

Description

The invention relates to a solar ray collection apparatus comprising a plurality of lenses, a plurality of light conducting members equal in number to the lenses, a second flat support member supporting the light conducting members in such positions that one end of each of the light conducting members faces one of the lenses associated therewith and coincides with a focal point of said one lense and with spacers between the lenses and the second flat support member.

Such a solar ray collection apparatus is known from the EP—A—00 50 189. This known solar ray collector uses a plurality of single hexagonal Fresnel lenses which are connected to each other. The lenses are kept at a distance from a flat support member by spacers which are integrally formed with the flat support member. The distance between the lenses and a support member corresponds to the focal length of each of the lenses. On the focal point of each lense, the flat support member carries the end of light conducting members so that the light passing through the lenses is focussed into the light conducting members. The material used for the lenses differs from the material used for the flat support member and the spacers which are integrally formed with the flat support member.

However, since a solar ray collector is inevitably affected by the solar heat due to the construction and operation thereto, the heat tends to expand structural elements of the apparatus to different levels thus totally destructing the required optical features thereof, e.g. focal points of the lenses. As a consequence, the efficiency in collecting solar rays is decreased.

From CH—A—572195, it is known to support the single lenses on a transparent support member. However, the solar apparatus as disclosed in this document does not focus solar light onto the entrance of optical fibres but it just focuses the light on a heat conducting pipe inside the collecting apparatus.

It is the task of the present invention to provide a solar ray collector, of the type above, which accomplishes a high light collection efficiency without being affected by warming up effects of its components.

According to the invention, this task is solved with an apparatus as mentioned above in which a first transparent flat support member is provided for supporting the lenses, which are in the form of single hexagonal lenses and which are fixed on the surface of the flat support member, and in which the first transparent flat support member, the second flat support member, the lenses and the spacers are made of materials having substantially the same coefficient of thermal expansion.

The feature that a first transparent flat support member is provided for supporting the lenses on the surface thereof leads to the advantage that the lenses themselves are not connected with each other but are only supported on the first trans-

parent flat support member. Therefore, when the transparent flat support member expands by warming up, the form of the lenses remains essentially the same, that is, the focal point does not vary. For the reasons that the first transparent flat support member and the second flat support member, as well as the spacers, are all made of the same material, the amount of expansion by warming up is the same for all the elements so that, in combination with the first feature, the imaging properties of the lenses onto the entrance of the light conducting members remain essentially the same for every expansion which may occur.

Moreover, since the second flat support member to which the light conducting members are connected is also a transparent member, the stray light which is not collected by the light conducting member is allowed to pass through the whole arrangement and, therefore, the warming up effects are lowered.

Figure 1 is a front view of a solar ray collection apparatus embodying the present invention;

Figure 2 is a section along line II—II of Figure 1;

Figure 3 is an exploded plan view of a frame included in the apparatus of Figure 1;

Figure 4 is a plan view of a spacer which forms part of the construction shown in Figure 2;

Figure 5 is a view of the spacers and lenses shown in an exemplary position relative to each other;

Figure 6 is a fragmentary exploded view of the solar ray collector demonstrating a procedure for assembling it;

Figure 7 is a view similar to Figure 2 but showing another embodiment of the present invention;

Figure 8 is a fragmentary view of a modification to the construction shown in Figure 7;

Figure 9 is a section of a device for positioning a light conducting member relative to a lens in accordance with the present invention;

Figure 10 is a schematic diagram representing an assembly of solar ray collectors of the present invention which may be employed for a larger collection capacity; and

Figure 11 is a perspective view of the assembly of Figure 10 which is in practical operation encapsulated in a housing.

Description of the Preferred Embodiments

While the solar ray collection apparatus of the present invention is susceptible of numerous physical embodiments, depending upon the environment and requirements of use, substantial numbers of the herein shown and described embodiments have been made, tested and used, and all have performed in an eminently satisfactory manner.

Referring to Figure 1 of the drawings, a solar ray collection apparatus embodying the present invention is shown and generally designated by the reference numeral 10. The collector 10 comprises a mass of hexagonal lenses 12 which are

3 rigidly mounted on a flat hexagonal lens mount 14 and arranged in contact with each other in a honeycomb structure. The lens mount 14 is made of a transparent material substantially common to the lenses 12, e.g., glass or acrylic composition, and elastically retained by a hexagonal frame 16 as will be described hereinafter.

