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(54) Title: SOLAR PANEL AND GLAZING PANEL

(57) Abstract: This invention relates to a solar panel, and in particular to a solar panel designed to absorb heat from solar radiation. The invention provides a solar panel adapted to fit between two sheets of glass in a glazing panel, the solar panel being adapted to absorb heat from a proportion of the incident light, and to permit another proportion of the incident light to be transmitted through the solar panel and the glazing panel. The invention also provides a glazing panel fitted with a solar panel.

SOLAR PANEL AND GLAZING PANEL

FIELD OF THE INVENTION

- 5 This invention relates to a solar panel, and in particular to a solar panel designed to absorb heat from solar radiation. The invention also relates to a glazing panel fitted with a solar panel.

In this description, directional and orientational terms such as “top”, “bottom”,
10 “vertical” etc. refer to the solar panel in its normal orientation of use as shown in Fig.1, unless otherwise indicated.

BACKGROUND TO THE INVENTION

- 15 Solar panels fall into two main classes. The first class comprises panels which absorb heat from the sun and utilise that heat either directly or indirectly. The most common form of solar panel of this class comprises a number of tubes which carry a liquid (typically water), the incident solar radiation heating up the liquid in the pipes, which heated liquid is pumped to a location where the heat is recovered
20 or used.

The second class of solar panels comprise photovoltaic cells which convert the incident solar radiation into electricity. The second class has the advantage that the electricity can be more efficiently transmitted to a remote location, and can be
25 more efficiently stored for subsequent use. The major disadvantage is the relatively high cost of the solar panels of this class.

The present invention relates to the first class of solar panels.

- 30 The disadvantages of the first class of solar panels can be reduced by arranging the solar panels as close as possible to the eventual site of use of the heated liquid. Solar panels of this class are widely used in domestic dwellings, where the solar panel can be fitted to the outside of the building relatively close to a hot

water tank which stores water which is heated by the liquid, and in which the heat recovered from the solar radiation can thereby be stored.

Despite their relatively widespread (and increasing) utilisation, the inventor has realised that the existing solar panels have a number of drawbacks which are believed to limit their use.

Firstly, the solar panels are relatively unsightly. The solar panels are most often fitted to the roof of a building and the dark colouring of the solar panel (necessary to maximise the heat which can be captured) contrasts starkly with the colouring of the remainder of the roof. Whilst to some people the clear visual indication is a benefit in that third parties can see that the building occupier is seeking to save fossil fuels, for others it is understood that the visual unattractiveness is a barrier to the utilisation of the solar panels.

Secondly, the fitment of a solar panel to a roof often requires an opening to be formed in the roof through which the water pipes can pass. The installation also often requires other openings to be formed for the fixings for the solar panel. Any one of the openings can over time cause the roof to leak and the repair of a (slow) leak into a roof space will often be relatively expensive because it will not likely be noticed for a considerable period of time.

Thirdly, the structure securing a planar solar panel to a non-planar roof (comprising tiles, slates or the like), is necessarily complex and cumbersome. The structure also includes at least one insulating material to protect the roof from the high temperatures which can be attained by the solar panel.

Fourthly, the angle of the solar panel is determined by the angle of the roof, and that angle may not permit the solar panel to absorb the maximum amount of solar radiation which is available. Thus, ideally the solar panel should be perpendicular to the incident solar radiation, and the desired angle of the solar panel is therefore determined by the latitude of the building to which the solar panel is fitted, and to the time of year.

Fifthly, solar panels are heavy and the roof structure may not be designed to support the panels in addition to other loads such as snow for example.

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SUMMARY OF THE INVENTION

The inventor has sought to provide a solar panel which avoids or reduces the above-stated problems, with a view to increasing the utilisation of solar panels of
10 this class, and thereby reducing the reliance upon fossil fuels.

According to the invention there is provided a solar panel adapted to fit between two sheets of glass in a glazing panel, the solar panel being adapted to absorb heat from a proportion of the incident light, and to permit another proportion of the
15 incident light to be transmitted through the solar panel and the glazing panel.

The inventor has therefore appreciated that at least some of the above-stated problems can be avoided by fitting the solar panel to a glazing panel, perhaps in an existing glazing frame, and thereby removing the requirement to fit the solar
20 panel to the roof of a building.

