

Description

The present invention relates to a device for tracking a moving light source according to the generic clause of claim 1. Devices for tracking a moving light source of this type are, for example, used for chasing the sun in a solar energy collection apparatus. The solar sensor is designed to cause the light collecting surface of the solar energy collector to always face the sun, thereby allowing it to effectively collect the solar energy. This is to fulfill the need that the solar energy be effectively collected for effective utilization thereof and, therefore, the collector can be operated in the most efficient conditions.

A known type of such a device is disclosed in Figs. 1 and 2 of the EP—A—0 064 746 document. Figs. 1 to 9 of the present application represent the state of the art as discussed in the above-mentioned European patent application with respect to Figs. 5 to 17. This latter state of the art was available to the public only after the priority date of the present application.

According to this state of the art, the position of the frame of a solar collector is controlled in response to an output of the solar sensor so that the light input end of each lens of the collector may be oriented sunward as long as the sunlight is available. Concerning the solar sensor installed in the solar energy collector, various propositions have been presented and they generally comprise a box-shaped housing and a plurality of sensor elements mounted on the housing. The prior art solar sensors are acceptable but not fully satisfactory, however. Particularly, there is a demand for an ability for disassembly and adjustment which will facilitate the production and maintenance of such a sensor, and for a configuration which will minimize an error due to indirect light beams entering the housing while covering a wider range of light source positions.

Summary of the Invention

It is an object of the present invention to provide a device for chasing a moving light source which can be disjoined to facilitate mounting sensor elements on a housing as well as adjustment and maintenance after the assembly.

It is another object of the present invention to provide a device for chasing a moving light source which overcomes influence of indirect incident light beams and the like to achieve accurate operation.

It is another object of the present invention to provide a device for chasing a moving light source which positively follows the light source over a substantial range of positions of the light source.

It is another object of the present invention to provide a generally improved device for chasing a moving light source.

In order to solve these objects, the device as mentioned above is characterised in that said aperture is a cruciform aperture, the opposite edges defining the spacing between the sensor

elements of said pair being those edges of the cruciform aperture which are arranged transversely to one of the two major extensions of said aperture; said plurality of photosensors comprises an additional sensor element arranged on said optical axis; the support member is arranged to close said second opening.

The objects, features and advantages of the present invention will become apparent from the following detailed description taken with the accompanying drawings.

Brief Description of the Drawings

Figure 1 is a perspective view of a solar energy collection apparatus to which a chasing device of the present invention is applicable;

Figure 2 is a perspective view of a prior art chasing device installed in the solar energy collector of Figure 1;

Figure 3 is a section along line III—III of Figure 2;

Figure 4 is a plan view of the prior art chasing device;

Figure 5 is a section along line V—V of Figure 3;

Figure 6 is a graph showing a distribution of indirect light beams observed in the prior art chasing device;

Figures 7—9 are views of other prior art chasing devices of the kind concerned;

Figure 10 is an exploded perspective view of a chasing device embodying the present invention;

Figure 11 is a plan view of a top plate included in the chasing device shown in Figure 10;

Figure 12 is a plan view of a first casing of the chasing device shown in Figure 10;

Figure 13 is a plan view of an intermediate plate of the chasing device shown in Figure 10;

Figure 14 is a plan view of a second casing of the chasing device shown in Figure 10;

Figure 15 is a plan view of an adjusting plate of the chasing device shown in Figure 10;

Figure 16 is a plan view of a bottom plate of the chasing device shown in Figure 10;

Figure 17 is a section along line A—A of Figure 16;

Figure 18 is a section along line B—B of Figure 17;

Figures 19 and 20 are perspective views of screws which are suitably applicable to the construction in accordance with the present invention; and

Figure 21 is a sectional side elevation of the chasing device of the present invention, with an adjusting plate shown in a section along line C—C of Figure 15.

Description of the Preferred Embodiment

While the device for chasing a moving light source of the present invention is susceptible of numerous physical embodiments, depending upon the environment and requirements of use, a substantial number of the herein shown and described embodiment have been made, tested and used, and all have performed in an eminently satisfactory manner.

While the present invention finds application to various kinds of chasing devices for moving light sources, the following description will concentrate on a solar sensor for use with a solar energy collection apparatus by way of example.