Referring also to Figure 2, the lens mount 14 carrying the lenses 12 thereon is received along peripheral edges thereof in a groove or recess 18 which is formed in the inner periphery of the frame 16. As best shown in Figure 3, the frame 16 comprises frame halves 16a and 16b which are shaped to form a hexagon when mated together. Pins 20 are studded on opposite ends of the frame half 16a, while holes (not shown) for receiving the pins 20 are formed in both ends of the counterpart 16b. The frame halves 16a and 16b are individually recessed at their inner surfaces so that the groove 18 extends throughout the inner periphery of the hexagonal frame 16. A filler 22 made of rubber or like soft elastic material is fit in the groove 18 to yieldably back up the lens mount 14. The filler 22 will compensate for or absorb any horizontal expansion of the lens mount 14 or vibration applied thereto. The frame 16, like the lens mount 14, is preferably substantially identical in material or coefficient of expansion with the lenses 12.

As shown in Figure 2, a second flat mount 24 is positioned below and parallel to the lens mount 14. Elongate light conducting members 26 are individually rigidly fit in apertures 28 which are formed through the second mount 24. The location of each light conducting member 26 is such that light incident on a lens 12 positioned just thereabove becomes focused on its top, that is, each light conducting member 26 is located at the focal point of its associated lens 12. The light conducting members 26 constitute so-called pig tails each of which comprises a crystal rod, quartz fiber or like single optical element and may be bundled up into a second light conducting member which, although not shown, may be a cable, fiber or tube made of quartz or plastics. With this construction, light incident on each lens 12 will be converged into the associated light conductor 26 through the lens mount 14 and then transmitted by the second conductor to a desired location.

The conductor mount 24 is securely connected to the lens mount 14 through a plurality of upright pieces 30, which are mounted on the conductor mount 24 and have a common generally Y-shaped cross section (see Figure 4). The upright pieces 30 will maintain the lens mount 14 and conductor mount 24 and, thereby, the lenses 12 and conductors 26 at a predetermined spacing from each other. The pieces 30 will also serve the function of a reference for positioning the lenses 12 on the lens mount 14 as will be described later. Again, the pieces 30 are made of a material substantially common in coefficient of expansion to the lenses 12.

In assembly, the lenses 12 are first arranged in segments each consisting of several lenses as

5 shown in Figure 5 by way of example. The pieces (Spacers) 28 are adhered to selected positions on the underside of the lens mount 14. Each lens segment, 12A in Figure 5, is positioned on the lens mount 14 as specified by the pieces (references) 30 and then adhered to the lens mount 14. This sets up an integral assembly of the lenses 12, lens mount 14 and pieces 30. Thereafter, the peripheral edges of the lens mount 14 are inserted into the groove 18 in the frame 16 and elastically retained therein by the filler 22. This is followed by placing the frame 16 of the conductor mount 24 and adhering the other or lower ends of the pieces 30 to the conductor mount 24. Such a procedure is illustrated in Figure 6.

10 The solar ray collector 10 features various advantages as will be described. Any desired number of the collectors 10 can be assembled together to a required capacity, using the same structural elements. This, coupled with the small size of each lens 12, accomplishes economical production of such solar ray collector. The light conductors 26 can be accurately positioned relative to the lenses 12 merely by uniting the lens mount 14 and conductor mount 24 with each other through the pieces 30. The absence of any special positioning mechanism will simplify the construction and reduce the weight. Because the lenses 12, lens mount 14, frame 16, conductor mount 24 and spacers 30 are made of materials whose coefficients of expansion are substantially the same, thermal expansion of the assembly due to the solar heat will not entail distortion or deformation in any part of the assembly or effect the focal point of the lens system.

15 In Figure 5, the pieces 28 may be positioned symmetrically with respect to central one of the lenses 12. Then, deformation, if any, due to thermal expansion or the like would be substantially evenly distributed throughout the assembly thereby maintaining the lens mount 14 and conductor mount 24 and thereby the focal point of each lens and the light input end of the adjacent pig tail 26 under the constant relationship. This will further enhance the light collection efficiency despite the deformation or the like.