Whilst it is accepted that a solar panel which also acts as a glazing panel, and which therefore does not absorb all of the incident light, cannot be as efficient as a solar panel which absorbs substantially all of the incident light, the inventor
25 expects that the benefits of the invented solar panel in terms of ease of installation and low cost will make it attractive for users, and upon buildings, where the use of solar panels would not otherwise be considered.

Preferably, the solar panel comprises a first manifold and a second manifold
30 which are adapted to fit into the profile of a glazing panel, and a number of tubes which can be fitted between the panels of glass of the glazing panel and connect the first manifold to the second manifold.

Desirably, at least one of the manifolds includes a baffle. The provision of a baffle enables the installer to connect the liquid inlet to the bottom end of the first manifold and to connect the liquid outlet to the bottom end of the second manifold, whilst maintaining a liquid flow through all of the tubes regardless of their distance
5 from the bottom ends of the manifolds.

Preferably, the tubes are acircular throughout a substantial part of their length, and are ideally flattened so as to increase their surface area relative to their cross-sectional area. Ideally, however, the tubes are substantially circular at their ends,
10 the provision of circular ends facilitating ease of fitment to the respective manifolds. The provision of circular ends also enables the manufacturer to install the tubes with the required angular relationship to the manifolds in order to maximise the heat absorption.

15 Preferably, the angular relationship between the tubes and manifolds is variable, so that the tubes can be adjusted to maximise the heat captured from the incident solar radiation at different times of the year. Ideally the angle of the tubes can be adjusted by the user. Desirably, the tubes are movable between two angular positions, one being suited to the Sun's position during the summer months, the
20 other being suited to the Sun's position during the winter months.

Embodiments of the solar panel in which the angle of the tubes can be adjusted by the user may have the option of a "closed" setting, i.e. the tubes may be movable to a position in which there are substantially no gaps between adjacent
25 tubes, so that the tubes prevent substantially all of the incident light from passing through the solar panel. Such an arrangement can replicate a blind which might otherwise be used to reduce or prevent the passage of light.

The solar panel is expected to be used in conservatories of domestic dwellings,
30 and in particular in the conservatory roof and in the (vertical) glazing panels of the conservatory close to the ground, where their visual impact will be minimal. The solar panel could alternatively, or additionally, be used in other glazing panels of a building, such as the vertical glazing panels of bathrooms where the partial

transmission of light is an advantage. In addition, the solar panel could be used as a roof light, for example, ideally in locations where the roof is adapted to support the weight of a glazing panel.

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BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

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Fig.1 shows a representation of the solar panel of the invention fitted into a glazing panel;

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Fig.2 shows a horizontal sectional view through a part of a glazing panel fitted with a solar panel according to a first embodiment of the invention;

Fig.3 shows a front view of a part of a glazing panel of fitted with a solar panel according to the first embodiment;

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Fig.4 shows a horizontal sectional view through a part of a glazing panel fitted with a solar panel according to a second embodiment of the invention; and

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Fig.5 shows a front view of a part of a glazing panel fitted with a solar panel according to the second embodiment.

DETAILED DESCRIPTION

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The solar panel 10 which is shown in Figs. 2 and 3, and which is represented in Fig.1, comprises a first manifold 12, a second manifold 14, and a number of tubes 16 which are connected between the first and second manifolds.

In common with known solar panels of this class, the manifolds and tubes carry a liquid, typically water, which flows from an inlet 20 into the first manifold 12, along the tubes 16, into the manifold 14, and out of the outlet 22. During its passage through the tubes 16 the liquid absorbs heat from the incident solar radiation SR, and the heated liquid is pumped from the outlet 22 to a location where the heat is extracted or used.

In a typical installation the liquid for the solar panel 10 is recirculated in a closed circuit, the circuit perhaps including a coil within a domestic hot water tank, whereby the heated liquid can give up some of the acquired heat to the water within the hot water tank, which hot water is then used within the building. The parts of the liquid circuit between the outlet 22 and the inlet 20 are not part of the present invention and so are not represented in the drawings.

As is common with solar panels of this class, a sheet of glass 24 or other transparent material is located between the tubes 16 and the incident solar radiation SR. The present invention differs from the prior art solar panels of this class in having a second sheet of glass (or other transparent material) 26, with the tubes 16 located between the sheets of glass 24, 26. Accordingly, unlike a conventional solar panel of this class, the solar panel can be fitted into a (double) glazing panel with at least some of the incident light able to pass through the glazing panel.

