absorbed or transmitted, at least partially, in particular to the greatest possible extent, from the outside, that is, infrared radiation incident on the back side **103** from the surroundings. In the embodiment according to FIG. **11**, it is further provided that the front side **102** comprises an absorbent coating **120**. The absorbent coating **120** is set to be absorbent for the wavelength range of the infrared radiation, so that the absorber **100** or the absorber sheet **7** has a high heat retention capability.

[0095] The coatings of the front side **102** and the back side **103**, in particular the reflective coating **130**, preferably comprise a low-e coating. The coating can comprise TiO_xN_y comprising a sputter layer. Such layers can also have a SiO_2 component. In general, the reflective coating **130** comprises a highly solar-selective layer. The coating can be deposited, for example, by a sol-gel method. Preferably, the coating is deposited in a sol-gel process, wherein the coating has a low-e optimization and comprises, for example, materials such as TiO_2 and ZnO or TiO_2 and SiO_2 or the like. Alternatively, the coating can comprise TEOS/Al_2O_3 and/or SiO_2.

[0096] The absorber **100** according to FIG. **12** differs from the absorber according to FIG. **11** in that the absorber tube **8** is arranged on the back side **103** of the absorber sheet **7**. The absorber tube **8** is here preferably welded with the absorber sheet **7** or coupled by a thermal connection **16** with the absorber sheet **7**, as already described in connection with FIGS. **3** and **9**. The absorber **100** according to FIG. **12** further has a reflective coating **130** that extends across the back side

103 of the absorber sheet **7**. The reflective coating **130** can here also comprise the absorber tube **8**. This means that the sides of the absorber tube **8** facing away from the solar radiation can also be provided with the reflective coating **130**.

[0097] The front side of the absorber **100** can have, as also provided according to FIG. **11**, a coating **120** absorbing infrared radiation. It is noted that the absorbent coating **120** and the reflective coating **130** can comprise the same material. The absorber **100** or the absorber sheet **7** can thus be coated on both sides with the same coating material, wherein the coating material has an absorbent effect, in particular on the front side **102**, and a reflective or heat-insulating effect, in particular on the back side **103**. The two-sided coating can preferably comprise a low-e coating. It is possible to deposit the two-sided coating on the absorber **100** by a dipping process. In this way a simultaneous coating of the front side **102** and the back side **103** is possible. The production of the absorber **100** is thus accelerated.

[0098] Alternatively, the absorbent coating **120** can comprise different layer systems on the front side **102** and the reflective coating **130** on the back side **103**. The different layer systems or coating materials can be deposited on the absorber **100** or the absorber sheet **7**, for example, by a spray coating.

[0099] In general, it is advantageous if the respective coating materials, which can even be identical, are selected such that the other processing steps in the manufacturing process can be executed simultaneously for both coatings or for the two-sided coatings. Such a further processing can comprise, for example, a heat treatment or radiation or illumination of the coating. For example, the layer materials for the absorbent coating **120** and the reflective coating **130** are each selected such that both the absorbent coating **120** and also the reflective coating **130** can be subjected to a common further treatment process, for example a heat-treatment method or an radiation with ultraviolet light.

[0100] FIG. **13** shows a preferred embodiment of a solar collector configuration having an absorber **100** according to FIG. **11**. In the solar collector configuration, the absorber **100** or the absorber sheet **7** having integrated fluid channels or the integrated absorber tube **8** is coupled with a front glass pane **2** by spacers **4**, **5**. The front glass pane **2** thus forms the cover **200** of the solar collector. The configuration according to FIG. **13** corresponds essentially to a composite glass configuration, wherein the back glass pane **3** is replaced by the absorber element **100**. Here, the back side **103** of the absorber **100** or of the absorber sheet **7** has the coating **130** reflecting infrared radiation.

[0101] The embodiment according to FIG. **13** can be expanded by another back glass pane **3**, which comprises an additional coating reflecting infrared radiation or is constructed as heat-insulating glass. For achieving the higher action desired here, it is possible to provide an insulating glass composite or a composite pane, which comprises a front glass pane **2**, a back glass pane **3**, and an absorber **100** arranged in-between, wherein the medium reflecting infrared radiation, in particular the coating **130** reflecting infrared radiation is provided on the side of the absorber **100** facing away from the solar radiation. The coating **130** reflecting infrared radiation here can be arranged both on the back side **103** of the absorber **100** and also on a surface of the back glass pane **3**. It is also possible that a medium reflecting infrared radiation, in particular glass bead bulk material, is provided between the absorber **100** and the back glass pane **3**, that is, in the back pane interspace **15**. The arrangement and use of the mentioned media reflecting infrared radiation can be realized individually and also in combination. This means that, for example, the back side **103** of the absorber sheet **7** or the back glass pane **3** or the back side **103** of the absorber sheet **7** and the back glass pane **3** can comprise a coating **130** reflecting infrared radiation, or in general a medium reflecting infrared radiation.