Referring to Figure 1 of the drawings, there is shown a solar ray collection apparatus which comprises a generally cylindrical base 10, a transparent dome-shaped head 12, and a transparent intermediate member 14 for interconnecting the base 10 and head 12. These members constitute a housing generally designated by the reference numeral 16. A lens assembly 18 is installed in the housing 16 and comprises a number of lenses 20 for converging sunlight, and a solar sensor 22 for sensing the varying position of the sun. The lenses 20 and solar sensor 22 are integrally supported by a frame 24 which is mounted on a shaft 26. The shaft 26 is selectively driven for rotation by a motor 28. A generally C-shaped arm 30 supports the integral assembly 20—28. A second shaft 32 extends perpendicular to the shaft 26 to be rotated by a second motor (not shown). In response to an output signal of the solar sensor 22, the first and second motors are controlled such that all the lenses 20 are always oriented sunward. The sunlight collected by the lenses 20 may be conducted by optical cables or the like to any desired location for illumination and other applications.

One example of the solar sensor 22 heretofore proposed is shown in Figures 2—5 in which N, E, W and S indicate the directions as usual. As shown, the solar sensor comprises a hollow casing 40, a top plate 42, a bottom plate 44, and photosensor X_0 , X_1 — X_4 and X_5 . The top plate 42 is formed with a polygonal or circular opening 46 in a central portion thereof. As shown in Figure 5, the photosensors X_1 and X_2 are paired and located to face each other and so are the photosensors X_3 and X_4 . The location of the photosensors X_1 — X_4 is such that their inner edges coincide with the inner edges of a shadow which will be formed by the top plate 42 when the casing 40 is oriented precisely sunward. The photosensor X_5 is positioned substantially at the center of the upper surface of the bottom plate 44. In this construction, so long as the casing 40 is directed exactly toward the sun, that is, while the sunlight is incident on the solar sensor as indicated by the letter A, the photosensors X_1 — X_4 are irradiated not by the direct ray but by the indirect rays only and the photosensor X_5 is irradiated by both the direct and indirect rays. Meanwhile, when the sunlight is incident on the solar sensor as shown by the letter B, for example, due to dislocation of the casing 40 relative to the sun, the photosensor X_1 will receive the direct ray in its limited area α while receiving the indirect rays on the entire surface. In more detail, when the orientation of the casing 40 is exactly toward the sun, the same amount of light reaches the photosensors X_1 and X_2 (X_3 and X_4); on misorientation of the casing 40 relative to the sun, the amount of light incident on the photosensor X_1 (X_3) becomes different from

that incident on the counterpart X_2 (X_4). The difference is sensed to perform a control such that the amounts of light incident on the photosensors X_1 and X_2 are equalized, that is, the casing 40 is positioned to become parallel to the direction A and thereby accurately sunward. This will cause the whole lens assembly 18 to accurately face the sun.

Now, as shown in Figure 6, the distribution of indirect light (I) within the casing 40 is larger in the central area than in the peripheral area. It is desirable to compensate for this difference in distribution for the purpose of accurately determining the position where the direct light traverses the sensor elements, i.e. the position α . This is implemented by a solar sensor which is capable of accurately sensing a deviation between the sensor orientation and the sun position as a numerical value, taking into account the distribution of indirect beams inside the casing as well. For details of this type of sensor, a reference is made to Japanese Patent Application No. 99993/1981, which is a priority document to EP—A—0 064 746.

Referring to Figure 7, another prior art solar sensor is shown which precludes the occurrence that, when the sunlight is momentarily intercepted by clouds or the like, it becomes diffused for a moment to reach the photosensors X_1 — X_4 either in an uneven distribution or with a certain time lag. The solar energy collector would sharply follow even such a momentary unbalance thereby cause hunting. In Figure 7, the photosensors X_1 — X_4 are located such that perpendiculars extending from the edges of the opening 46 intersect intermediate portions of the photosensors X_1 — X_4 , in contrast to the construction of Figures 2—5 in which the perpendiculars merge into the edges of the photosensors.

What is required for the construction of Figure 7 in finishing the sensors X_1 — X_4 is only the accuracy in width, because the perpendiculars from the edges of the opening 46 need only be individually somewhere in the intermediate portions of the respective sensor elements. Meanwhile, because the border line for determining the presence/absence of direct light is located in the intermediate portion of each sensor element, the sensor element attains a linear output characteristic for a shift of the border line. Additionally, even an externally derived disturbance has no substantial effect on the operation inasmuch as the output is biased in advance in the area which has received direct light. In short, the signal-to-noise ratio and linearity are improved to enhance the ease of control, compared to the previously described solar sensor.