As better seen in Fig.1, it is ideally arranged that the glazing panel is located towards the floor in a conservatory, or in another location where the full transmission of light is not required or desired. When so located, the tubes 16 can absorb much of the heat from the incident solar radiation SR, and yet can permit the passage of light so that an observer O located within the conservatory can still see through parts of the solar panel 10, and specifically can receive light rays such as 30 which pass between adjacent tubes 16, as well as light rays 32 which pass over the top of the solar panel 10.

Fig.1 also shows the preferred orientation of the tubes 16. In order to increase their surface area relative to their cross-sectional area the tubes 16 are flattened and their longer sides are aligned at an angle α to face the predominant direction of the solar radiation SR. In the central area of the UK for example the angle α should be around 40° in the summer, and the angle α can be varied (by the manufacturer) depending upon the latitude of the location of use of the solar panel (with a smaller angle α for locations closer to the equator).

In Fig.1 the tubes 16 are shown as rectangular, but in practice the tubes will ideally be oval, with substantially flat longer sides and curved ends. If desired, the tubes 16 can be made as an extrusion with a central hole, the extrusion being cut to the desired length and the ends machined to form the sealing faces which cooperate with openings in the respective manifolds 12 and 14.

It will be seen from Fig.1 that the size and positions of the tubes 16 are such that the incident solar radiation SR cannot pass through the solar panel, and this is an added benefit for the use in conservatories or the like where it is not uncommon to use blinds to prevent the direct passage of sunlight into parts of the conservatory, especially during the summer months. It will be understood from Fig.1 that if the solar panel 10 is arranged below the eye height of an observer, then the observer will have an unobstructed view through the window of the conservatory above the top of the solar panel (represented by the light ray 32), and will have a partially limited view through the glazing panel and solar panel 10 (represented by the light rays 30). By arranging the solar panel 10 somewhat below the eye height of a person seated in the conservatory the solar panel 10 (or more likely the set of solar panels 10 arranged around the conservatory) will be substantially unobtrusive in practice.

As shown in Fig.2, the glazing panel includes a frame 34, in this embodiment of hollow plastics profile. The form of the profile is simplified in this figure, and will in practice include formations to carry seals and the like, and be suited to a particular manufacturer. Substantially all hollow plastic glazing frames include a chamber such as 36, and the present invention utilises this chamber to carry

some of the inlet and outlet conduits for the solar panel. Thus, it will be understood that the frame 34 surrounding the whole of the glazing panel will be of substantially identical profile, and will be mitred at the corners, so that the chamber 36 of the vertical edge of the glazing panel shown in Fig.2 will continue
5 into the corresponding chamber 36 of the neighbouring horizontal edges of the glazing panel.

As seen in Fig.3, the tubes providing the inlet 20 and the outlet 22 (only part of which are shown in Fig.3) are located within the chamber 36, and the tubes can
10 be bent to pass along the chamber 36 and subsequently to pass out of the chamber 36, and out of the frame 34, by way of corresponding holes formed through the wall of the chamber (not shown). In addition, the tubes providing the inlet 20 and outlet 22 pass through holes (not shown) in the wall of the chamber 36 and sealingly engage the respective manifolds 12 and 14.

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Whilst it would be possible to arrange the inlet at the bottom of the manifold 12 and the outlet at the top of the manifold 14, it is desirable to locate both of the inlet and outlet at the bottom of the respective manifolds, as this requires the insertion of inlet and outlet tubing only into the bottom edge of the frame 34. In order to
20 ensure that the liquid flows substantially equally through all of the tubes 16, a baffle 40 is located into one of the manifolds (in this embodiment the inlet manifold 12), the baffle separating the flow conduit 42 into an inlet part 44 and a return part 46.

25 The top of the baffle 40 is slightly above the topmost tube 16. The inlet 20 is connected to the inlet part 44 and the return part 46 is connected to the tubes 16. Liquid entering the manifold 12 is therefore required to pass up the inlet part 44, over the baffle 40 and down the return part 46 before it can enter the tubes 16. In an alternative embodiment the baffle is a tube within the manifold 12, such as the
30 tube 140 shown in Fig.4.

It will be seen from Fig.2 that the manifolds 12, 14 are located between the sheets of glass 24 and 26, and between the locating walls 50, 52 of the frame 34. It will

be understood that the locating walls 50, 52 will typically carry seals or beads which engage the sheets of glass 50, 52 and provide weather proofing.

If desired, the two sheets of glass, with the solar panel 10 therebetween, can be a sealed unit, through this is not shown in the embodiment of Fig.2.