[0102] In FIG. **14** a combination of the embodiments according to FIGS. **3** and **6** is shown. The configuration of the composite glass solar collector corresponds essentially to the configuration according to FIG. **3**, wherein in FIG. **14** it is shown how the absorber tube **8** is guided out from the composite glass solar collector. Leading the absorber tube **8** out from the composite glass solar collector is realized here analogous to the embodiment according to FIG. **6**.

[0103] In the following possible materials for the individual components of the composite glass solar collector will be explained as examples with reference to the representation according to FIG. **14**.

[0104] The composite glass solar collector comprises a front glass pane **2**, which preferably comprises a single pane safety glass, in particular white glass single pane safety glass. The front glass pane **2** can have a wall thickness of at least 2 mm, in particular at most 5 mm, in particular a thickness of 4 mm. The back glass pane **3** is preferably constructed as float glass, in particular as float glass single-pane safety glass. The back glass pane **3** can have the same dimensions as the front glass pane **2**. In particular the back glass pane has a wall thickness of 4 mm. The front glass pane **2** and the back glass pane **3** are connected by the secondary bonding agent **12**. Underneath the secondary bonding agent **12**, the spacers **4**, **5** are arranged, which are respectively connected to each other by the primary bonding agent **11** or to the front glass pane **2** and the back glass pane **3**. The primary bonding agent **11** and the secondary bonding agent **12** are each preferably constructed as sealing means or as seals. The spacers **4**, **5** each comprise a hollow profile in which a drying agent **13** is arranged. The drying agent **13** preferably includes a molecular sieve.

[0105] A Y-profile **6**, which forms a holding element for the absorber sheet **7**, is further arranged between the spacers **4**, **5**. In the Y-fork the Y-profile preferably comprises a holding wall **6*a***, which has a V-shaped or U-shaped construction. The U-shaped or rail-like profile of the holding wall **6*a*** can comprise a polycarbonate. Within the holding wall **6*a*** there is a filling **6*b***, which preferably comprises silicon. In the filling **6*b*** the absorber sheet **7**, or in general the absorber, is embedded. The absorber sheet **7** preferably has a wall thickness of at least 0.3 mm, in particular at least 0.4 mm, in particular at most 0.6 mm, in particular at most 0.5 mm. Preferably, the absorber sheet comprises aluminum or an aluminum alloy. A pane interspace **14**, **15**, which has an essentially fixture-free construction, is arranged between the absorber sheet **7** and the front glass **2** and between the back glass pane **3**, respectively. The pane interspaces **14**, **15** are each preferably filled with gas, in particular comprising argon.

[0106] The front glass pane **2** has a second anti-reflection coating **18** directed toward the front pane interspace **14**. The second anti-reflection coating **18** is preferably constructed as low-e coating. The front side **102** of the absorber further has a first anti-reflection coating **17**, which is preferably constructed as a special absorber coating. The first anti-reflection coating **17** or absorber coating is characterized with respect to infrared radiation preferably by a degree of absorption of at least 70%, in particular at least 75%, in particular at least 80%, in particular at least 90%, in particular at least 95%, and/or a degree of reflection of at most 25%, in particular at most 20%, in particular at most 15%, in particular at most 10%, in particular at most 5%. The back glass pane **3** comprises a reflection layer **19**, which can comprise a low-e coating. Here, the reflection layer **19** is facing toward the second pane interspace **15**. The low-e coating of the second anti-reflection coating **18** or the reflection layer **19** can each be adapted such that infrared radiation emitted by the absorber **100** or the absorber sheet **7** is predominantly reflected. This means that the second anti-reflection coating **18** and the reflection layer **19** each have, with respect to infrared radiation, a degree of reflection in the direction of the absorber **100** that equals greater than 50%, in particular greater than 70%, in particular greater than 90%.

[0107] The absorber **100** further comprises an absorber tube **8**, which is connected rigidly to the absorber sheet **7**. The absorber tube **8** is guided outward through the back glass pane **3** or leaves the inside of the composite glass solar collector through the back glass pane **3**. For this purpose, a flange arrangement according to the embodiment from FIG. **6** is provided. The flange arrangement comprises an inner flange **26** and an outer flange **27**, wherein the outer flange **27** comprises a thread **30**, which can be screw-connected to a counter thread **30'** of the inner flange **26**. The inner flange **26** and the outer flange **27** further comprise O-rings **28**, which seal the flanges **26**, **27** against the back glass pane **3**. In addition, a sealing means **26***a*, which preferably comprises butyl, is allocated to the inner flange **26**. The sealing means **26***a* is arranged between the inner flange **26** and the back glass pane **3**, in particular between the O-rings **28**. The inner flange **26** is further connected rigidly to the absorber tube **8**, preferably soldered. The soldering **29** provided for this purpose can comprise a hemp solder.

