US 20110023866A1

(19) **United States**

(12) **Patent Application Publication**

BALBO DI VINADIO et al.

(10) **Pub. No.: US 2011/0023866 A1**

(43) **Pub. Date: Feb. 3, 2011**

(54) **SOLAR RECEIVER FOR A SOLAR CONCENTRATOR WITH A LINEAR FOCUS**

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(21) Appl. No.: **12/825,625**

(22) Filed: **Jun. 29, 2010**

(30) **Foreign Application Priority Data**

Jul. 29, 2009 (EP) 09425303.6

Publication Classification

(51) **Int. Cl.**
F24J 2/38 (2006.01)

(52) **U.S. Cl.** **126/600**

(57) **ABSTRACT**

A solar receiver for a linear-focusing solar concentrator, comprising, a base, which is elongated in a direction parallel to a focal line and carries an array of strip-shaped targets arranged orthogonal to said focal line and set at a distance apart from one another in a direction parallel to the focal line; a focusing assembly including an array of optical elements arranged for focusing solar radiation on said strip-shaped targets, the focusing assembly being mobile with respect to the base of the photovoltaic receiver in a direction parallel to said focal line; and an azimuthal pointing device, designed to move the focusing assembly with respect to said base as a function of the position of the sun.

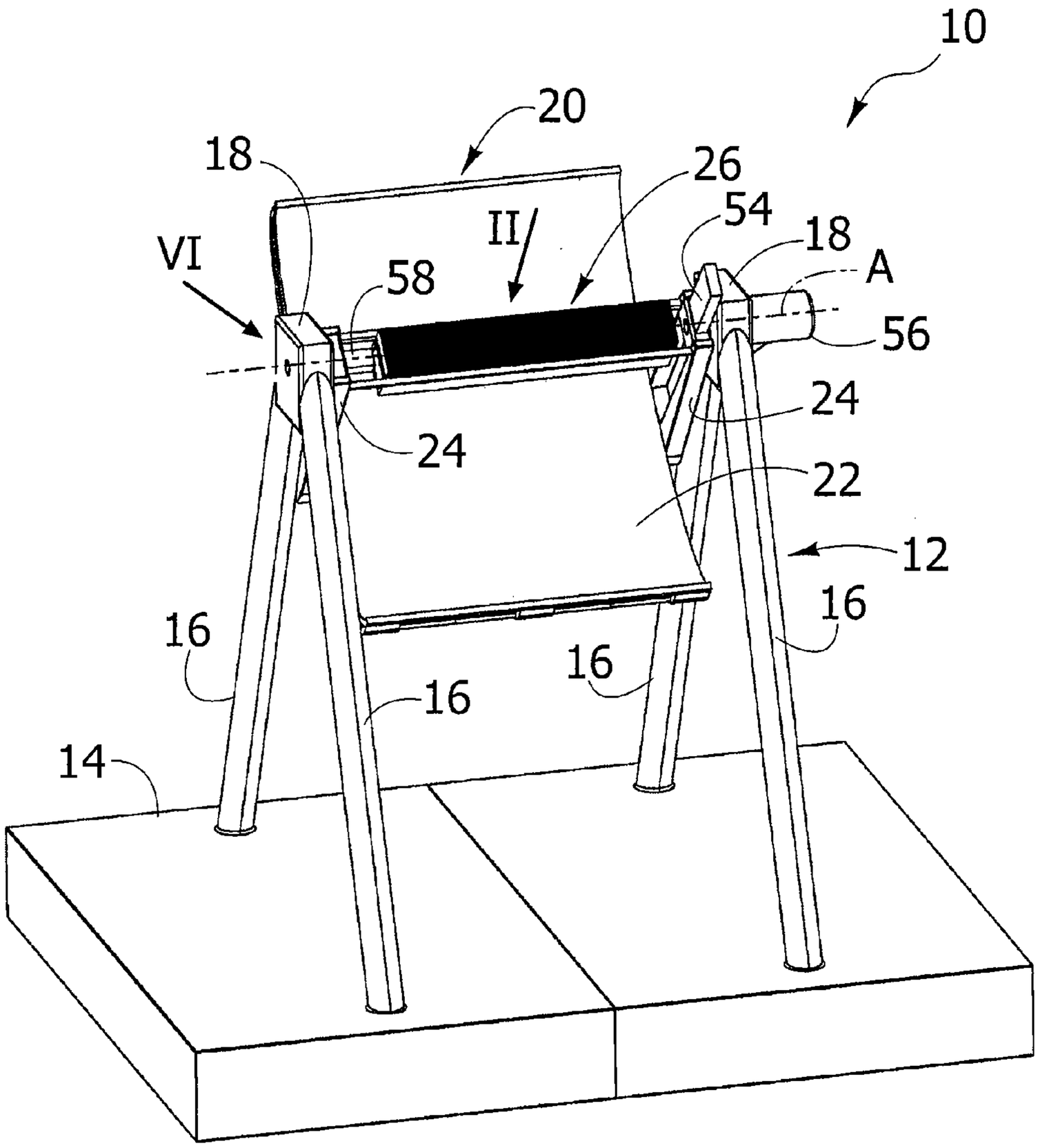


FIG. 1

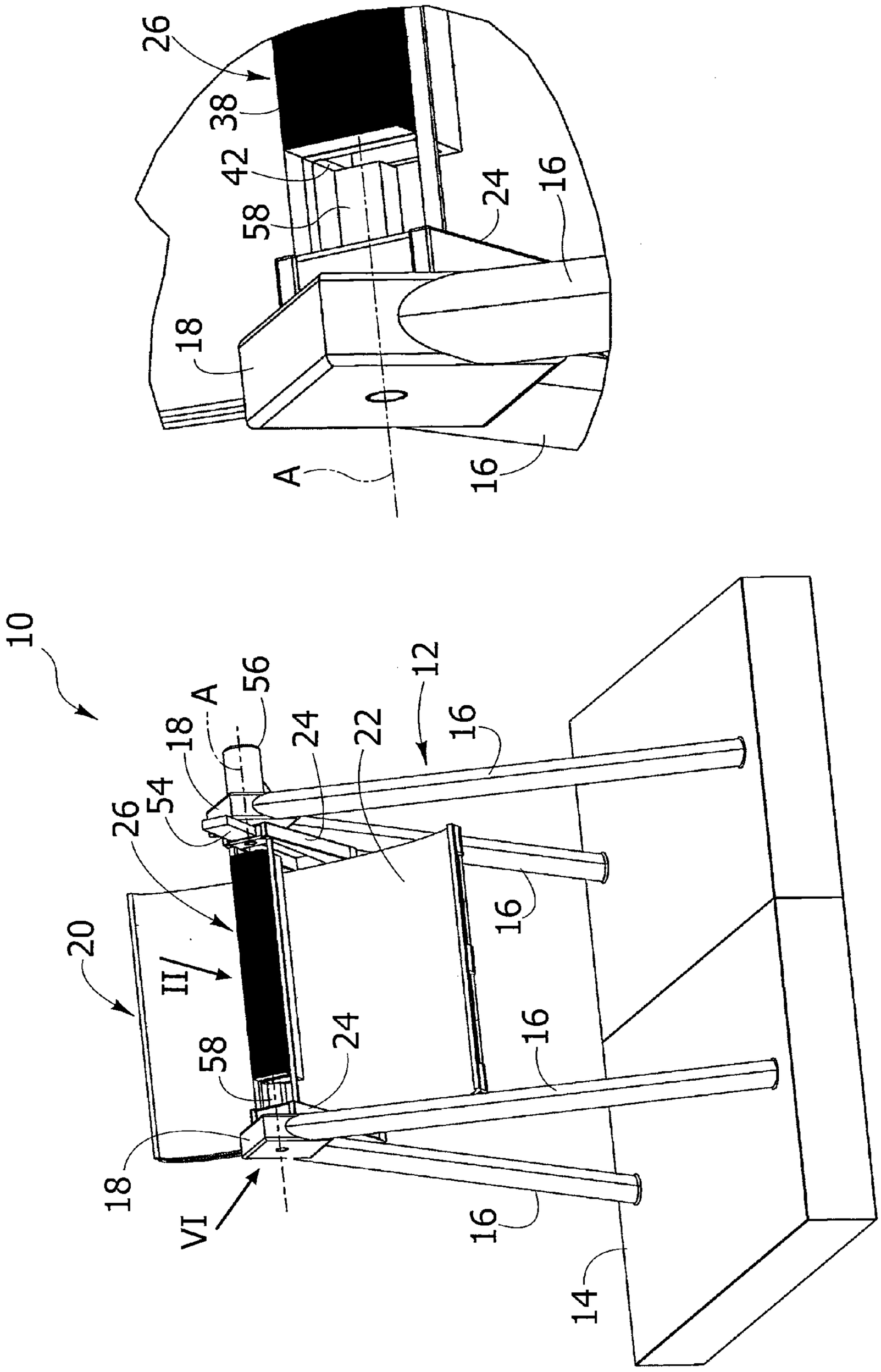


FIG. 6

FIG. 2

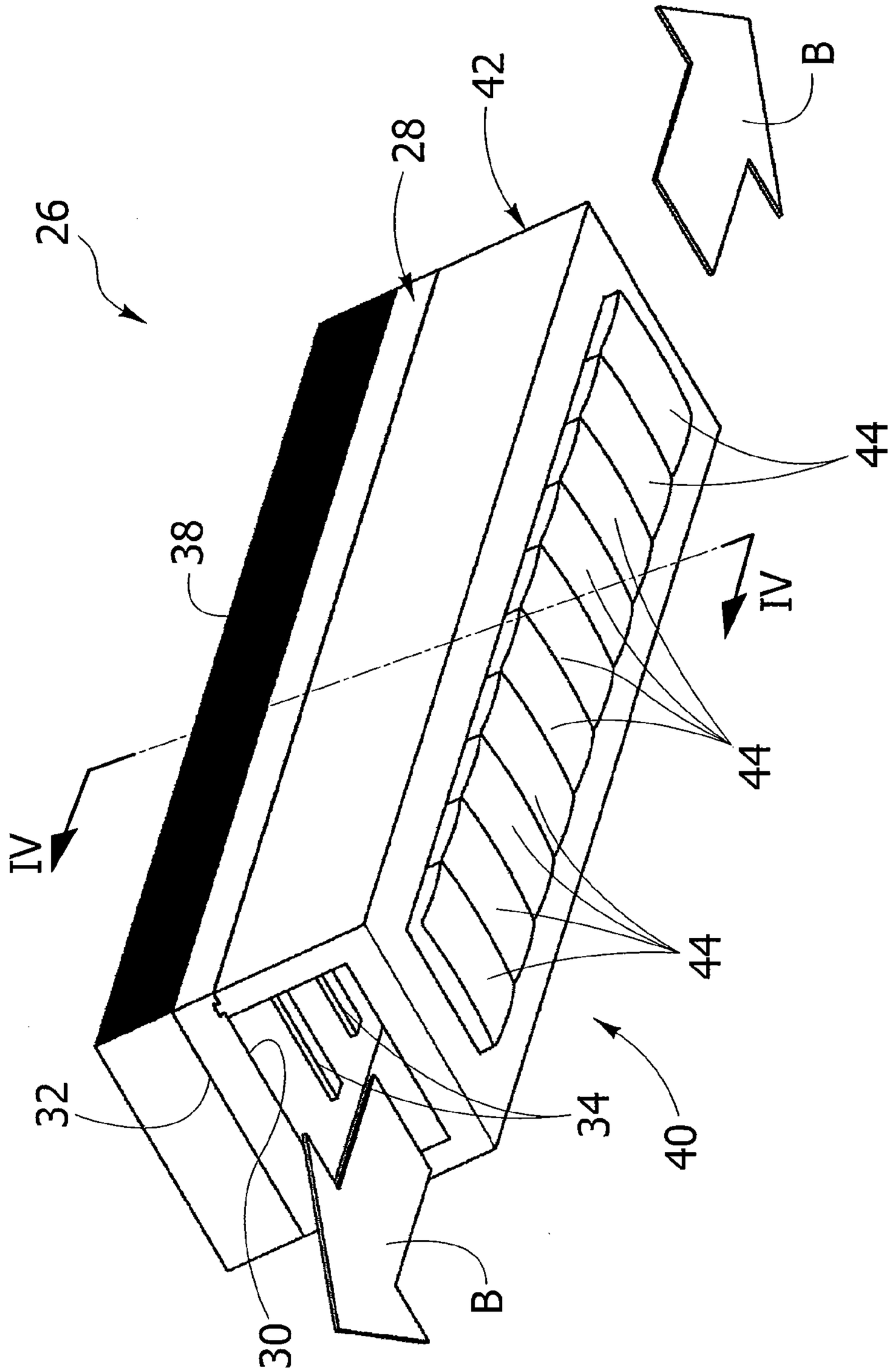
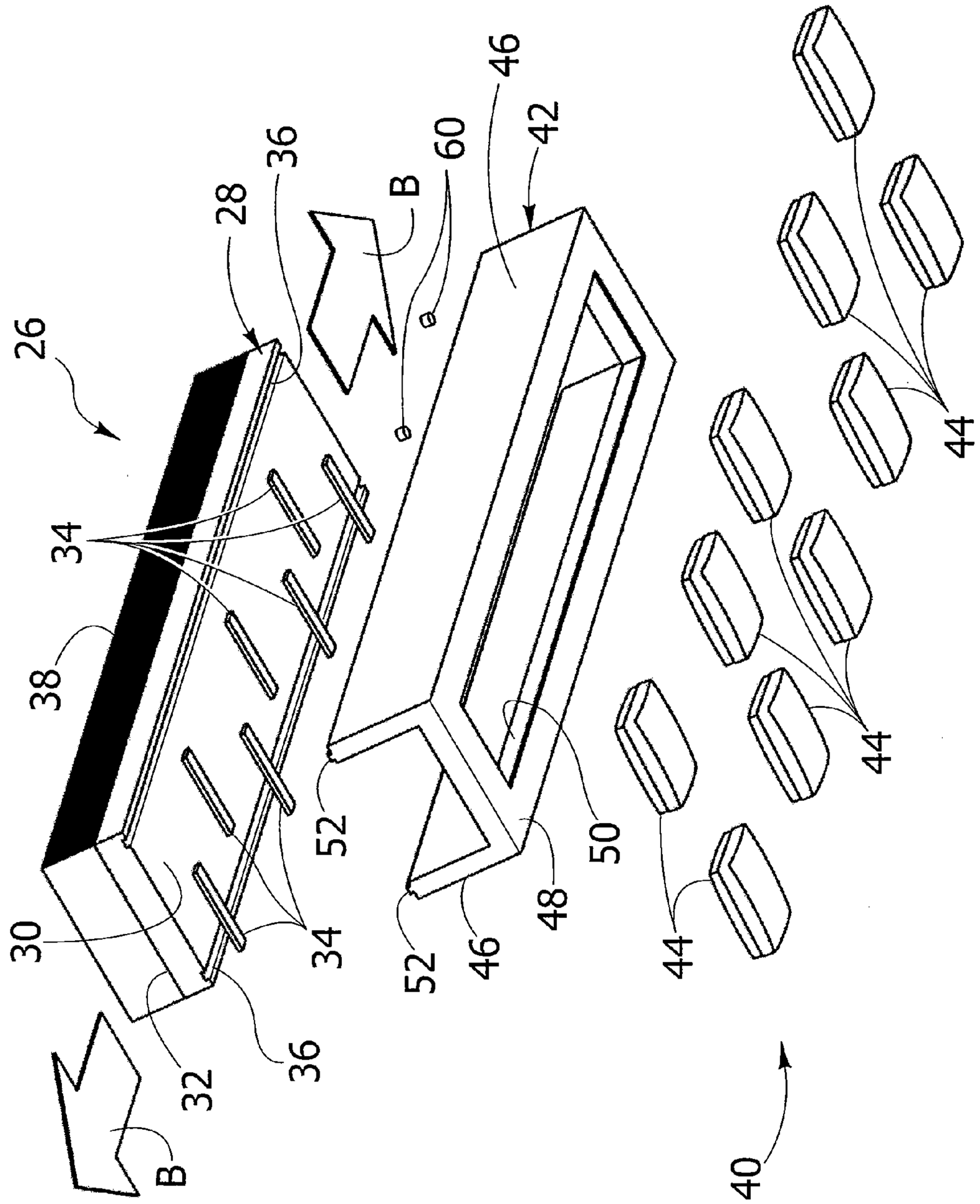