It will be seen from Fig.2 that the manifold 12 is visible in use, and thereby occupies some of the glazing area, i.e. in this embodiment the manifold 12 (and similarly the manifold 14) projects slightly beyond the locating walls 50, 52. In an alternative embodiment the manifold and frame 34 are sized so that the manifolds lie fully within the locating walls and are substantially invisible in use.

It will be observed from Fig.2 that the flattened region 16a of the tubes 16 does not continue into the manifolds, and the flattened region 16a is joined at each end to a substantially circular end part 16b. The advantage of having substantially circular end parts is that the seal to the manifolds can be easier to arrange, i.e. seals for (fixed or movable) circular tubes in circular openings are readily available. Also, the manufacturer can manufacture similar tubes and similar manifolds, and can vary the angle α as desired for a particular latitude, merely by utilising suitable jigs and fixtures during the assembly of the solar panel.

In a preferred embodiment, the tubes 16 are formed from circular-section tubing, the central part of which is pressed or flattened into the oval shape required. The ends are not flattened, however, so as to provide a circular sealing surface with the manifolds. Also, the circular ends 16b of the tubes 16 carry a suitable seal allowing the ends to be press-fitted into sealing engagement with the manifolds 12, 14.

As above indicated, in the embodiment of Figs. 2 and 3 it is necessary to cut or remove parts of the window frame 34 in order to fit the solar panel 10. The embodiment of Figs. 4 and 5 avoids that potential disadvantage. The embodiment of Figs. 4 and 5 differs from that of Figs. 2 and 3 in providing an additional frame component 60 which locates within the existing window frame

134 and carries the manifolds 112 and 114. The additional frame component is substantially of H-section in this embodiment, and can be sealed to the window frame 134 by way of a bead 64, in known fashion, and similarly can be sealed to the sheets of glass 124, 126 in known fashion (the seals are not shown in the figures).

This embodiment of solar panel 110 also has a sealing wall 62 adjacent to the manifold 112 which provides a seal around each of the end parts 116b of the tubes 116. The sealing wall 62 (and the corresponding sealing wall adjacent the manifold 114) provides a sealed unit comprising the flattened parts 116a of the tubes 116 and the sheets of glass 124, 126. A similar sealing wall can be used with the embodiment of Figs. 2 and 3 if desired.

Importantly, the inlet 120 and the outlet 122 from the respective manifolds 112, 114 pass through the wall of the additional frame component 60 rather than through the frame 134. Accordingly, it is not necessary to cut or remove any part of the frame 134. This has the additional benefit that, the solar panel 110 can readily be fitted to an existing window frame 134 as a retro-fit installation.

It will be understood that the embodiment of Figs. 4 and 5 obscures more of the glazing area than the embodiment of Fig. 2 and 3, but that will be an acceptable compromise to customers who do not wish to cut or remove any of the window frame.

In the simplest embodiments of the invention the solar panel will be a fixed fabrication heat exchanger with the tubes fixed at the required angle in order to optimise the collection of solar heat, i.e. the angle α will be fixed by the manufacturer, ideally as a compromise between the varying angular position of the Sun during the course of a year at the latitude of use. The circular form of the ends 16b of the tubes enables the manufacturer to use common parts but provide any desired angle α for such embodiments. In more complex embodiments, the circular form of the ends 16b of the tubes can permit the user to rotate the tubes 16 so as to adjust the angle α , for example between a "summer setting" and a

“winter setting”, which settings optimise the capture of solar radiation during the summer and winter months, respectively, at the latitude of use. Particularly complex embodiments can be continuously adjustable so that the angle α varies, perhaps automatically, to follow the position of the Sun.

5

Also, in embodiments in which the angle α of the tubes 16 can be adjusted by the user, the solar panel may have a “closed” setting, i.e. it may be possible to adjust the angle α so as to eliminate the passage of the light rays 30. The solar panel 10 could therefore have the function of a blind in addition to its function as a solar collector.

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Another manufacturing benefit can be attained by making the manifolds 12, 14 in a number of discrete lengths, and by making the tubes 16 in a number of discrete lengths, it being understood that the vast majority of glazing panels are made to certain standard sizes which can be fitted with solar panels made up of relatively few standard-sized components.

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It is not intended that the solar panel 10 be used in a pivoting glazing panel as that would require a movable liquid connection between the pivoting glazing panel and its fixed frame. Also, the weight of the glazing panel would be increased, potentially requiring more robust hinges to be used. However, the present invention is not precluded from use with movable panels as a movable (rotatable) liquid connection can be provided if required, and the additional weight of the solar panel will not be prohibitive.

