

Description

The present invention relates to a sunlight collecting and concentrating apparatus, comprising a collector means for collecting and concentrating the sunlight, a first support means for rotatably supporting the collector means about a first axis of rotation, a second support means for rotatably supporting the first support means about a second axis of rotation perpendicular to the first axis, one of said first and second axes being horizontal and the other being vertical, detecting means movable with the collector means for detecting the sun's azimuth and altitude, drive means for generating independent movement of the collector means about the first and the second axis of rotation, transmission means for transmitting signals from the detecting means to the drive means so that the collector means follows the daily and hourly changes in the sun's azimuth and altitude to keep the collector means always facing the sun, first optical conductor means for transmitting light arranged to move together with the collector means, second optical conductor means for transmitting light to a predetermined area outside of the apparatus, said second optical conductor means being arranged to move together with the second support means, and coupling means arranged between the first and second optical conductor means for transmitting the light from the former to the latter while permitting relative rotation therebetween.

In recent years, a need has arisen to save energy. Many attempts have been made to provide systems making effective use of the solar light energy reaching the earth's surface. Conventional systems are provided with a mirror or lens means operated to follow the daily and hourly changes in the sun's azimuth and altitude so as to always face the sun and collect solar light energy most effectively. For most effective use, the solar light energy must be directly used in the form of light without conversion to other forms of energy, such as electric or thermal energy.

In view of the above, the inventor has already developed a sunlight collecting and concentrating apparatus comprising a collector, operable to follow the change in the sun's azimuth and altitude and capable of condensing the collected sunlight, and an optical fiber or other optical conductor for receiving the condensed light. The condensed light is transmitted via the optical fiber to the region where the light is required. Thus, effective collection is attained irrespective of the daily and hourly change in the sun's azimuth and altitude and without any loss due to energy conversion.

In this type of apparatus, the collector is advantageously comprised of a mirror or lens means having two perpendicular axes of rotation one horizontal and the other vertical, independent rotational motion capable by each axis, thus enabling the mirror or lens means to follow the changes in the sun's azimuth and altitude. Thus, the optical conductor connected to the collector

and the cables connecting the tracking means with an outside controller tend to become wound up or subject to torsion. This winding or torsion of the optical conductor for the cables adversely affects the tracking operation.

Further FR—A—2 310 477 discloses an apparatus wherein the mirror can be moved both vertically and horizontally and wherein the light collected by the mirror is received by the optical conductors, which substantially corresponds to the construction as defined in the preamble of the independent claims of the present application. However, according to the reference there are no provisions to avoid the problem of winding or torsion of the optical cable necessary for transporting the collected sun light.

Thus, it is the object of the present invention to provide a sunlight collecting and concentrating apparatus of the type defined in the preamble of the independent claims avoiding winding and torsion of an optical conductor for transmitting useful collected light and light signals, respectively, when the mirror or lense means is rotated to keep them continually facing the sun.

This object according to the three independent solutions of this invention is accomplished

a) in that said first optical conductor means is an optical conductor member having an inlet end opened outwardly for receiving the collected light from the collector means, and a second end arranged coaxially with respect to the first axis and being connected to the coupling means, and in that said second conductor means is an optical conductor member having an inlet end rotatably connected to the coupling means, a middle portion arranged concentrically with the second axis, and a second end connectible to the area where the collected sunlight is used;

b) in that said transmission means comprises a radio transmitter means connected to the detecting means for providing signals indicating the sun's azimuth and altitude and a radio receiver means connected to the drive means for driving the collector in accordance with the sun's position, said receiver means being arranged on a desired position remote from the collector means; and

c) in that said transmission means comprises a first transducer connected to the detecting means for converting the electric signals from the detecting means to photo signals, an optical signal cable having an end connected to the first transducer, a middle section having a portion connected to the first axis, and a portion connected to the second axis, and a second end freely opened, a second transducer means stationarily arranged so as to face the free end of the cable for converting the optical signals from the optical signal cable to electric signals, and an electric line connecting the second transducer means to the drive means, respectively.

The present invention will be fully understood from the following description together with the accompanying drawings, in which:

Fig. 1 is a schematic vertical side view of a

mirror type apparatus according to one embodiment of the present invention;

Fig. 2 is a schematic perspective view of an optical coupling for transmission of signals from sun tracking sensors to a control circuit;

Fig. 3 is a schematic perspective view of another modification of an optical coupling.

Fig. 4 shows a diagram of a radio transmission system for transmitting the signal from the tracking sensor to the controller.

Figs. 5 and 6 show other embodiment of the present invention.

In Fig. 1, showing an embodiment of the present invention, there is a transparent housing 14 enclosing a parabolic mirror 1. At the rear of parabolic mirror 1 are arms 3 and 3'. Arms 3' have balance weights 4 connected to them. Arms 3 are fixedly connected on ends remote from parabolic mirror 1 to pins 2 having an axis of rotation H—H which extends horizontally. Pins 2 are rotatably connected on the ends thereof to support arms 6. Support arms 6 extend integrally from shaft 7 having an axis of rotation V—V which extends vertically. Shaft 7 is rotatably connected to a base column 70. Electric motor 5 is mounted to one of arms 6 to rotate the corresponding pin 2 so as to turn parabolic mirror 1 about first axis H—H. Another electric motor 50 is also connected to second shaft 7 via gears 52 and 54 to rotate shaft 7. Thus parabolic mirror 1 rotates about second axis V—V.