[0108] In FIG. **15** it is shown in a longitudinal section how the preferred composite glass solar collector is constructed. The composite glass solar collector or the insulating glass element with integrated absorber **100** has an absorber **100**, which comprises an absorber sheet **7** and a meander-shaped absorber tube **8** arranged on the absorber sheet **7**. The meander-shaped windings of the absorber tube **8** have, in a lower region of the solar collector, a spacing AU, which is greater than the spacing AO of the meander-shaped windings in the upper region of the solar collector. The packing density of the absorber tube windings is thus preferably greater in the upper region of the absorber than in the lower region of the absorber. It is preferred when the spacing of the absorber tube windings from the upper spacing AO to the lower spacing AU increases continuously. For the use of the composite glass solar collector or insulating glass element in a building façade, this embodiment has the advantage that the higher temperatures in the upper region of the solar collector can be used more effectively for the energy generation or energy conversion. Alternatively or additionally, the heat-exchanger medium **22** can be guided through the absorber **100** or the absorber tube **8** in a counter-flow principle.

[0109] In European Patent EP 1 279 905 B1, a solar collector is mentioned having an absorber tube, which is connected to an integrally constructed absorber sheet and is integrated into a box-shaped configuration. In other words in EP 1 279 905 B1 a solar collector is mentioned having absorber tubes, which carry a flow of a heat carrier medium, and having an absorber for retaining the solar energy, which is constructed as an integrally formed absorber sheet, which is connected to the absorber tubes and covers these tubes, wherein the absorber sheet has a completely planar profile and the absorber tubes are completely covered, and the absorber sheet is made of copper or aluminum and has a selective surface coating, and the profiling of the absorber sheet has, in cross section, an essentially wavy, fold-like, or sawtooth-like construction, and the absorber tubes are arranged parallel to each other, and the orientation of the profiling of the absorber sheet is parallel to the absorber tubes. Such a solar collector construction corresponds to the prior art. Here, 0.1 mm to 0.5 mm thick copper or aluminum sheets are used having a conventional, maximum sheet width of 50 mm to maximum 1200 mm or 1250 mm and an absorber length up to approximately 3 m and with an absorber coating having approximately 95% degree of solar absorption and approximately 4% thermal emissions degree in combination with copper tubes having 8 mm to 12 mm outer diameter and approximately 0.5 m wall thickness and a spacing between the tubes of typically 70 mm to 140 mm. As an example, the absorber tubes were fixed, in general in a meander-like shape by ultrasound or laser welding or soldering, or in general with a thermal contacting on the absorber sheets. The feed lines and discharge lines can be constructed here essentially optimized to the application. The typical weight here equals 2 kg per m2 to 3.5 kg per m2. As embodiments for typically available absorber sheets, as an example, the products from the company Alanot-Sunselect GmbH & Co. KG in D-37597 Lauenförde, Germany, having the designation "Sunselect," or from the company TiNOX GmbH in D-80993 Munich, Germany, having the designation "TiNOX Classic" or "TiNOX Art-Line," are mentioned. In both cases, the thin absorber coating is produced in a vacuum.

[0110] The solar collector according to above-mentioned DE 10 2006 006 718 B4 comprises at least one heat-exchanger tube or heat-exchanger element having inlet tubes and outlet tubes leading into the collector and out from this collector, respectively, in particular feed lines and discharge lines, respectively, and a flat cover, which is, for the most part, transparent and forms the supporting component of the collector, and the collector is essentially formed only from the, for the most part, transparent cover, an absorber, and at least one heat-exchanger tube, wherein the absorber is connected to the cover at a given spacing. It is further mentioned that the absorber is bonded with the, for the most part, transparent cover or with the glass pane. In this prior art, a glass pane as a cover consequently forms the support component of the collector.

[0111] This support function of the glass pane is expanded according to an associated aspect of the present invention in the sense of the use of an insulating glass configuration according to the prior art, however, under consideration of the temperatures given by the integration of a thermal solar collector. In particular, the so-called primary and secondary bonding agent compounds are designed for the high temperatures to be expected in the case of the standstill (stagnation) of a collector. The temperatures of the collector can here rise to greater than 150° C. up to approximately 200° C. Furthermore, the thermal solar collector is fixed in the inside of the insulating glass composite element, such that the thermal expansion is considered and a warping due to the typically asymmetric collector configuration is kept within limits, and for higher collector temperatures, the coated collector sheet side does not come into contact with the glass inside, and furthermore the mounting is designed so that an economical and permanent assembly is possible in the course of the insulating glass fabrication.