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Whilst it is primarily intended that the solar panel 10 be for use in a substantially vertical glazing panel, that is not necessary, and the invention could be utilised in a roof light or similar glazing panel. In such embodiments, the angling of the tubes 16 would be arranged to be as close as possible to the desired angle α for the latitude of use, but also to permit the passage of a proportion of the light between adjacent tubes.

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Whilst the side of the tubes facing the solar radiation SR will ideally be matt black so as to capture as much of the incident solar radiation as possible, the other parts which are visible to the observer O can be white or silver so as to minimise the radiated heat. Also, if desired, the size and position of the tubes 16, and/or
5 the colouring of the visible parts of the tubes 16, can be patterned to match a blind, so that in use in a conservatory for example some of the windows can be covered by blinds whilst others are fitted with matching solar panels 10.

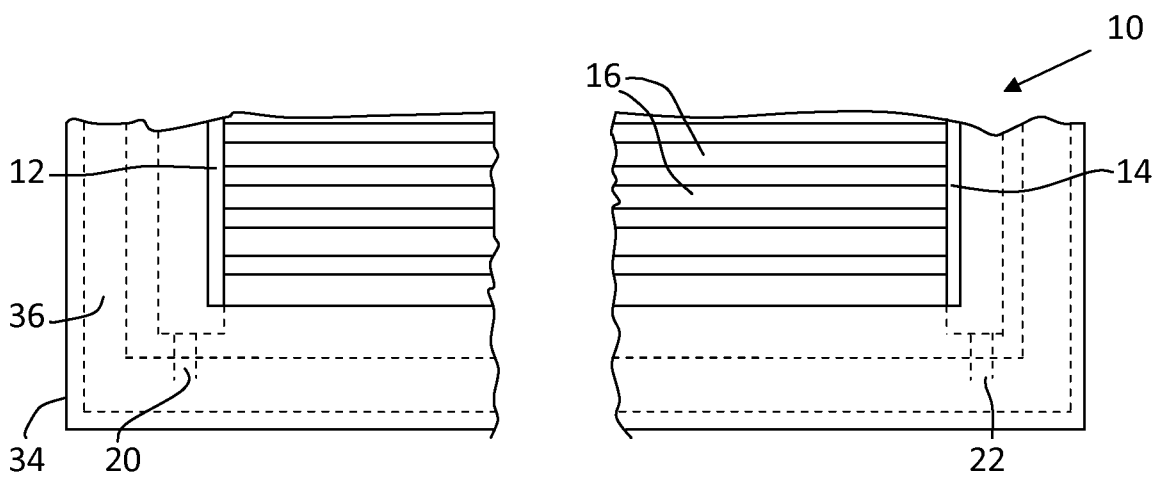
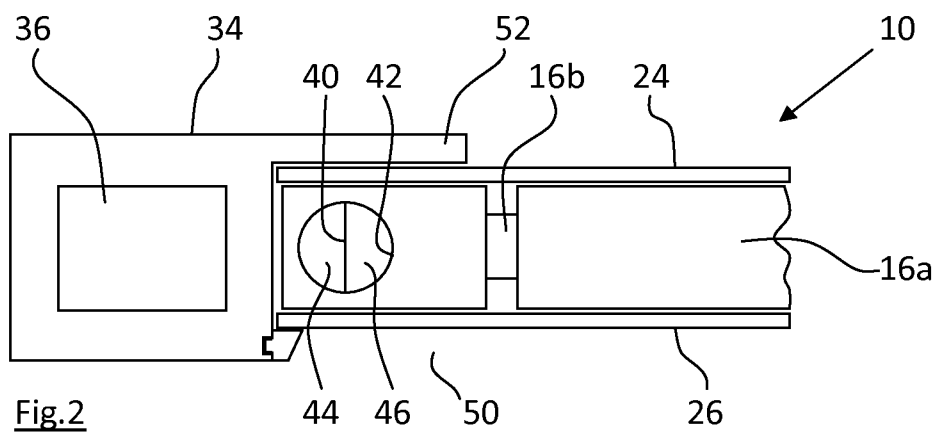
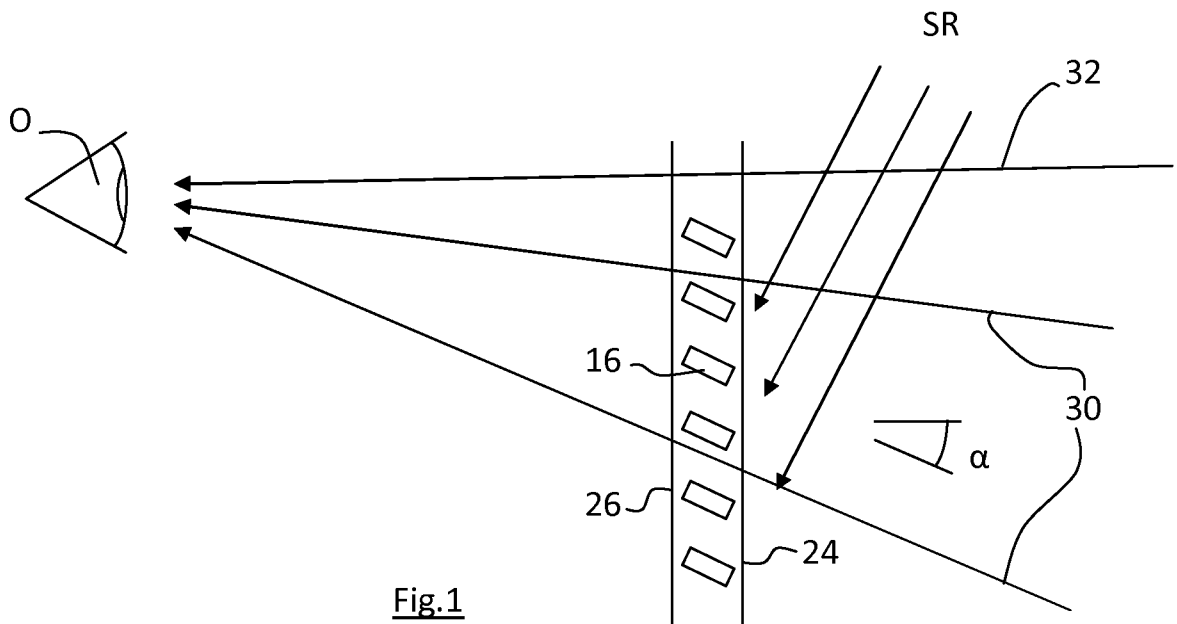
It will be understood that in alternative embodiments the tubes could be aligned
10 substantially vertically. In particular embodiments the angle of the tubes could be adjustable and be controlled to track the sun's movement during the day.