Referring to Figure 8, there is shown another prior art solar sensor which does not lose its function even when the sun gets behind the clouds for a substantial period of time. As shown, the solar sensor comprises a pair of photosensors X_5 and X_6 in addition to the sensors X_0 , X_3 , X_4 and X_5 . The sensors X_5 and X_6 are individually mounted on intermediate inner walls of the casing 40 (south

and north walls parallel to the direction of movement of the sun). With this construction, if the incident angle of the sunlight to the solar sensor exceeds θ_1 making the photosensors X_3 and X_4 inoperable any longer, the chasing function is fulfilled by the photosensors X_5 and X_6 . As the sun reappears to become incident on the sensor assembly after a substantial period of clouding, the assembly will immediately start chasing the sun again. To further enlarge the operable angular range of the solar sensor, another pair of photosensors X_7 and X_8 may be located above the photosensors X_5 and X_6 , in which case the operable range will be extended to an angle θ_3 . In Figure 8, L_1 , L_2 and L_3 individually indicate light from the sun.

Still another prior art solar sensor is shown in Figure 9 which overcomes the dependence of the photoelectric sensitivity (photoelectric conversion coefficient) of the central photosensor X_0 on the temperature, which would be detrimental to accurate sun sensing. In Figure 9, the bottom plate 44 is made of a heat transmitting material and formed with a hole 48 in its central area which is aligned with the opening 46. The photosensor X_0 is mounted on a base plate 50 made of a heat transmitting and electrically insulating material. The base plate 50 spans the hole 48 carrying the photosensor X_0 on its inner surface. With this construction, the solar heat reaching the photosensor X_0 will be effectively dissipated through the base plate 50 and bottom plate 44.

Referring now to Figures 10—21, a solar sensor of the present invention is shown which constitutes an improvement over the various prior art constructions described. In Figure 10 the solar sensor is illustrated upside down to facilitate better understanding of its unique features. The solar sensor generally comprises a top plate 100, a first hollow casing 102, an intermediate plate 104, a second hollow casing 106, an adjusting plate 108, and a bottom plate 110. The top plate 100 is formed with a generally cruciform opening 112 in its central portion and oversized holes 114a—114d at its four corners. Screws will be passed through the oversized holes 114a—114d into four posts 116a—116d which are integral with the second casing 106, as will be described later in detail. A photosensor X_0 corresponding to the previously mentioned photosensor X_0 is mounted on the top of the plate 100. The four corners of the first casing 102 are dimensioned complementary to the four posts 116a—116d so that coupling the casing 102 over the posts 116a—116d while guiding the former with the latter will bring them into an integral and accurately positioned structure. The intermediate plate 104 is formed with a generally rectangular opening 118. Assuming that the cruciform opening 112 of the top plate 100 has a length a in one direction and a length b in the other direction perpendicular to the first, the opening 118 is dimensioned equal to or somewhat longer than the length a along a set of opposite sides and equal to or somewhat longer than the length b

along the other set of opposite sides. Holes 120a—120d are formed through the four corners of the plate 104 in order to allow the posts 116a—116d to pass through the intermediate plate 104, thereby positioning the intermediate plate 104 relative to the casing 106.

Photosensors X_5 and X_6 equivalent in effect to those previously mentioned are mounted on the intermediate plate 104 along at least a pair of symmetrical opposite edges which define the opening 118 together with the others. The post 116a is formed with threaded holes 116'a and 116''a, the post 116b with threaded holes 116'b and 116''b, the post 116c with threaded holes 116'c and 116''c, and the post 116d with threaded holes 116'd and 116''d. After the four posts 116a—116d are inserted into the first casing 102 in the manner described, screws are individually threaded into the holes 116'a—116'd through the oversized holes 114a—114d of the top plate 100 as shown in Figure 21, thereby joining the top plate 100, casing 102, intermediate plate 104 and casing 106.

The adjusting plate 108 has in its central area a rectangular opening 119 whose one side is slightly longer than the length a of the cruciform opening 112, the other side slightly longer than the length b . The adjusting plate 108 also has oversized holes 121a—121d through which screws will be passed to fasten the plate 108 to the posts 116a—116d, and elongate slots 122a—122d for fastening the bottom plate 110 to the adjusting plate 108 while allowing the former to move in two perpendicular directions relative to the latter. Screws (not shown) are passed through the oversized holes 121a—121d to be threaded into the holes 116'a—116'd in the posts 116a—116d as shown in Figure 21, thereby fastening the plate 108 to the casing 106. The plate 108 is counterbored along the edges of the holes 121a—121d to conceal the heads of the screws.