20 Referring to Figure 7, another embodiment of the present invention is shown. The collector, generally 40, includes a number of first lenses 42 arranged on a transparent lens mount 44. Second lenses 46 smaller than the first 42 are carried on the underside of the lens mount 44 in one-to-one correspondence with the first 42 to form lens pairs 42, 46. The optical axes of the lenses 42 and 46 in each pair are aligned with each other. Thus, each lens pair 42, 46 constitutes means for converging solar rays L incident thereon. A flat transparent conductor mount 48 carries therewith light conducting members or pig tails 50 each of which has a light input end 50a facing a lens pair 42, 46 located just thereabove and being positioned at the focal point of the lens 46. With this construction, the light L incident on each lens 42 will be converged thereby into the associated lens 46 through the lens mount 44 and, therefrom, into

the end 50a of the associated pig tail 50. The reference numeral 52 shows an example of the second light conducting member discussed with reference to Figure 2 and which may comprise a fiber optic cable or tube or an optical fiber. The light conducted by the individual conductors 50 will be collectively routed by the second light conductor 52 to a desired location.

The lens mount 44 and conductor mount 48 are integrally retained by a frame 54 at a spacing from each other which sets up the discussed optical relationship between the lenses 46 and the ends 50a of their associated pig tails 50. Elastic fillers 56a and 56b intervene between the frame 54 and the lens mount 44 and between the frame 54 and the conductor mount 48 respectively, each for the purpose described in conjunction with the filler 22 of the first embodiment.

The lenses 42 and 46, lens mount 44 and conductor mount 48 are made of materials whose coefficients of expansion are substantially the same, e.g. glass or acrylic composition.

Spacers 58 are interposed between the lens mount 44 and the conductor mount 48. The spacers 58 will not only assist the frame 54 in spacing the mounts 44 and 48 as described but promote easy integration of the mounts 44 and 48. The spacers 58 may be made of glass or acrylic composition to be moulded integrally with the others.

The lenses 46 on the underside of the lens mount 44 may comprise chromatic aberration lenses which are capable of transmitting all the wavelength components of sunlight to the pig tails 50.

In the solar ray collector 40, it will be seen that the lenses 46 paired with the lenses 42 serve to shorten the focal length of the lens system and thereby reduce the size (thickness) of the overall construction. The lenses 46 will not complicate the assembly because they need only be bonded to the lens mount 44.

The solar ray collector 40 shown in Figure 7 further includes means for effectively converting into electrical energy the stray part of the solar rays which is not steered into the pig tails 50. For example, the light converged by the lenses 42 is partly reflected within the lens mount 44 to advance radially outwardly through the lens mount 44. This part of the light will be transformed into electrical energy by a photoelectric transducer 60 which is located to surround the lens mount 44 as illustrated. Meanwhile, the solar energy failed to enter the pig tails 50 through the conductor mount 48 will be transformed into electrical energy by photoelectric transducers 62 which are carried on the top or the bottom of the conductor mount 48 and each around a pig tail 50.

Where use is made of an acrylic composition for the mounts 44 and 48, lenses 42 and 46 etc., there is a fear of the sunlight converged by each lens pair 42, 46 burning the conductor mount 48. To avoid this, a light intercepting plate may be laid on the top of the conductor mount 48. In this

case, the transducers 62 cannot be arranged on the conductor mount 48.

Shown in Figure 8 is a modification to the construction of Figure 7. In this modification, the lens mount 44 and conductor mount 48 are supported by a frame 54' which is common in material to the mounts 44 and 48. A photoelectric transducer 64 is mounted on the outer periphery of the frame 54', which is thus transparent.

Referring to Figure 9, a device for manually positioning each pig tail relative to its associated lens is illustrated. While the device shown in Figure 9 is applicable to any one of the foregoing embodiments to replace the collective positioning procedure, the description will be made taking the solar ray collector 10 of Figure 2 for example.

In Figure 9, a sleeve 70 is rigidly mounted on each light conducting member 26 adjacent to a light input end 26a thereof which faces the lens 12 located thereabove. A holder member 72 having a generally T-shaped section holds the sleeve 70 such that the focal point of the lens 12 is registered with the light input end 26a of the conductor 26. The holder 72 is formed with a plurality of holes 72a throughout the head of "T" and a plurality of holes 72b throughout the leg of "T".