CLAIMS

1. A solar panel adapted to fit between two sheets of glass in a glazing panel, the solar panel being adapted to absorb heat from a proportion of the incident light, and to permit another proportion of the incident light to be transmitted through the solar panel and the glazing panel.
2. A solar panel according to claim 1 in which the solar panel comprises a first manifold and a second manifold , and a number of tubes which can be fitted between the sheets of glass of the glazing panel and connect the first manifold to the second manifold.
3. A solar panel according to claim 2 in which the tubes are spaced apart whereby light can pass between neighbouring tubes in use.
4. A solar panel according to claim 2 or claim 3 in which at least one of the manifolds includes a baffle.
5. A solar panel according to any one of claims 2-4 in which the manifolds are adapted to fit within respective parts of the frame of the glazing panel.
6. A solar panel according to claim 1 in which the solar panel comprises an additional frame component, the additional frame component being adapted to fit within the frame of the glazing panel.
7. A solar panel according to any one of claims 1-6 in which the tubes are acircular throughout a substantial part of their length.
8. A solar panel according to claim 7 in which the tubes are flattened so as to increase their surface area relative to their cross-sectional area.
9. A solar panel according to claim 7 or claim 8 in which the tubes are substantially circular at their ends.

10. A solar panel according to any one of claims 7-9 in which the angular relationship between the tubes and the manifolds is variable.
- 5 11. A solar panel according to claim 10 in which the tubes are movable between two predetermined angular positions.
12. A glazing panel fitted with a solar panel according to any one of claims 1-11, the glazing panel comprising two sheets of glass with all or part of the solar
10 panel mounted therebetween, a proportion of the incident light being absorbed by the solar panel and another proportion of the incident light passing through the solar panel and the glazing panel.
13. A glazing panel according to claim 12 in which the longitudinal axes of the
15 tubes is substantially horizontal.
14. A glazing panel according to claim 12 in which the longitudinal axes of the tubes is substantially vertical.

1/2



2/2