The bottom plate 110 is formed with an opening 124 which is dimensioned equal to the lengths a and b of the cruciform opening 112 of the top plate 100, and elongate slots 126a—126d which will cooperate with the elongate slots 122a—122d of the adjusting plate 108. The orientations of the slots 126a—126d are such that, if the slots 122a and 122b of the plate 108 extend in the X direction (Figure 15) and the slots 122c and 122d in the Y direction (Figure 15) for example, the slots 126a and 126b of the bottom plate 110 extend in the Y direction and the slots 126c and 126d in the X direction. A box 128 having an open top is mounted on the bottom of the bottom plate 110. The box 128 carries therein a photosensor mount 130 formed with an opening 132 which is smaller than the opening 124 and larger than a photosensor X_0 . Photosensors X_1 — X_4 corresponding to those mentioned in conjunction with the prior art assemblies are supported by the mount 130 while being positioned in the manner described with reference to Figure 3 or 7. The photosensor X_0 corresponds to the already mentioned one and is located below the opening 132

in the same manner as in Figure 9. It is not always necessary to locate the photosensor X_0 at a predetermined spacing from the mount 130; it may be loaded even on the mount 130 as described with reference to Figure 3.

In assembly, after the slots 122a—122d of the adjusting plate 108 have been respectively aligned with the slots 126a—126d of the bottom plate 110, screws 134 are inserted into the slots 122a—122d and then into the slots 126a—126d. Nuts are then fit on the screws 134 from the back of the bottom plate 110.

Examples of the screws 134 suitable for the construction described above are shown in Figures 19 and 20. The screw 134 in Figure 19 has a portion 134a which is narrower than the slots 122a—122d of the adjusting plate 108 in one diametrical direction, wider than the slots 126a—126d of the bottom plate 110 in the other diametrical direction perpendicular to the first, and thicker than the adjusting plate 108. The screw 134 in Figure 20, on the other hand, has a shank 134b which is narrower than the slots 122a—122d in one diametrical direction and wider than the slots 126a—126d in the other diametrical direction perpendicular to the first.

When the screws 134 are inserted into the slots 126a—126d via the slots 122a—122d and nuts are loosely fit on the screws, the bottom plate 110 is free to move relative to the plate 108 in the two perpendicular directions. Under this condition adjusting plate 108 is fastened to the posts 116a—116d of the second casing 106 using the oversized holes 121a—121d. Such a manner of assembly permits the bottom plate 110 to be adjusted in two perpendicular directions relative to the plate 108 after the solar sensor is fixed to the solar energy collector as shown in Figure 1. After the adjustment, the nuts on the screws 134 will be tightened to secure the bottom plate 110 to the plate 108, the slots 122a—122d in the plate 108 serving to prevent rotation of the screws 134.

The adjustability stated above is desirable in the following respect. Generally, a solar energy collector such as the one shown in Figure 1 is assembled by mounting the solar sensor sunward, positioning light input ends of light conducting cables in conformity to the so located solar sensor and such that light converged by their associated lenses become incident thereon in the most efficient manner, and then fixing the light input ends of the cables to the collector body. On failure of the solar sensor, it is usually removed from the collector body, repaired and then mounted again on the collector body. In this instance, the adjustability particular to the present invention eliminates the need for repositioning the lenses and cables, that is, what is required is to simply adjust the solar sensor in the manner previously discussed.

In operation, the photosensors X_1 — X_4 on the mount 130 are exposed to the light which enters the solar sensor via the cruciform opening 112 in the top plate 100, opening 118 in intermediate plate 104, opening 119 in the adjusting plate 108,

and opening 124 in the bottom plate 110. Meanwhile, the photosensor X_0 is irradiated by the light which advances through the opening 132 in the mount 130 after the openings 112, 118, 119 and 124. Only the direct light is allowed to reach the photosensors X_1 — X_4 and X_0 because all the diffused components will be removed while the light sequentially advances through the openings. Concerning the photosensors X_5 and X_6 on the intermediate plate 104, they are irradiated by the light which enters the solar sensor via the entire length of the cruciform opening 112 (a in this particular embodiment). When the incident angle of the sunlight on the solar sensor is relatively large as represented by the angle θ_3 in Figure 8, the photosensors X_1 — X_4 and X_0 will miss the sun. This does not matter at all because the photosensors X_5 and X_6 will roughly sense the position of the sun and cause the solar energy collector to move until the photosensors X_1 — X_4 become exposed to the direct light from the sun.

In summary, it will be seen that the present invention provides a device for chasing a moving light source which features ease of assembly and maintenance, accuracy and adjustability of positioning, least possibility of erroneous detection due to indirect light, and applicability to a light source which moves over a substantial angular range.