Reference numeral 8 denotes tracking sensor device for providing signals indicating the sun's azimuth and altitude. Sensor device 8 operates, as well known, to provide signals indicating whether or not parabolic mirror 1 faces the sun. Sensor device 8 may have the construction proposed by the present inventor in Japanese Patent Application No. 56-69781. The signals are transmitted via transmission system 60 including, as will be fully described later, optical conductor 15 and electric lines 17, and introduced into an outside control circuit 66. Control circuit 66 is connected to motor 5 and 50 via electric lines 68 and 71, respectively. When sensor device 8 detects that the parabolic mirror 1 is not facing the sun, control circuit 66 operates to provide signals directed to motors 5 and 50 via electric lines 68 and 71, respectively. This initiates rotational motion of the mirror about horizontal axis H—H and/or vertical axis V—V, respectively, independent with each other, to bring parabolic mirror 1 to face the sun. Thus, the parabolic mirror 1 can follow the daily and hourly changes in the sun's azimuth and altitude, so that the sunlight received by parabolic mirror 1 can always be condensed to the mirror focal point.

At the focal point of parabolic mirror 1, there is arranged second parabolic mirror 10 for generating a substantially parallel condensed beam X. Beam X is transmitted to the region where the light is desired via an optical conductor system, as will be fully described hereinbelow. Such an optical conductor system comprises, according to the embodiment shown in Fig. 1, first, second,

and third sections 11, 12, and 13, each being made of optical conductor tubes or rods. First optical conductor rod 11 is arranged concentrically with respect to horizontal axis H—H. First optical conductor rod 11 is provided with first end 11A opened so as to receive condensed beam X from second parabolic mirror 10 and with second end 11B rotatably connected to one end 12A of second optical conductor rod 12. Second optical conductor rod 12 has portion 12B passed concentrically through shaft 7. Second optical conductor rod 12 at second end 12C is rotatably connected to one end 13A of third optical conductor rod 13, which is fixedly connected to column 70. The other end (not shown) of third optical conductor rod 13 is connected to the region where the collected sunlight desired. It should be noted that, instead of connection to third, optical conductor rod 13, second optical conductor rod 12 may extend downward through base column 70 so that one end of the rod 12 terminates at the region where the collected sunlight is to be used.

When parabolic mirror 1 is rotated about axis H—H or V—V during the tracking operation, relative rotation is allowed between the first and second optical conductor rods 11 and 12 or between second and third optical conductor rods 12 and 13. This enables transmission of light from parabolic mirror 1 to the region where the light is desired without winding or torsion of optical conductor rods 11, 12, and 13.

As will be clear from the above, the present invention enables transmission of the collected sunlight to the desired place without winding or torsion of the optical conductor during tracking motion of parabolic mirror 1. In addition, the present invention also prevents winding or torsion otherwise generated in electric line 60 for connecting sensor device 8 with control circuit 66. As shown in Fig. 1, the transmission system 60 for connecting sensor device 8 with control circuit 66 includes luminescent semiconductor diodes of transducer 80 to convert electric signals from sensor device 8 into photo signals. It further includes optical conductor 15 connected on one end 15b to diodes of transducer 80. Optical conductor 15 has portion 15C arranged along shaft 7. Optical conductor 15 is open at second end 15a to a photoelectric transducer 16 stationarily mounted on column 70. Photoelectric transducer 16 comprises, as shown in Fig. 2, a plurality of circumferentially arranged photocells 16a each connected to control circuit 66 via electric lines 17. Thus, photo signals from optical conductor 15 are received by one of photocells 16a even if shaft 7 is rotated during the tracking operation of parabolic mirror 1.

If the signal from the transducer 80 connected to the sensor 8 is directly introduced to the controller to operate the motors, a high accuracy cannot be obtained due to the low sensitivity of the photocells 16 and the disturbance (noise). Thus, the diode of transducer 80 may be advantageously on-off controlled to provide digital photo signals introduced into the cable 15.

In another modification, photoelectric transducer 16 may comprise, as shown in Fig. 3, ring-shaped optical conductor 18 having widened inlet end 18a and second converged end 18b. Optical conductor 15 is open to inlet end 18a of optical conductor 18. Photocell 16 is arranged to face end 18b of optical conductor 18. Photocell 16 is connected via a single electric line 17 to control circuit 66 in Fig. 1. Photosignal from the cable 15 connected to sensor device 8 may be received by photocell 16 at all times irrespective of the angular position of optical conductor 15 with respect to optical conductor 18.

Instead of arranging transmission system 60 to connect sensor device 8 to control circuit 66, cordless radio transmitter 90 may be, as shown in Fig. 4, connected to sensor device 8, and be arranged on parabolic mirror 1. Receiver 92 is connected to control circuit 66. Transmitter 90 emits radio signals indicating the sun's azimuth and altitude. The radio signals are received by receiver 92 and cause control circuit 66 to operate motors 5 and 50 (Fig. 1) to keep parabolic mirror 1 always facing the sun.

In another embodiment, shown in Fig. 5, in place of the single parabolic mirror 1 of Fig. 1, a plurality of lenses 20 is used mounted on common support 96 by arms 3. At the focus of each of the lenses 20, an inlet of optical conductor rods 21 is arranged. The other end of each of optical conductor rods 21 is connected to first optical conductor rod 11, which is, as in Fig. 1, connected to pin 2 so as to rotate about horizontal axis X—X. Other constructions are substantially the same as those in Fig. 1. Transmission system 60, as described in Fig. 1, is also provided, though not shown in Fig. 5.

In the embodiment shown in Fig. 6, sunlight reflected by first mirror 30 is reflected by second mirror 31 to form parallel beam Y. Parallel beam Y is again reflected by first mirror 30 and is received by optical conductor cable 32. Optical conductor cable 32 has a portion a located on axis H—H of pins 2. Optical conductor cable 32 has a second end connected to second optical conductor cable 32' by coupling 33. Coupling 33 allows relative rotation between cables 32 and 32', preventing the cables from winding or being subject to torsion.