To so position the light conductor 26 relative to the lens 12, the holder 72 having the sleeve 70 and conductor 26 therein is moved in sliding contact with the conductor mount 24, until the center of the conductor 26 becomes aligned with that of the lens 12. Under this condition, adhesive is charged into the holes 72a of the holder 72 to rigidly connect the holder 72 to the conductor mount 24. Thereafter, the sleeve 70 and thereby the conductor 26 is moved through the holder 72 along the optical axis of the lens 12. As the end 26a of the conductor 26 is brought into the focal point of the lens 12, adhesive is injected into the holes 72b to rigidly connect the sleeve 70 to the holder 72.

Where the lens 12 shown in Figure 9 comprises a Fresnel lens, the center of the conductor 26 will be accurately registered with that of the lens 12 only if the conductor center is registered by eyes with the center of the fringe pattern of the lens 12. For a more generally applicable method, use may be made of a photometer or the like and laser beams or like parallel beams, in which case the other or light output end of the conductor 26 will be connected to the photometer while the parallel beams will be directed toward the lens 12 as indicated by arrows A. In a plane perpendicular to the optical axis of the lens 12, the holder 72 will be moved until the output of the photometer reaches the maximum. Then, in a plane parallel to the optical axis, the light conductor 12 will be moved together with the sleeve 70 to find out a position where the output of the photometer becomes the maximum.

The solar ray collector 10 or 40 described hereinabove may be combined with other desired number of identical collectors as illus-

trated in Figure 10. A framework, generally 100, has a honeycomb structure made up of hexagonal subframes 100A. Each subframe 100A comprises a few different kinds of flat members each being formed with at least one bend and fastened to the others as by bolts 102. The collector 10 or 40 of the present invention is mounted on one end of the subframe 100A through a device not shown in the drawing. The collector assembly shown in Figure 10 may be replaced by a larger transparent lens mount carrying a larger number of lenses than shown and described.

Referring to Figure 11, the assembly of the solar ray conductor 10 or 40 in accordance with the present invention may be encapsulated in a transparent dome-shaped housing 110, which is mounted on a generally cylindrical base structure 112. The collector assembly carries therewith a sensor 114 sensitive to the sun. The collector assembly with the sensor 114 is pivotally supported by a generally C-shaped arm 116 which in turn is rigidly supported by a rotatable shaft 118. In operation, the shaft 118 and arm 116 are controlled in response to an output of the sensor 114 so that the collector assembly may constantly chase the sun as long as the solar rays are available. As will be recalled, the sunlight incident on each collector 10 or 40 in the assembly is effectively converted by the lenses into the associated pig tails and routed therethrough to a desired location.

Now, a large size apparatus for solar ray collection may be implemented by using a large size lens made of glass or acrylic composition. However, for a given light receiving area, such a lens is disproportionately large in volume and weight. In accordance with the present invention, use is made of a number of small glass or acrylic lenses each having a diameter of about 4 cm so that the weight of the lens is reduced for its light receiving area. Therefore, a large size solar ray collector is achievable which makes the whole apparatus comparatively light weight.

Another advantage particular to the use of small lenses is that it permits the light input end of each conductor or pig tail to be reduced. For example, where the lens 12 or 42 has a diameter of 4 cm, or a focal length of about 4 cm, the diameter of a core member of each pig tail 26 or 50 needs only be about 400—800 microns which is equal to the diameter of the resulting focal point of the lens. This allows the use of a single flexible pig tail for each lens. In contrast, where the lens has a diameter as large as 40 cm as has been the case with the prior art apparatus, the flexibility is unattainable unless numerous optical fibers of a small diameter are bundled up to form a light receiving surface; the gaps between adjacent fibers undesirably reduce the effective light receiving area. Additionally, it is quite difficult to finish the end of a fiber bundle to a precise flat surface and the light receiving efficiency heretofore attained was not more than about 30—40%. Experiments proved that the use of a single optical fiber (pig tail) for each lens in accordance

with the present invention increases the light receiving efficiency to about 80%.