[0112] The feed lines and discharge lines of the collector tubes represent another critical point in the function and for the assembly. In the simple case there are two feedthroughs for a meander-shaped thermal solar collector. Four feedthroughs, however, can also be provided. Here, for a meander-shaped collector, collection tubes can be arranged in the inside of the insulating glass. For the use of a harp-shaped collector, the collection tubes can likewise be constructed with four feedthroughs.

[0113] It has been shown that a feedthrough through the back-side glass pane produces a very stable solution and allows a relatively simple assembly, because the entire collector can be already connected or pre-mounted with the back-side glass pane during the insulating-glass fabrication process. The feedthroughs of the feed lines and discharge lines preferably have a permanently elastic and long-term-stable, sealed construction, and care is preferably taken such that the metallic feedthrough does not have a glass contact directly, but instead a permanently elastic and long-term-stable sealed and temperature-resistant, polymer element is always arranged in-between.

[0114] In one preferred construction of the present invention, a special aspect lies in that the glass surfaces of a solar collector actually provided for the radiation of solar radiation are constructed, at least in some regions, such that infrared radiation is reflected from the surface of the glass pane located within the solar collector. Here, a glass pane provided on the back side of the absorber is especially suitable, because this allows a compact configuration and also at least one reduction of the damping materials being used.

[0115] Overall, in another preferred construction of the present invention, one core consideration features the integration of an absorber element in a composite glass or sandwich glass construction, wherein the surface directed inward, the glass pane provided on the back side of the absorber, is provided with a layer reflecting infrared radiation.

[0116] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the present invention as defined by the appended claims.

1.-**18**. (canceled)

19. A solar collector comprising an absorber having a front side facing toward solar radiation during use and a back side facing away from the solar radiation during use, a transparent cover arranged essentially plane-parallel opposite the front side of the absorber, and a medium which reflects infrared radiation and is reflective toward the absorber, wherein the medium is allocated to the back side of the absorber.

20. The solar collector according to claim **19**, wherein the medium reflecting infrared radiation comprises at least one of a coating reflecting infrared radiation and additives reflecting infrared radiation.

21. The solar collector according to claim **19**, further comprising a back wall arranged opposite the back side of the absorber.

22. The solar collector according to claim **21**, wherein the back wall comprises a transparent pane, optionally a glass pane or plastic pane, and at least in some regions comprises the medium reflecting infrared radiation.

23. The solar collector according to claim **21**, wherein the cover and the back wall each comprise glass, optionally a glass pane, which forms an outer boundary of the solar collector.

24. The solar collector according to claims **21**, wherein at least one of the cover and the back wall, optionally the medium reflecting infrared radiation, comprises a heat-insulating glass.

25. The solar collector according to claim **21**, comprising a composite glass construction having a sandwich configuration, wherein the absorber is arranged between two glass panes, which form the cover and the back wall, respectively.

26. The solar collector according to claim **21**, wherein the medium reflecting infrared radiation comprises pigment-like bodies, optionally glass beads, arranged on a side of the back wall facing toward the back side of the absorber.

27. The solar collector according to claim **21**, wherein the cover and the back wall are arranged spaced from the absorber and are connected by a frame.

28. The solar collector according to claim **21**, comprising a pane interspace between the cover and the back wall, the pane interspace being closed gas-tight relative to its surroundings.

29. The solar collector according to claim **21**, wherein the solar collector has a form of a composite glass pane having two glass panes arranged on an the outside and the absorber in the inside.

30. The solar collector according to claim **29**, wherein the two glass panes form the cover and the back wall, respectively.

31. The solar collector according to claim **29**, wherein surfaces of the two glass panes facing toward the absorber comprise, at least in some sections, the medium reflecting infrared radiation.

32. The solar collector according to claim **19**, wherein the solar collector has a construction of a flat collector or tube collector, wherein a first glass region is on a side of the solar collector facing toward the solar radiation as a solar glass pane, and a second glass region is on a side of the solar collector facing away from the solar radiation as heat-insulating glass.

33. A composite pane comprising a frame connecting at least two transparent panes, optionally glass panes, spaced from each other and arranged plane-parallel to each other in a gas-tight manner, wherein the transparent panes each have a medium reflecting infrared radiation inward, and wherein at least one absorber for solar energy is arranged between the transparent panes.

34. An absorber comprising a front side, a back side, and at least one fluid channel for a heat-exchange medium, the channel being arranged between the front side and the back side, wherein the back side has, at least in some regions, a medium reflecting infrared radiation in a direction of the fluid channel.

35. The absorber according to claim **34**, wherein the medium reflecting infrared radiation comprises a coating which reflects infrared radiation.

36. The absorber according to claim **34**, wherein the front side has, at least in some regions, a coating absorbing infrared radiation.

37. A solar collector comprising the absorber according to claim **34**.

38. A composite pane comprising the absorber according to claim **34**.

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