In this embodiment, electric signals from the sensor device 8 are led via electric line 34 to a control circuit (not shown in Fig. 6, but similar to 66 in Fig. 1). Electric line 34 has portion 34A passed freely through arm 3 and portion a' located on first axis of rotation H—H which extends horizontally. Electric line 34 also has portion 34B passed freely through shaft 7. When the mirror 30 is rotated about first axis of rotation H—H, electric line 34 tends to be twisted. However, this twist is substantially diminished due to the facts that electric line 34 has long portion 34B freely and coaxially passed through shaft 7 and that both ends of electric line 34 are supported relatively freely. The twist of electric line 34 due to the rotation of shaft 7 about second axis V—V of

rotation is also substantially diminished due to the same reason as described with reference to the first axis of rotation. Electric line 34 is arranged together with optical conductor cables 32 and 32'. However, the line 34 and cables are arranged separately with each other.

Claims

1. A sunlight collecting and concentrating apparatus, comprising:

a collector means (1, 10; 20; 30, 31) for collecting and concentrating the sunlight;

a first support means (2, 3) for rotatably supporting the collector means (1, 10; 20; 30, 31) about a first axis (H—H) of rotation;

a second support means (6, 7, 70) for rotatably supporting the first support means (2, 3) about a second axis (V—V) of rotation perpendicular to the first axis (H—H), one of said first and second axes being horizontal and the other being vertical;

detecting means (8) movable with the collector means (1, 10; 20; 30, 31) for detecting the sun's azimuth and altitude;

drive means (5, 50, 52, 54) for generating independent movement of the collector means (1, 10; 20; 30, 31) about the first and the second axis of rotation;

transmission means (60) for transmitting signals from the detecting means (8) to the drive means (5, 50, 52, 54; 66) so that the collector means (1, 10; 20; 30, 31) follows the daily and hourly changes in the sun's azimuth and altitude to keep the collector means always facing the sun;

first optical conductor means (11; 32) for transmitting light arranged to move together with the collector means (1, 10; 20; 30, 31);

second optical conductor means (12; 32') for transmitting light to a predetermined area outside of the apparatus, said second optical conductor means (12; 32') being arranged to move together with the second support means (6, 7, 70); and

coupling means (33) arranged between the first and second optical conductor means for transmitting the light from the former to the latter while permitting relative rotation therebetween,

characterized in that said first optical conductor means is an optical conductor member (11) having an inlet end (11A) opened outwardly for receiving the collected light from the collector means, and a second end (11B) arranged coaxially with respect to the first axis and being connected to the coupling means, and in that said second conductor means is an optical conductor member (12) having an inlet end (12A) rotatably connected to the coupling means, a middle portion (12B) arranged concentrically with the second axis (V—V), and a second end (12C) connectible to the area where the collected sunlight is used.

2. An apparatus according to claim 1, further comprising another optical conductor member (13) fixed to the second support means (70), a

In another modification, photoelectric transducer 16 may comprise, as shown in Fig. 3, ring-shaped optical conductor 18 having widened inlet end 18a and second converged end 18b. Optical conductor 15 is open to inlet end 18a of optical conductor 18. Photocell 16 is arranged to face end 18b of optical conductor 18. Photocell 16 is connected via a single electric line 17 to control circuit 66 in Fig. 1. Photosignal from the cable 15 connected to sensor device 8 may be received by photocell 16 at all times irrespective of the angular position of optical conductor 15 with respect to optical conductor 18.

Instead of arranging transmission system 60 to connect sensor device 8 to control circuit 66, cordless radio transmitter 90 may be, as shown in Fig. 4, connected to sensor device 8, and be arranged on parabolic mirror 1. Receiver 92 is connected to control circuit 66. Transmitter 90 emits radio signals indicating the sun's azimuth and altitude. The radio signals are received by receiver 92 and cause control circuit 66 to operate motors 5 and 50 (Fig. 1) to keep parabolic mirror 1 always facing the sun.

In another embodiment, shown in Fig. 5, in place of the single parabolic mirror 1 of Fig. 1, a plurality of lenses 20 is used mounted on common support 96 by arms 3. At the focus of each of the lenses 20, an inlet of optical conductor rods 21 is arranged. The other end of each of optical conductor rods 21 is connected to first optical conductor rod 11, which is, as in Fig. 1, connected to pin 2 so as to rotate about horizontal axis X—X. Other constructions are substantially the same as those in Fig. 1. Transmission system 60, as described in Fig. 1, is also provided, though not shown in Fig. 5.

In the embodiment shown in Fig. 6, sunlight reflected by first mirror 30 is reflected by second mirror 31 to form parallel beam Y. Parallel beam Y is again reflected by first mirror 30 and is received by optical conductor cable 32. Optical conductor cable 32 has a portion a located on axis H—H of pins 2. Optical conductor cable 32 has a second end connected to second optical conductor cable 32' by coupling 33. Coupling 33 allows relative rotation between cables 32 and 32', preventing the cables from winding or being subject to torsion.

In this embodiment, electric signals from the sensor device 8 are led via electric line 34 to a control circuit (not shown in Fig. 6, but similar to 66 in Fig. 1). Electric line 34 has portion 34A passed freely through arm 3 and portion a' located on first axis of rotation H—H which extends horizontally. Electric line 34 also has portion 34B passed freely through shaft 7. When the mirror 30 is rotated about first axis of rotation H—H, electric line 34 tends to be twisted. However, this twist is substantially diminished due to the facts that electric line 34 has long portion 34B freely and coaxially passed through shaft 7 and that both ends of electric line 34 are supported relatively freely. The twist of electric line 34 due to the rotation of shaft 7 about second axis V—V of

rotation is also substantially diminished due to the same reason as described with reference to the first axis of rotation. Electric line 34 is arranged together with optical conductor cables 32 and 32'. However, the line 34 and cables are arranged separately with each other.