Furthermore, difficulty has been experienced in arranging a number of lenses neatly on a common surface without any gap. However, if such numerous lenses are arranged on the lens mount 14 or 44, what will be required is only to place the lenses on and bond them to a transparent plate finished to a flat surface (a glass or acrylic plate is easy to finish so).

In summary, it will be seen that the present invention provides a solar ray collection apparatus which is economical, easy to produce, small size, light weight and excellent in light collection efficiency. Light conducting members included in the collector can be simply yet accurately positioned into register with the focal points of their associated lenses, eliminating the need for service after the assembly.

Claims

1. A solar ray collection apparatus comprises a plurality of lenses (12, 42, 46), a plurality of light conducting members (26, 50) equally numbered to the lenses, a second flat support member (24, 48) supporting the light conducting members in such positions that one end of each of the light conducting members faces one of the lenses associated therewith and coincides with a focal point of said one lens and with spacers (30) between the lenses and the second flat support member, characterized in that a first transparent flat support member (14, 44) is provided for supporting the lenses (12, 42), which are in the form of single hexagonal lenses and which are fixed on the surface of the flat support member and that the first transparent flat support member (14, 44), the second flat support member (24, 48), the lenses (12, 42) and the spacers (30) are made of materials having substantially the same coefficient of thermal expansion.

2. An apparatus as claimed in claim 1, in which the lenses (12, 42), the first and second support members (14, 44, 24, 48) and the spacers (30) are made of glass.

3. An apparatus as claimed in claim 1, in which the lenses (12, 42), the first and second support members (14, 44, 24, 48) and the spacers (30) are made of acrylic composition.

4. An apparatus as claimed in any one of the foregoing claims, in which the spacers comprise a plurality of spacers (30), each having a generally Y-shaped cross-section.

5. An apparatus as claimed in any one of the foregoing claims, further comprising means (60, 62, 64) for converting part of the solar rays non-converged toward the light conducting members into electrical energy.

6. An apparatus as claimed in claim 5, in which the solar ray energy to electrical energy conversion means comprises a photoelectric transducer (60, 62, 64).

7. An apparatus as claimed in claim 6, in which the photoelectric transducer (60) is mounted on

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Another advantage particular to the use of small lenses is that it permits the light input end of each conductor or pig tail to be reduced. For example, where the lens 12 or 42 has a diameter of 4 cm, or a focal length of about 4 cm, the diameter of a core member of each pig tail 26 or 50 needs only be about 400—800 microns which is equal to the diameter of the resulting focal point of the lens. This allows the use of a single flexible pig tail for each lens. In contrast, where the lens has a diameter as large as 40 cm as has been the case with the prior art apparatus, the flexibility is unattainable unless numerous optical fibers of a small diameter are bundled up to form a light receiving surface; the gaps between adjacent fibers undesirably reduce the effective light receiving area. Additionally, it is quite difficult to finish the end of a fiber bundle to a precise flat surface and the light receiving efficiency heretofore attained was not more than about 30—40%. Experiments proved that the use of a single optical fiber (pig tail) for each lens in accordance

with the present invention increases the light receiving efficiency to about 80%.

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In summary, it will be seen that the present invention provides a solar ray collection apparatus which is economical, easy to produce, small size, light weight and excellent in light collection efficiency. Light conducting members included in the collector can be simply yet accurately positioned into register with the focal points of their associated lenses, eliminating the need for service after the assembly.

Claims

1. A solar ray collection apparatus comprises a plurality of lenses (12, 42, 46), a plurality of light conducting members (26, 50) equally numbered to the lenses, a second flat support member (24, 48) supporting the light conducting members in such positions that one end of each of the light conducting members faces one of the lenses associated therewith and coincides with a focal point of said one lens and with spacers (30) between the lenses and the second flat support member, characterized in that a first transparent flat support member (14, 44) is provided for supporting the lenses (12, 42), which are in the form of single hexagonal lenses and which are fixed on the surface of the flat support member and that the first transparent flat support member (14, 44), the second flat support member (24, 48), the lenses (12, 42) and the spacers (30) are made of materials having substantially the same coefficient of thermal expansion.

2. An apparatus as claimed in claim 1, in which the lenses (12, 42), the first and second support members (14, 44, 24, 48) and the spacers (30) are made of glass.