The solar sensor assembly may be finished to have a non-reflective inner periphery and a reflective outer periphery with or without the top plate 100 shaped convex toward the outside, taking into account the influence of light diffusion and heat on the photosensors. As shown in Figure 21, the top plate 100 may be formed with a recess large enough to accommodate the photosensor X_0 so as to reduce the heat acting thereon.

Claims

1. A device for tracking a moving light source comprising:

a casing (102, 106) having a first opening in a first surface area and a second opening in a second surface area opposite of the first surface area;

a closure member (100) provided with an aperture (112) of a predetermined form, said member being arranged in said first opening so as to enable the passage of light into the interior of the casing only through said aperture;

a support member (110, 128, 130) arranged to support a plurality of photosensors (X_0 , X_1 — X_4) in a predetermined position with respect to the light passing through said second opening, said plurality of photosensors comprising at least one pair of sensor elements (X_1 , X_2 ; X_3 , X_4) symmetrically disposed with respect to the central optical axis through said aperture (112), the spacing between said elements of the or each pair being such that a predetermined region of said elements is exposed to light rays extending parallel to said axis and passing through said aperture at opposite edges thereof;

in the same manner as in Figure 9. It is not always necessary to locate the photosensor X_c at a predetermined spacing from the mount 130; it may be loaded even on the mount 130 as described with reference to Figure 3.

In assembly, after the slots 122a—122d of the adjusting plate 108 have been respectively aligned with the slots 126a—126d of the bottom plate 110, screws 134 are inserted into the slots 122a—122d and then into the slots 126a—126d. Nuts are then fit on the screws 134 from the back of the bottom plate 110.

Examples of the screws 134 suitable for the construction described above are shown in Figures 19 and 20. The screw 134 in Figure 19 has a portion 134a which is narrower than the slots 122a—122d of the adjusting plate 108 in one diametrical direction, wider than the slots 126a—126d of the bottom plate 110 in the other diametrical direction perpendicular to the first, and thicker than the adjusting plate 108. The screw 134 in Figure 20, on the other hand, has a shank 134b which is narrower than the slots 122a—122d in one diametrical direction and wider than the slots 126a—126d in the other diametrical direction perpendicular to the first.

When the screws 134 are inserted into the slots 126a—126d via the slots 122a—122d and nuts are loosely fit on the screws, the bottom plate 110 is free to move relative to the plate 108 in the two perpendicular directions. Under this condition adjusting plate 108 is fastened to the posts 116a—116d of the second casing 106 using the oversized holes 121a—121d. Such a manner of assembly permits the bottom plate 110 to be adjusted in two perpendicular directions relative to the plate 108 after the solar sensor is fixed to the solar energy collector as shown in Figure 1. After the adjustment, the nuts on the screws 134 will be tightened to secure the bottom plate 110 to the plate 108, the slots 122a—122d in the plate 108 serving to prevent rotation of the screws 134.

The adjustability stated above is desirable in the following respect. Generally, a solar energy collector such as the one shown in Figure 1 is assembled by mounting the solar sensor sunward, positioning light input ends of light conducting cables in conformity to the so located solar sensor and such that light converged by their associated lenses become incident thereon in the most efficient manner, and then fixing the light input ends of the cables to the collector body. On failure of the solar sensor, it is usually removed from the collector body, repaired and then mounted again on the collector body. In this instance, the adjustability particular to the present invention eliminates the need for repositioning the lenses and cables, that is, what is required is to simply adjust the solar sensor in the manner previously discussed.

In operation, the photosensors X_1 — X_4 on the mount 130 are exposed to the light which enters the solar sensor via the cruciform opening 112 in the top plate 100, opening 118 in intermediate plate 104, opening 119 in the adjusting plate 108,

and opening 124 in the bottom plate 110. Meanwhile, the photosensor X_c is irradiated by the light which advances through the opening 132 in the mount 130 after the openings 112, 118, 119 and 124. Only the direct light is allowed to reach the photosensors X_1 — X_4 and X_c because all the diffused components will be removed while the light sequentially advances through the openings. Concerning the photosensors X_5 and X_6 on the intermediate plate 104, they are irradiated by the light which enters the solar sensor via the entire length of the cruciform opening 112 (a in this particular embodiment). When the incident angle of the sunlight on the solar sensor is relatively large as represented by the angle θ_s in Figure 8, the photosensors X_1 — X_4 and X_c will miss the sun. This does not matter at all because the photosensors X_5 and X_6 will roughly sense the position of the sun and cause the solar energy collector to move until the photosensors X_1 — X_4 become exposed to the direct light from the sun.