Claims

1. A sunlight collecting and concentrating apparatus, comprising:
 - a collector means (1, 10; 20; 30, 31) for collecting and concentrating the sunlight;
 - a first support means (2, 3) for rotatably supporting the collector means (1, 10; 20; 30, 31) about a first axis (H—H) of rotation;
 - a second support means (6, 7, 70) for rotatably supporting the first support means (2, 3) about a second axis (V—V) of rotation perpendicular to the first axis (H—H), one of said first and second axes being horizontal and the other being vertical;
 - detecting means (8) movable with the collector means (1, 10; 20; 30, 31) for detecting the sun's azimuth and altitude;
 - drive means (5, 50, 52, 54) for generating independent movement of the collector means (1, 10; 20; 30, 31) about the first and the second axis of rotation;
 - transmission means (60) for transmitting signals from the detecting means (8) to the drive means (5, 50, 52, 54; 66) so that the collector means (1, 10; 20; 30, 31) follows the daily and hourly changes in the sun's azimuth and altitude to keep the collector means always facing the sun;
 - first optical conductor means (11; 32) for transmitting light arranged to move together with the collector means (1, 10; 20; 30, 31);
 - second optical conductor means (12; 32') for transmitting light to a predetermined area outside of the apparatus, said second optical conductor means (12; 32') being arranged to move together with the second support means (6, 7, 70); and
 - coupling means (33) arranged between the first and second optical conductor means for transmitting the light from the former to the latter while permitting relative rotation therebetween, characterized in that said first optical conductor means is an optical conductor member (11) having an inlet end (11A) opened outwardly for receiving the collected light from the collector means, and a second end (11B) arranged coaxially with respect to the first axis and being connected to the coupling means, and in that said second conductor means is an optical conductor member (12) having an inlet end (12A) rotatably connected to the coupling means, a middle portion (12B) arranged concentrically with the second axis (V—V), and a second end (12C) connectible to the area where the collected sunlight is used.
2. An apparatus according to claim 1, further comprising another optical conductor member (13) fixed to the second support means (70), a



second coupling means for rotatable connection of the second conductor means (12) with the other optical conductor member (13), said other optical conductor member (13) being connected to the outside of the apparatus.

3. A sunlight collecting and concentrating apparatus, comprising:

a collector means (1, 10; 20; 30, 31) for collecting and concentrating the sunlight;

a first support means (2, 3) for rotatably supporting the collector means (1, 10; 20; 30, 31) about a first axis (H—H) of rotation;

a second support means (6, 7, 70) for rotatably supporting the first support means (2, 3) about a second axis (V—V) of rotation perpendicular to the first axis (H—H), one of said first and second axes being horizontal and the other being vertical;

detecting means (8) movable with the collector means (1, 10; 20; 30, 31) for detecting the sun's azimuth and altitude;

drive means (5, 50, 52, 54) for generating independent movement of the collector means (1, 10; 20; 30, 31) about the first and the second axis of rotation;

transmission means (60) for transmitting signals from the detecting means (8) to the drive means (5, 50, 52, 54; 66) so that the collector means (1, 10; 20; 30, 31) follows the daily and hourly changes in the sun's azimuth and altitude to keep the collector means always facing the sun;

first optical conductor means (11; 32) for transmitting light arranged to move together with the collector means (1, 10; 20; 30, 31);

second optical conductor means (12; 32') for transmitting light to a predetermined area outside of the apparatus, said second optical conductor means (12; 32') being arranged to move together with the second support means (6, 7, 70); and

coupling means (33) arranged between the first and second optical conductor means for transmitting the light from the former to the latter while permitting relative rotation therebetween,

characterized in that said transmission means comprises a radio transmitter means (90) connected to the detecting means (8) for providing signals indicating the sun's azimuth and altitude and a radio receiver means (92) connected to the drive means (5, 50, 52, 54, 66) for driving the collector in accordance with the sun's position, said receiver means (92) being arranged on a desired position remote from the collector means (1, 10; 20; 30, 31).

4. A sunlight collecting and concentrating apparatus, comprising:

a collector means (1, 10; 20; 30, 31) for collecting and concentrating the sunlight;

a first support means (2, 3) for rotatably supporting the collector means (1, 10; 20; 30, 31) about a first axis (H—H) of rotation;

a second support means (6, 7, 70) for rotatably supporting the first supporting means (2, 3) about a second axis (V—V) of rotation perpendicular to the first axis (H—H), one of said first and second

axes being horizontal and the other being vertical;

detecting means (8) movable with the collector means (1, 10; 20; 30, 31) for detecting the sun's azimuth and altitude;

drive means (5, 50, 52, 54) for generating independent movement of the collector means (1, 10; 20; 30, 31) about the first and the second axis of rotation;

transmission means (60) for transmitting signals from the detecting means (8) to the drive means (5, 50, 52, 54; 66) so that the collector means (1, 10; 20; 30, 31) follows the daily and hourly changes in the sun's azimuth and altitude to keep the collector means always facing the sun;

first optical conductor means (11; 32) for transmitting light arranged to move together with the collector means (1, 10; 20; 30, 31);

second optical conductor means (12; 32') for transmitting light to a predetermined area outside of the apparatus, said second optical means (12; 32') being arranged to move together with the second support means (6, 7, 70); and

coupling means (33) arranged between the first and second optical conductor means for transmitting the light from the former to the latter while permitting relative rotation therebetween, characterized in that said transmission means (60) comprises a first transducer (80) connected to the detecting means (8) for converting the electric signals from the detecting means to photo signals, an optical signal cable (15) having an end (15b) connected to the first transducer (80), a middle section having a portion connected to the first axis (H—H) and a portion connected to the second axis (V—V) and a second end (15a) freely opened, a second transducer means (16) stationarily arranged so as to face the free end (15a) of the cable (15) for converting the optical signals from the optical signal cable (15) to electric signals, and an electric line (17), connecting the second transducer means (16) to the drive means (5, 50, 52, 54, 66).