3. An apparatus as claimed in claim 1, in which the lenses (12, 42), the first and second support members (14, 44, 24, 48) and the spacers (30) are made of acrylic composition.

4. An apparatus as claimed in any one of the foregoing claims, in which the spacers comprise a plurality of spacers (30), each having a generally Y-shaped cross-section.

5. An apparatus as claimed in any one of the foregoing claims, further comprising means (60, 62, 64) for converting part of the solar rays non-converged toward the light conducting members into electrical energy.

6. An apparatus as claimed in claim 5, in which the solar ray energy to electrical energy conversion means comprises a photoelectric transducer (60, 62, 64).

7. An apparatus as claimed in claim 6, in which the photoelectric transducer (60) is mounted on



the outer periphery of the first support member (44).

8. An apparatus as claimed in claim 7, further comprising a frame member (54) for uniting the first and second support members with each other, said frame member being substantially common in coefficient of expansion to the support members, the photoelectric transducer (64) being mounted on the outer periphery of the frame member.

9. An apparatus as claimed in claim 5 or 6, in which the photoelectric transducer (62) is mounted on the second support member (48) around said one end (50a) of the light conducting members (50).

10. An apparatus as claimed in any one of the foregoing claims, further comprising a plurality of second lenses (46), mounted on the other surface of the first support member (44) with optical axes thereof aligned with optical axes of the first lenses (42), said one end of the light conducting members (50a) being located at the focal points of said second lenses (46), whereby light converged by the first lenses (42) are further converged by the second lenses (46) before reaching the light conducting members (50).

11. An apparatus as claimed in claim 10, in which the first and second lenses (42, 46) and the first and second support members (44, 48), are substantially common in coefficient of expansion.

12. An apparatus as claimed in any one of the claims 1 to 8, further comprising a light intercepting plate which covers the surface of the second support member except for said one end of the light conducting members.

13. An apparatus as claimed in any one of the foregoing claims, further comprising positioning means (72) for positioning each of the light conducting members (26) in said position relative to one of the lenses (12) associated therewith.

14. An apparatus as claimed in claim 13, in which the positioning means comprises a holder member (72) for holding the light conducting member (26) therein, said holder member (72) being bonded to the second support member (24) after positioning the center of the light conducting member into register with the optical axis of the lens (12).

15. An apparatus as claimed in claim 13 or 14, further comprising a sleeve (70) which is rigidly carried on the light conducting member (26), said sleeve (70) being bonded to the holder member (72) after being moved along the optical axis of the lens until said one end of the light conducting member (26a) becomes located at the focal point of the lens.

16. An apparatus as claimed in any one of the foregoing claims, in which the lenses (12, 42) are individually provided with a hexagonal shape.

17. An apparatus as claimed in any one of the foregoing claims, in which the first support member (44) is provided with a hexagonal shape.

Patentansprüche

1. Vorrichtung zum Auffangen von Sonnenstrahlen mit mehreren Linsen (12, 42, 46), mit mehreren lichtleitenden Elementen (26, 50), die in der Anzahl der Anzahl der Linsen entsprechen, mit einem zweiten flachen Trägerelement (24, 48), das die lichtleitenden Elemente in solchen Lagen hält, in denen jeweils das Ende eines lichtleitenden Elements einer Linse zugeordnet ist und im Fokus dieser einen Linse jeweils liegt und mit Abstandsstücken (30) zwischen den Linsen und dem zweiten flachen Trägerelement, dadurch gekennzeichnet, daß ein erstes transparentes flaches Trägerelement (14, 44) als Halter für die Linsen (12, 42) vorgesehen ist, wobei die Linsen die Form von einzelnen hexagonalen Linsen haben und auf der Oberfläche des flachen Trägerelements befestigt sind und daß das erste durchsichtige flache Trägerelement (14, 44), das zweite flache Trägerelement (24, 48), die Linsen (12, 42) und die Abstandsstücke (30) aus Materialien bestehen, die im wesentlichen den selben Wärmeausdehnungskoeffizienten haben.

2. Vorrichtung nach Anspruch 1, wobei die Linsen (12, 42), das erste und zweite Trägerelement (14, 44, 24, 48) und die Abstandsstücke (30) aus Glas bestehen.