In summary, it will be seen that the present invention provides a device for chasing a moving light source which features ease of assembly and maintenance, accuracy and adjustability of positioning, least possibility of erroneous detection due to indirect light, and applicability to a light source which moves over a substantial angular range.

The solar sensor assembly may be finished to have a non-reflective inner periphery and a reflective outer periphery with or without the top plate 100 shaped convex toward the outside, taking into account the influence of light diffusion and heat on the photosensors. As shown in Figure 21, the top plate 100 may be formed with a recess large enough to accommodate the photosensor X_c so as to reduce the heat acting thereon.

Claims

1. A device for tracking a moving light source comprising:

a casing (102, 106) having a first opening in a first surface area and a second opening in a second surface area opposite of the first surface area;

a closure member (100) provided with an aperture (112) of a predetermined form, said member being arranged in said first opening so as to enable the passage of light into the interior of the casing only through said aperture;

a support member (110, 128, 130) arranged to support a plurality of photosensors (X_c , X_1 — X_4) in a predetermined position with respect to the light passing through said second opening, said plurality of photosensors comprising at least one pair of sensor elements (X_1 , X_2 ; X_3 , X_4) symmetrically disposed with respect to the central optical axis through said aperture (112), the spacing between said elements of the or each pair being such that a predetermined region of said elements is exposed to light rays extending parallel to said axis and passing through said aperture at opposite edges thereof;



the device being characterized in that said aperture is a cruciform aperture (112), the opposite edges defining the spacing between the sensor elements of said pair being those edges of the cruciform aperture which are arranged transversely to one of the two major extensions of said aperture;

said plurality of photosensors ($X_0, X_1 \dots X_4$) comprises an additional sensor element (X_c) arranged on said optical axis;

the support member (110, 128, 130) is arranged to close said second opening.

2. The device as claimed in claim 1, in which said predetermined region of each of the sensor elements is an inner edge thereof facing said optical axis.

3. The device as claimed in claim 1, in which the predetermined region is an intermediate portion.

4. The device as claimed in claim 1, in which the casing (102, 106) and the support and closure members (100, 110, 128, 130) are removable from each other.

5. The device as claimed in claim 1, in which the support member (110, 128, 130) is formed with a recess centered on said optical axis, the additional sensor element (X_c) being received in said recess.

6. The device as claimed in claim 1, further comprising an intermediate plate (104) supported by a portion of the casing substantially axially intermediate between said openings, said intermediate plate being provided with a substantially rectangular opening (118) defined by a first set of two opposite sides each of which is at least equal in length to one of the two major extensions of the cruciform aperture (112) and a second set of opposite sides each of which is at least equal in length to the other major extension of the cruciform aperture perpendicular to said one extension.

7. The device as claimed in claim 6, further comprising at least a pair of third photosensors (X_5, X_6) mounted on the intermediate plate (104) to respectively extend along opposite edges of the rectangular opening (118) in the intermediate plate.

8. The device as claimed in claim 6, in which the casing, the support and the closure members (100; 110, 128, 130) and the intermediate plate (104) are removable from each other.

9. The device as claimed in claim 1, further comprising an adjusting plate (108) interposed between the support member and the casing (102, 106), said adjusting plate being formed with a generally rectangular opening (119) which is defined by a first set of opposite sides each of which is at least equal in length to one of the two major extensions of the cruciform aperture (112) and a second set of opposite sides at least equal in length to the other major extension of the cruciform aperture perpendicular to said one extension, the adjusting plate (108) being arranged to enable movement of the support member mounted to this plate in two perpendicular directions within the plane of the plate.

10. The device as claimed in claim 9, in which the casing (102, 106), the support and closure members (100; 110, 128, 130) and the adjusting plate (108) are removable from each other.

Patentansprüche

1. Vorrichtung zur Verfolgung einer beweglichen Lichtquelle, umfassend:

ein Gehäuse (102, 106), das eine erste Öffnung in einem ersten Flächenbereich und eine zweite Öffnung in einem zweiten Flächenbereich gegenüberliegend dem ersten Flächenbereich aufweist;

ein Schließelement (100), das mit einer Öffnung (112) einer bestimmten Form versehen ist, wobei das Element in der ersten Öffnung so angeordnet ist, daß Licht in das Innere des Gehäuses nur durch diese Öffnung eintreten kann;