5. An apparatus according to claim 4, wherein said first transducer means comprises luminescent semiconductor diodes (80) and a modulator for converting signals from the diodes (80) to digital signals by pulsatively modulating the signals from the transducer.

6. An apparatus according to claim 4, wherein said second transducer means (16) comprises a plurality of circumferentially located photocells (16a) fixedly connected to the second support means (70) and arranged to open to the end of the optical signal cable (15) remote from the detecting means (8), each of the photocells (16a) being connected to the drive means (5, 50, 52, 54, 66).

7. An apparatus according to claim 4, wherein said second transducer means comprises an optical conductor (18) of substantially tubular shape fixedly connected to the second support means (70), having an inlet end (18a) with a substantially circular surface opened to the end of the optical signal cable (15) remote from the detecting



means (8) and a converging end (18b) and a photo-transducer (16) facing said converging end (18b) for receiving photo signals, and an electric line (17) connecting the photo-transducer (16) with the drive means (5, 50, 52, 54, 66).

Patentansprüche

1. Vorrichtung zum Sammeln und Konzentrieren des Sonnenlichts, umfassend:

eine Kollektoranordnung (1, 10; 20; 30, 31) zum Sammeln und Konzentrieren des Sonnenlichts;

eine erste Trägeranordnung (2, 3) zum drehbaren Haltern der Kollektoranordnung (1, 10; 20; 30, 31) bezüglich einer ersten Drehachse (H—H);

eine zweite Trägeranordnung (6, 7, 70) zum drehbaren Haltern der ersten Trägeranordnung (2, 3) bezüglich einer zweiten Drehachse (V—V), welche senkrecht zu der ersten Achse (H—H) verläuft, wobei eine der beiden Drehachsen horizontal und die andere vertikal verläuft;

Detektoreinrichtungen (8), welche mit der Kollektoranordnung (1, 10; 20; 30, 31) beweglich sind, um den Azimuth und die Höhe der Sonne zu erfassen;

Antriebseinrichtungen (5, 50, 52, 54) zum Erzeugen einer unabhängigen der Kollektoranordnung (1, 10; 20; 30; 31) um die erste und die zweite Drehachse;

Übertragungseinrichtung (60) zum Übertragen von Signalen von den Detektoreinrichtungen (8) zu den Antriebseinrichtungen (5, 50, 52, 54; 66), derart, daß die Kollektoranordnung (1, 10; 20; 30, 31) den täglichen und Stündlichen Änderungen von Azimuth und Höhe der Sonne folgt, um die Kollektoranordnung ständig in einem Zustand zu halten, in dem sie der Sonne zugewandt ist;

erste optische Leiteinrichtungen (11; 32) zur Lichtübertragung, welche derart angeordnet sind, daß sie sich zusammen mit der Kollektoranordnung (1, 10; 20; 31, 31) bewegen;

zweite optische Leiteinrichtungen (12; 32') zur Übertragung von Licht zu einem vorgegebenen Bereich außerhalb der Vorrichtung, wobei die zweiten Leiteinrichtungen (12; 32') derart angeordnet sind, daß sie sich zusammen mit der zweiten Trägeranordnung (6, 7, 70) bewegen; und

Kupplungseinrichtungen (33), die zwischen den ersten und zweiten optischen Leiteinrichtungen angeordnet sind, um das Licht von den ersteren und den letzteren zu übertragen, während sie eine relative Drehbewegung zwischen denselben ermöglichen,

dadurch gekennzeichnet, daß die ersten optischen Leiteinrichtungen aus einem optischen Leitelement (11) bestehen, welches ein Einlaßende (11A) besitzt, welches sich nach außen öffnet, um das gesammelte Licht von der Kollektoranordnung zu empfangen, und welches ein zweites Ende (11B) besitzt, welches coaxial zu der ersten Achse angeordnet und mit den Kupplungseinrichtungen verbunden ist, und daß die zweiten Leiteinrichtungen ein optisches Leitelement (12) sind, welches ein Einlaßende (12A) besitzt, das drehbar mit den Kupplungseinrichtungen ver-

bunden ist, welches ein Mittelstück (12B) besitzt, das konzentrisch zu der zweiten Achse (V—V) angeordnet ist und welches ein zweites Ende (12C) besitzt, welches mit dem Bereich verbindbar ist, in dem das gesammelte Sonnenlicht verwendet wird.

2. Vorrichtung nach Anspruch 1, welche ferner umfasst:

ein weiteres optisches Leitelement (13), welches an der zweiten Trägeranordnung (70) befestigt ist, zweite Kupplungseinrichtungen zum drehbaren Verbinden des zweiten Leitelements (12) mit dem anderen optischen Leitelement (13), wobei das andere optische Leitelement mit der Außenseite der Vorrichtung verbunden ist.