3. Vorrichtung nach Anspruch 1, wobei die Linsen (12, 42), das erste und das zweite Trägerelement (14, 44, 24, 48) und die Abstandsstücke (30) aus einer Acrylverbindung bestehen.

4. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, wobei die Abstandsstücke mehrere Abstandshalter (30) umfassen, die im Querschnitt jeweils Y-förmig sind.

5. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, mit einer Einrichtung (60, 62, 64) zum Umwandeln derjenigen Sonnenstrahlung in elektrische Energie, die nicht auf die lichtleitenden Elemente gerichtet ist.

6. Vorrichtung nach Anspruch 5, wobei die Einrichtung zum Umwandeln von Sonnenstrahlungsenergie in elektrische Energie einen fotoelektrischen Wandler (60, 62, 64) umfaßt.

7. Vorrichtung nach Anspruch 6, wobei der fotoelektrische Wandler (60) am äußeren Bereich des ersten Trägerelementes (44) befestigt ist.

8. Vorrichtung nach Anspruch 7, mit einem Rahmen (54), der das erste mit dem zweiten Trägerelement verbindet, wobei der Rahmen einen im wesentlichen gleichen Wärmeausdehnungskoeffizienten wie die Trägerelemente hat und wobei der fotoelektrische Wandler (64) am Außenumfang des Rahmens angeordnet ist.

9. Vorrichtung nach Anspruch 5 oder 6, wobei der fotoelektrische Wandler (62) auf dem zweiten Trägerelement (48) um das eine Ende (50a) der lichtleitenden Elemente (50) herum angeordnet ist.

10. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, mit mehreren zweiten Linsen (46), die auf der Außenfläche des ersten Trägerelementes (44) so angeordnet sind, daß ihre optischen Achsen mit den optischen Achsen



der ersten Linsen (42) zusammenfallen, wobei das eine Ende der lichtleitenden Elemente (50a) im Fokus der zweiten Linsen (46) liegt, so daß das Licht, das von den ersten Linsen (42) gesammelt wird, von den zweiten Linsen (46) noch weiter konvergiert wird, bevor es die lichtleitenden Elemente (50) erreicht.

11. Vorrichtung nach Anspruch 10, wobei die ersten und zweiten Linsen (42, 46) und die ersten und zweiten Trägerelemente (44, 48) einen im wesentlichen gleichen Ausdehnungskoeffizienten haben.

12. Vorrichtung nach irgendeinem der Ansprüche 1 bis 8, mit einer Blendenplatte, die die Oberfläche des zweiten Trägerelementes abdeckt, ausgenommen an dem einen Ende der lichtleitenden Elemente.

13. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, mit einer Positioniereinrichtung (72), mit der die lichtleitenden Elemente (26) jeweils in ihren Lagen bezüglich den zugeordneten Linsen (12) positioniert werden können.

14. Vorrichtung nach Anspruch 13, wobei die Positioniereinrichtung einen Halter (42) zum Halten eines lichtleitenden Elements (26) aufweist, und wobei der Halter mit dem zweiten Trägerelement (24) verbunden wird, nachdem das Zentrum des lichtleitenden Elements bezüglich der optischen Achse der Linse (12) ausgerichtet worden ist.

15. Vorrichtung nach Anspruch 13 oder 14, mit einer Hülse (70), die fest auf einem lichtleitenden Element (26) angeordnet ist und die mit dem Halter (72) verbunden wird, nachdem sie zunächst entlang der optischen Achse der Linse so bewegt worden ist, bis das Ende des lichtleitenden Elements (26a) im Fokuspunkt der Linse liegt.

16. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, wobei die Linsen (12, 42) jeweils einzelne Linsen mit hexagonaler Form sind.

17. Vorrichtung nach irgendeinem der vorangehenden Ansprüche, wobei das erste Trägerelement (44) eine hexagonale Form hat.