mit einem Halter (110, 128, 130), der mehrere Fotosensoren (X_0, X_1 bis X_4) in einer vorbestimmten Lage bezüglich des Lichtes, das durch die zweite Öffnung eintritt, trägt, wobei die mehreren Sensoren wenigstens ein Sensorelementpaar ($X_1, X_2; X_3, X_4$) umfassen, das bezüglich der optischen Mittelachse durch die Öffnung (112) symmetrisch angeordnet sind und wobei der Abstand zwischen dem oder den Elementenpaaren so ist, daß ein bestimmter Teil der Elemente Lichtstrahlen ausgesetzt ist, die sich parallel zur Achse erstrecken und die durch die Öffnung an entgegengesetzten Kanten hindurchtreten,

dadurch gekennzeichnet,

daß die Öffnung eine kreuzförmige Öffnung (112) ist und daß die gegenüberliegenden Kanten, die den Abstand zwischen den Sensorelementen der Paare festlegen, diejenigen Kanten der kreuzförmigen Öffnung sind, die quer zu einer der zwei Haupterstreckungsrichtungen der Öffnungen angeordnet sind; und daß die mehreren Fotosensoren (X_0, X_1 bis X_4) ein zusätzliches Sensorelement (X_c) aufweisen, das auf der optischen Achse angeordnet ist; und daß das Halteelement (110, 128, 130) so angeordnet ist, daß es die zweite Öffnung verschließt.

2. Vorrichtung nach Anspruch 1, wobei der bestimmte Bereich auf jedem Sensorelement die Innenkante des Elements ist, die auf die optische Achse weist.

3. Vorrichtung nach Anspruch 1, wobei der vorbestimmte Bereich ein Zwischenbereich ist.

4. Vorrichtung nach Anspruch 1, wobei das Gehäuse (102, 106) und die Halte- und Verschließelemente (100, 110, 128, 130) auseinanderbaubar sind.

5. Vorrichtung nach Anspruch 1, wobei das Halteelement (110, 128, 130) mit einem Ausschnitt zentriert zur optischen Achse versehen ist und wobei der zusätzliche Sensor (X_c) in diesem Ausschnitt angeordnet ist.

6. Vorrichtung nach Anspruch 1, wobei weiterhin eine Zwischenplatte (104) vorgesehen ist, die von einem Teil des Gehäuses im wesentlichen Axial in der Mitte zwischen den Öffnungen gehalten wird, wobei die Zwischenplatte eine im



wesentlichen rechteckige Öffnung (118) aufweist, die von einem ersten gegenüberliegenden Seitenpaar begrenzt ist, wobei jede dieser Seiten wenigstens die gleiche Länge wie einer der beiden Haupterstreckungsrichtungen der kreuzförmigen Öffnung (112) hat und wobei die Öffnung durch ein zweites Paar gegenüberliegender Seiten begrenzt ist, wobei jede dieser Seiten wenigstens gleich lang wie die andere Haupterstreckung der kreuzförmigen Öffnung senkrecht zu der einen Erstreckungsrichtung ist.

7. Vorrichtung nach Anspruch 6, mit wenigstens einem Paar dritter Fotosensoren (X_5, X_6), die auf der Zwischenplatte (104) angeordnet sind und sich entlang gegenüberliegenden Kanten der rechteckigen Öffnung (118) in der Zwischenplatte erstrecken.

8. Vorrichtung nach Anspruch 6, wobei das Gehäuse, die Halte- und Verschiebelemente (100; 110, 128, 130) und die Zwischenplatte (104) auseinanderbaubar sind.

9. Vorrichtung nach Anspruch 1, die weiterhin eine Justierplatte (108) aufweist, die zwischen dem Halteelement und dem Gehäuse (102, 106) angeordnet ist und wobei die Justierplatte mit einer im wesentlichen rechteckigen Öffnung (119) versehen ist, die von einem ersten gegenüberliegenden Seitenpaar begrenzt wird, wobei jede dieser Seiten wenigstens die gleiche Länge wie eine der beiden zwei Haupterstreckungsrichtungen der kreuzförmigen Öffnungen (112) aufweist und die durch ein zweites Seitenpaar begrenzt ist, wobei die Länge dieser Seiten wenigstens gleich wie die andere Haupterstreckungsrichtung der kreuzförmigen Öffnung senkrecht zu der einen Haupterstreckungsrichtung ist und wobei die Justierplatte (108) so angeordnet ist, daß sie eine Bewegung des auf dieser Platte befestigten Halteelements in zwei senkrechten Richtungen in der Plattenebene ermöglicht.

10. Vorrichtung nach Anspruch 9, wobei das Gehäuse (102, 106), die Halte- und Verschiebelemente (100, 110, 128, 130) und die Justierplatte (28) auseinanderbaubar sind.