3. Vorrichtung zum Sammeln und Konzentrieren des Sonnenlichts, umfassend:

eine Kollektoranordnung (1, 10; 20; 30, 31) zum Sammeln und Konzentrieren des Sonnenlichts;

eine erste Trägeranordnung (2, 3) zum drehbaren Haltern der Kollektoranordnung (1, 10; 20; 30, 31) bezüglich einer ersten Drehachse (H—H);

eine zweite Trägeranordnung (6, 7, 70) zum drehbaren Haltern der ersten Trägeranordnung (2, 3) bezüglich einer zweiten Drehachse (V—V), welche senkrecht zu der ersten Achse (H—H) verläuft, wobei eine der beiden Drehachsen horizontal und die andere vertikal verläuft;

Detektoreinrichtungen (8), welche mit der Kollektoranordnung (1, 10; 20; 30, 31) beweglich sind, um den Azimuth und die Höhe der Sonne zu erfassen;

Antriebseinrichtungen (5, 50, 52, 54) zum Erzeugen einer unabhängigen Bewegung der Kollektoranordnung (1, 10; 20; 30, 31) um die erste und die zweite Drehachse; Übertragungseinrichtungen (60) zum Übertragen von Signalen von den Detektoreinrichtungen (8) zu den Antriebseinrichtungen (5, 50, 52, 54; 66), derart, daß die Kollektoranordnung (1, 10; 20; 30, 31) den täglichen und stündlichen Änderungen von Azimuth und Höhe der Sonne folgt, um die Kollektoranordnung ständig in einem Zustand zu halten, in dem sie der Sonne zugewandt ist;

erste optische Leiteinrichtungen (11; 32) zur Lichtübertragung, welche derart angeordnet sind, daß sie sich zusammen mit der Kollektoranordnung (1, 10; 20; 31, 31) bewegen;

zweite optische Leiteinrichtungen (12; 32') zur Übertragung von Licht zu einem vorgegebenen Bereich außerhalb der Vorrichtung, wobei die zweiten Leiteinrichtungen (12; 32') derart angeordnet sind, daß sie sich zusammen mit der zweiten Trägeranordnung (6, 7, 70) bewegen; und

Kupplungseinrichtungen (33), die zwischen den ersten und zweiten optischen Leiteinrichtungen angeordnet sind, um das Licht von den ersteren und den letzteren zu übertragen, während sie eine relative Drehbewegung zwischen denselben ermöglichen,

dadurch gekennzeichnet, daß die Übertragungseinrichtungen eine Funk-Übertragungseinrichtung (90) umfassen, die mit den Detektoreinrichtungen (8) verbunden ist, um Signale zu liefern, welche Azimuth und Höhe der Sonne anzei-





gen, sowie eine Funk-Empfangseinrichtung (92), die mit den Antriebseinrichtungen (5, 50, 52, 54, 66) verbunden ist, um den Kollektor entsprechend der Position der Sonne anzutreiben, wobei die Empfangseinrichtung (92) an einer gewünschten Stelle fern von der Kollektoranordnung (1, 10; 20; 30, 31) angeordnet ist.

4. Vorrichtung zum Sammeln und Konzentrieren des Sonnenlichts, umfassend:

eine Kollektoranordnung (1, 10; 20; 30, 31) zum Sammeln und Konzentrieren des Sonnenlichts;

eine erste Trägeranordnung (2, 3) zum drehbaren Halten der Kollektoranordnung (1, 10; 20; 30, 31) bezüglich einer ersten Drehachse (H—H);

eine zweite Trägeranordnung (6, 7, 70) zum drehbaren Halten der ersten Trägeranordnung (2, 3) bezüglich einer zweiten Drehachse (V—V), welche senkrecht zu der ersten Achse (H—H) verläuft, wobei eine der beiden Drehachsen horizontal und die andere vertikal verläuft;

Detektoreinrichtungen (8), welche mit der Kollektoranordnung (1, 10; 20; 30, 31) beweglich sind, um den Azimuth und die Höhe der Sonne zu erfassen;

Antriebseinrichtungen (5, 50, 52, 54) zum Erzeugen einer unabhängigen Bewegung der Kollektoranordnung (1, 10; 20; 30, 31) um die erste und die zweite Drehachse;

Übertragungseinrichtung (60) zum Übertragen von Signalen von den Detektoreinrichtungen (8) zu den Antriebseinrichtungen (5, 50, 52, 54; 66), derart, daß die Kollektoranordnung (1, 10; 20; 30, 31) den täglichen und stündlichen Änderungen von Azimuth und Höhe der Sonne folgt, um die Kollektoranordnung ständig in einem Zustand zu halten, in dem sie der Sonne zugewandt ist;

erste optische Leiteinrichtungen (11; 32) zur Lichtübertragung, welche derart angeordnet sind, daß sie sich zusammen mit der Kollektoranordnung (1, 10; 20; 31, 31) bewegen;

zweite optische Leiteinrichtungen (12; 32') zur Übertragung von Licht zu einem vorgegebenen Bereich außerhalb Vorrichtung, wobei die zweiten Leiteinrichtungen (12; 32') derart angeordnet sind, daß sie sich zusammen mit der zweiten Trägeranordnung (6, 7, 70) bewegen; und

Kupplungseinrichtungen (33), die zwischen den ersten und zweiten optischen Leiteinrichtungen angeordnet sind, um das Licht von den ersteren und den letzteren zu übertragen, während sie eine relative Drehbewegung zwischen denselben ermöglichen,

dadurch gekennzeichnet, daß die Übertragungseinrichtungen (80) einen ersten Wandler (80) umfassen, der mit den Detektoreinrichtungen (8) verbunden ist, um die elektrischen Signale von den Detektoreinrichtungen in Fotosignale umzusetzen, sowie ein optisches Signalkabel (15), welches ein Ende (15b) hat, welches mit dem ersten Wandler (80) verbunden ist, sowie einen Mittelteil, der ein Teilstück aufweist, welches mit der ersten Achse (H—H) verbunden ist, und ein Teilstück, welches mit der zweiten Achse (V—V) verbunden ist, sowie ein zweites Ende (15a), welches frei geöffnet ist, und außer-

dem eine zweite Wandlereinrichtung (16), die derart stationär angeordnet ist, daß sie dem freien Ende (15a) des Kabels (15) gegenüberliegt, um die optischen Signale von dem optischen Signalkabel in elektrische Signale umzuwandeln, sowie eine elektrische Leitung (17), welche die zweite Wandlereinrichtung (16) mit den Antriebseinrichtungen (5, 50, 52, 54, 66) verbindet.