Revendications

1. Dispositif pour capter les rayons solaires, comprenant des lentilles (12, 42, 46), des conducteurs de lumière (26, 50) en nombre égal aux lentilles, un second élément de support plat (24, 48) supportant les conducteurs de lumière à des positions telles qu'une extrémité de chaque conducteur de lumière est dirigée vers une lentille coordonnée à ce conducteur et coïncide avec le foyer de cette lentille, ainsi que des entretoises (30) entre les lentilles et le second élément de support plat, caractérisé en ce qu'un premier élément de support plat (14, 44) est prévu pour supporter les lentilles (12, 42) qui se présentent sous forme de lentilles hexagonales séparées et sont fixées sur la surface de l'élément de support plat, et en ce que le premier élément de support plat, transparent (14, 44), le second élément de support plat (24, 48), les lentilles (12), (42) et les entretoises (30) sont

réalisés de matériaux ayant sensiblement le même coefficient de dilatation thermique.

2. Dispositif selon la revendication 1, dans lequel les lentilles (12, 42), les premier et second éléments de support (14, 44, 24, 48) et les entretoises (30) sont fabriqués de verre.

3. Dispositif selon la revendication 1, dans lequel les lentilles (12, 42), les premier et second éléments de support (14, 44, 24, 48) et les entretoises (30) sont fabriqués d'une composition acrylique.

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les entretoises possèdent chacune une section droite de forme générale en Y.

5. Dispositif selon l'une quelconque des revendications précédentes comprenant en outre des moyens (60, 62, 64) pour convertir en énergie électrique la partie des rayons solaires qui n'est pas concentrée et dirigée vers les conducteurs de lumière.

6. Dispositif selon la revendication 5, dans lequel les moyens pour convertir l'énergie des rayons solaires en énergie électrique sont constitués par un transducteur photoélectrique (60, 62, 64).

7. Dispositif selon la revendication 6, dans lequel le transducteur photoélectrique (60) est monté sur la périphérie extérieure du premier élément de support (44).

8. Dispositif selon la revendication 7, comprenant en outre un cadre (54) pour assembler les premier et second éléments de support entre eux, ce cadre ayant sensiblement le même coefficient de dilatation que les éléments de support, le transducteur photoélectrique (64) étant monté sur la périphérie extérieure du cadre.

9. Dispositif selon la revendication 5 ou 6, dans lequel le transducteur photoélectrique (62) est monté sur le second élément de support (48), autour de ladite extrémité (50a) des conducteurs de lumière (50).

10. Dispositif selon l'une quelconque des revendications précédentes, comprenant en outre une seconde série de lentilles (46) montées sur l'autre face du premier élément de support (44), avec leurs axes optiques alignés avec les axes optiques des premières lentilles (42), ladite extrémité (50a) des conducteurs de lumière étant située au foyer des secondes lentilles (46), de manière que la lumière concentrée par les premières lentilles (42) soit concentrée davantage par les secondes lentilles (46) avant d'atteindre les conducteurs de lumière.

11. Dispositif selon la revendication 10, dans lequel les premières et secondes lentilles (42, 46) et les premier et second éléments de support (44, 48) possèdent sensiblement le même coefficient de dilatation.

12. Dispositif selon l'une quelconque des revendications 1 à 8, comprenant en outre une plaque d'interception de la lumière qui recouvre la surface du second élément de support à l'exception de ladite extrémité des conducteurs de lumière.

13. Dispositif selon l'une quelconque des revendications précédentes, comprenant en outre



un moyen de positionnement (72) pour positionner chacun des conducteurs de lumière (26) à ladite position par rapport à l'une des lentilles (12), lentille à laquelle ce conducteur est coordonné.

14. Dispositif selon la revendication 13, dans lequel le moyen de positionnement est constitué par une pièce de support (72) conçue pour maintenir le conducteur de lumière (26) à l'intérieur, cette pièce de support (72) étant collée au second élément de support (24) après le centrage du conducteur de lumière sur l'axe optique de la lentille (12).

15. Dispositif selon la revendication 13 ou 14, comprenant en outre un manchon (70) qui est

supporté rigidement sur le conducteur de lumière (26), ce manchon (70) étant collé à la pièce de support (72) après avoir été déplacé le long de l'axe optique de la lentille, jusqu'à ce que ladite extrémité (26a) du conducteur de lumière soit placée au foyer de la lentille.

16. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les lentilles (12, 42) possèdent individuellement une forme hexagonale.

17. Dispositif selon l'une quelconque des revendications précédentes, dans lequel le premier élément de support (44) possède une forme hexagonale.

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