Revendications

1. Un dispositif pour suivre une source lumineuse mobile comprenant:

— un carter (102, 106) pourvu d'une première ouverture dans une première zone superficielle et d'une seconde ouverture dans une seconde zone superficielle qui est opposée à la première zone superficielle;

— un élément de fermeture (100) pourvu d'une ouverture (112) d'une forme prédéterminée, ledit élément étant disposé dans ladite première ouverture de façon à permettre le passage de la lumière vers l'intérieur du carter seulement au travers de ladite ouverture;

— un élément de support (110, 128, 130) agencé pour supporter une pluralité de photodétecteurs (X_0, X_1-X_4) dans une position prédéterminée par rapport à la lumière passant au travers de ladite

seconde ouverture, ladite pluralité de photodétecteurs comprenant au moins une paire d'éléments de captage ($X_1, X_2; X_3, X_4$) disposés symétriquement par rapport à l'axe optique central traversant ladite ouverture (112), l'espacement entre lesdits éléments de la ou de chaque paire étant tel qu'une région prédéterminée desdits éléments soit exposée à des rayons lumineux orientés parallèlement audit axe et passant au travers de ladite ouverture sur ses bords opposés;

— le dispositif étant caractérisé en ce que:

— ladite ouverture est une ouverture en forme de croix (112), les bords opposés définissant l'espacement entre les éléments de captage de ladite paire étant les bords de l'ouverture en forme de croix qui sont disposés transversalement à une des deux dimensions principales de ladite ouverture;

— ladite pluralité de photodétecteurs (X_0, X_1-X_4) comprend un élément de captage additionnel (X_0) disposé sur ledit axe optique;

— ledit élément de support (110, 128, 130) est agencé pour obturer ladite seconde ouverture.

2. Le dispositif tel que revendiqué dans la revendication 1, dans lequel ladite région prédéterminée de chacun des éléments de captage est un bord intérieur de ceux-ci qui est dirigé vers ledit axe optique.

3. Le dispositif tel que revendiqué dans la revendication 1, dans lequel la région prédéterminée est une partie intermédiaire;

4. Le dispositif tel que revendiqué dans la revendication 1, dans lequel le carter (102, 106) et les éléments de support et de fermeture (100, 110, 128, 130) sont amovibles l'un de l'autre.

5. Le dispositif tel que revendiqué dans la revendication 1, dans lequel l'élément de support (110, 128, 130) est pourvu d'un évidement centré sur ledit axe optique, l'élément de captage additionnel (X_0) étant reçu dans ledit évidement.

6. Le dispositif tel que revendiqué dans la revendication 1, comprenant en outre une plaque intermédiaire (104) supportée par une partie du carter sensiblement axialement intermédiaire entre lesdites ouvertures, ladite plaque intermédiaire étant pourvue d'une ouverture sensiblement rectangulaire (118), définie par une première série de deux côtés opposés qui ont chacun une longueur égale à une des deux dimensions principales de l'ouverture en forme de croix (112) et par une seconde série de côtés opposés qui ont chacun une longueur au moins égale à l'autre dimension principale de l'ouverture en forme de croix perpendiculaire à ladite première dimension.

7. Le dispositif tel que revendiqué dans la revendication 6, comprenant en outre au moins une paire de troisièmes photodétecteurs (X_5, X_6) montés sur la plaque intermédiaire (104) de façon à s'étendre respectivement le long de bords opposés de l'ouverture rectangulaire (118) ménagée dans la plaque intermédiaire.

8. Le dispositif tel que revendiqué dans la revendication 6, dans lequel le carter, les élé-



ments de support et de de fermeture (100; 110, 128, 130) et la plaque intermédiaire (104) sont amovibles l'un de l'autre.

9. Le dispositif tel que revendiqué dans la revendication 1, comprenant en outre une plaque de réglage (108) interposée entre l'élément de support et le carter (102, 106), ladite plaque de réglage étant pourvue d'une ouverture rectangulaire dans l'ensemble (119), qui est définie par une première série de côtés opposés ayant chacun une longueur au moins égale à une des deux dimensions principales de l'ouverture en forme de croix (112), et par une seconde série de côtés

opposés ayant une longueur au moins égale à l'autre dimension principale de l'ouverture en forme de croix perpendiculaire à ladite première dimension, la plaque de réglage (108) étant agencée de façon à permettre un mouvement de l'élément de support monté sur cette plaque dans deux directions perpendiculaires dans le plan de la plaque.

10. Le dispositif tel que revendiqué dans la revendication 9, dans lequel le carter (102, 106), les éléments de support et de fermeture (100; 110, 128, 130) et la plaque de réglage (108) sont amovibles l'un de l'autre.

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