5. Vorrichtung nach Anspruch 4, bei der die erste Wandlereinrichtung Lumineszenz-Halbleiterdioden (80) und einen Modulator zum Umsetzen der Signale von den Dioden (80) in Digitalsignale umfasst, und zwar durch pulsierendes Modulieren der Signale von dem Wandler.

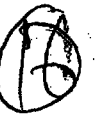
6. Vorrichtung nach Anspruch 4, bei der die zweite Wandlereinrichtung (16) mehrere, in Umfangsrichtung angeordnete Fotozellen (16a) umfasst, die fest mit der zweiten Trägeranordnung (70) verbunden und so angeordnet sind, daß sie sich zu dem von den Detektoreinrichtungen (8) abgewandten Ende des optischen Signalkabels (15) öffnen wobei jede der Fotozellen (16a) mit den Antriebseinrichtungen (5, 50, 52, 54, 66) verbunden ist.

7. Vorrichtung nach Anspruch 4, bei der die zweite Wandlereinrichtung einen optischen Leiter (18) von im wesentlichen rohrförmiger Gestalt umfasst, der fest mit der zweiten Trägeranordnung (17) verbunden ist, und ein einlaßseitiges Ende (18a) mit einer im wesentlichen kreisförmigen Oberfläche besitzt, die sich zu dem von den Detektoreinrichtungen (8) abgewandten Ende des optischen Signalkabels (15) öffnet, sowie ein konvergierendes Ende (18b) und einen Fotowandler (16), der dem konvergierenden Ende (18b) gegenüberliegt, um Fotosignale zu empfangen, sowie eine elektrische Leitung (17), welche den Fotowandler (16) mit den Antriebseinrichtungen (5, 50, 52, 54, 66) verbindet.

Revendications

1. Appareil destiné à collecter et à concentrer de la lumière solaire, comportant: un collecteur (1, 10; 20; 30, 31) pour collecter et concentrer la lumière solaire; un premier support (2, 3) qui supporte le collecteur (1, 10; 20; 30; 31) pour qu'il puisse tourner autour d'un premier axe de rotation (H—H); un second support (6, 7, 70) destiné à supporter le premier support (2, 3) pour qu'il puisse tourner autour d'un second axe (V—V) de rotation, perpendiculaire au premier axe (H—H), l'un desdits premier et second axes étant horizontal et l'autre étant vertical; un dispositif de détection (8) mobile avec le collecteur (1, 10; 20; 30; 31) pour détecter l'azimut et la hauteur du soleil; un dispositif d'entraînement (5, 50, 52, 54) destiné à produire des mouvements indépendants du collecteur (1, 10; 20; 30; 31) autour des premier et second axes de rotation; un dispositif de transmission (60) destiné à transmettre des signaux depuis le dispositif de détection (8) vers le dispositif d'entraînement (5, 50, 52, 54; 66) de manière que le collecteur (1, 10; 20; 30; 31) suive les variations journalières et horaires d'azimut et de





hauteur du soleil pour maintenir toujours le collecteur orienté vers le soleil; un premier dispositif conducteur optique (11; 32) destiné à transmettre la lumière, agencé pour se déplacer avec le collecteur (1, 10; 20; 30; 31); un second dispositif conducteur optique (12; 32') pour transmettre de la lumière vers une région prédéterminée à l'extérieur de l'appareil, ledit second dispositif conducteur optique (12, 32') étant agencé pour se déplacer avec le second support (6, 7, 70); et un dispositif de couplage (33) disposé entre le premier et le second dispositifs conducteurs optiques pour transmettre la lumière du premier au second, tout en permettant une rotation relative entre eux, caractérisé en ce que le premier dispositif conducteur optique est une pièce conductrice optique (11) ayant une extrémité d'entrée (11A) ouverte vers l'extérieur pour recevoir la lumière collectée provenant du collecteur et une seconde extrémité (11B) disposée coaxialement par rapport au premier axe et reliée au dispositif de couplage, et en ce que ledit second dispositif conducteur est une pièce conductrice optique (12) ayant une extrémité d'entrée (12A) reliée en rotation avec le dispositif de couplage, une partie médiane (12B) disposée concentriquement avec le second axe (V—V) et une seconde extrémité (12C) pouvant être reliée à la région dans laquelle la lumière solaire collectée est utilisée.

2. Appareil selon la revendication 1, comportant en outre une autre pièce conductrice optique (13) fixée sur le second support (70), un second dispositif de couplage pour relier en rotation le second dispositif conducteur (12) avec l'autre pièce conductrice optique (13), ladite autre pièce conductrice optique (13) étant reliée à l'extérieur de l'appareil.

3. Appareil destiné à collecter et à concentrer de la lumière solaire, comportant: un collecteur (1, 10; 20; 30, 31) destiné à collecter et à concentrer la lumière solaire; un premier support (2, 3) pour supporter le collecteur (1, 10; 20; 30; 31) de manière qu'il puisse tourner autour d'un premier axe (H—H) de rotation; un second support (6, 7, 70) destiné à supporter le premier support (2, 3) de manière qu'il puisse tourner autour d'un second axe (V—V) de rotation, perpendiculaire au premier axe (H—H), l'un desdits premier et second axes étant horizontal et l'autre étant vertical; un dispositif de détection (8) mobile avec le collecteur (1, 10; 20; 30, 31) destiné à détecter l'azimut et la hauteur du soleil; un dispositif d'entraînement (5, 50, 52, 54) produisant des mouvements indépendants du collecteur (1, 10; 20; 31) autour des premier et second axes de rotation; un dispositif de transmission (60) pour transmettre des signaux depuis le dispositif de détection (8) vers le dispositif d'entraînement (5, 50, 52, 54; 66) de manière que le collecteur (1, 10, 20; 30; 31) suive les variations journalières et horaires d'azimut et de hauteur du soleil afin de maintenir le collecteur toujours orienté vers le soleil; un premier dispositif conducteur optique (11; 32) destiné à transmettre de la lumière, agencé pour se déplacer avec le collecteur (1, 10;

20; 30, 31); un second dispositif conducteur optique (12, 32') pour transmettre de la lumière vers une région prédéterminée extérieure à l'appareil, ledit second dispositif conducteur optique (12, 32') étant agencé pour se déplacer avec le second support (6, 7; 70); et un dispositif de couplage (33) disposé entre le premier et le second dispositifs conducteurs optiques pour transmettre la lumière du premier au second, tout en permettant une rotation relative entre eux, caractérisé en ce que ledit dispositif de transmission comporte un émetteur radioélectrique (90) connecté au dispositif de détection (8) pour produire des signaux indiquant l'azimut et la hauteur du soleil, et un récepteur radioélectrique (92) connecté au dispositif d'entraînement (5, 50, 52, 54; 66) pour entraîner le collecteur en fonction de la position du soleil, ledit récepteur (92) étant disposé dans une position voulue éloignée du collecteur (1, 10; 20; 30, 31).

4. Appareil destiné à collecter et à concentrer de la lumière solaire, comportant: un collecteur (1, 10; 20; 30, 31) destiné à collecter et à concentrer la lumière solaire; un premier support (2, 3) qui supporte le collecteur (1, 10; 20; 30, 31) de manière qu'il puisse tourner autour d'un premier axe de rotation (H—H); un second support (6, 7, 70) destiné à supporter le premier support (2, 3) de manière qu'il puisse tourner autour d'un second axe de rotation (V—V) perpendiculaire au premier axe (H—H), l'un desdits premier et second axes étant horizontal et l'autre étant vertical; un dispositif de détection (8) mobile avec le collecteur (1, 10, 20; 30; 31) pour détecter l'azimut et la hauteur du soleil; un dispositif d'entraînement (5, 50, 52, 54) destiné à produire des mouvements indépendants du collecteur (1, 10; 10; 20; 30; 31) autour des premier et second axes de rotation; un dispositif de transmission (60) destiné à transmettre des signaux depuis le dispositif de détection (8) vers le dispositif d'entraînement (5, 50, 52, 54; 66) de manière que le collecteur (1, 10; 20; 30; 31) suive les variations journalières et horaires d'azimut et de hauteur du soleil pour maintenir en permanence le collecteur orienté vers le soleil; un premier dispositif conducteur optique (11; 32) destiné à transmettre de la lumière et agencé pour se déplacer avec le collecteur (1, 10; 20; 30, 31); un second dispositif conducteur optique (12; 32') pour transmettre de la lumière vers une région prédéterminée extérieure à l'appareil, ledit second dispositif conducteur optique (12, 32') étant agencé pour se déplacer avec le second support (6, 7; 70); et un dispositif de couplage (33) disposé entre le premier et le second dispositifs conducteurs optiques pour transmettre la lumière du premier vers le second, tout en permettant une rotation relative entre eux; caractérisé en ce que le dispositif de transmission (60) comporte un premier transducteur (80) connecté au dispositif de détection (8) pour convertir les signaux électriques provenant du dispositif de détection en des signaux optiques, un câble à signaux optiques (15) ayant une extrémité (15b) reliée au premier transducteur



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(80), une section médiane comprenant une partie reliée au premier axe (H—H) et une partie reliée au second axe (V—V) et une seconde extrémité (15a) librement ouverte, un second dispositif transducteur (16) disposé de façon fixe en face de l'extrémité libre (15a) du câble (15) pour convertir les signaux optiques provenant du câble à signaux optiques (15) en des signaux électriques, et une ligne électrique (17) reliant le second transducteur (16) au dispositif d'entraînement (5, 50, 52, 54, 66).

5. Appareil selon la revendication 4, dans lequel ledit premier transducteur comprend des diodes semi-conductrices luminescentes (80) et un modulateur qui convertit les signaux provenant des diodes (80) en des signaux numériques par modulation par impulsions des signaux provenant du transducteur.

6. Appareil selon la revendication 4, dans lequel ledit second transducteur (16) comprend plusieurs cellules photoélectriques (16a) disposées

sur une circonférence montées de façon fixe sur le second support (70) et agencées pour déboucher à l'extrémité du câble de signaux optique (15) opposée au dispositif de détection (8), chacune des cellules photoélectriques (16a) étant reliée au dispositif d'entraînement (5, 50, 52, 54, 66).

7. Appareil selon la revendication 4, dans lequel ledit second transducteur comprend un conducteur optique (18) de forme à peu près tubulaire relié de façon fixe au second support (70) comprenant une extrémité d'entrée (18a) avec une surface à peu près circulaire ouverte à l'extrémité du câble à signaux optiques (15) éloignée du dispositif de détection (8) et une extrémité convergente (18b) et un photo-transducteur (16) en face de ladite extrémité convergente (18b) pour recevoir les signaux optiques, et une ligne électrique (17) qui relie le photo-transducteur (16) avec le dispositif d'entraînement (5, 50, 52, 54, 66).

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