FIG. 3



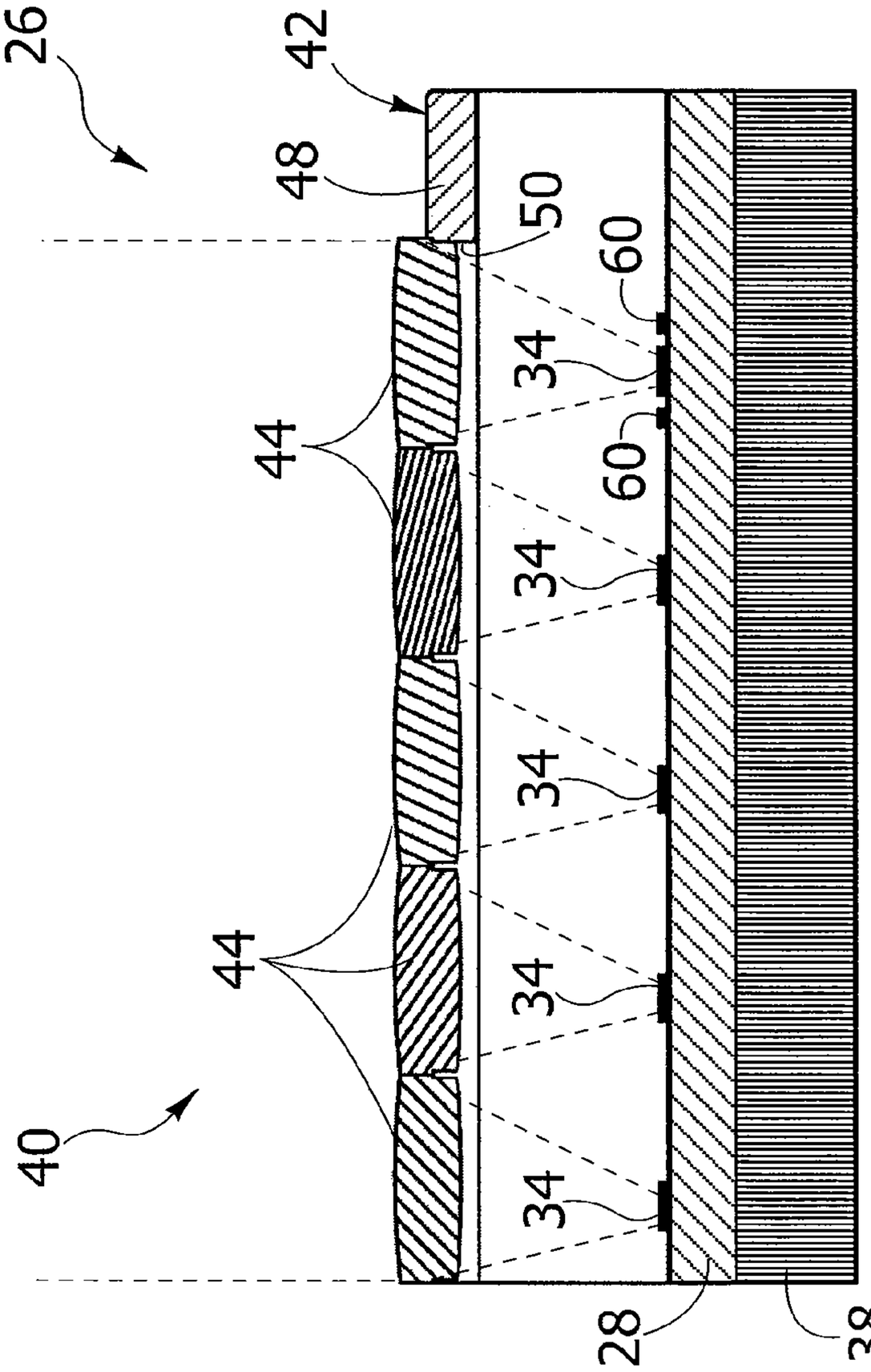

26
42
48
50
60
34
44
60
34
34
34
34
40
28
38

FIG. 5

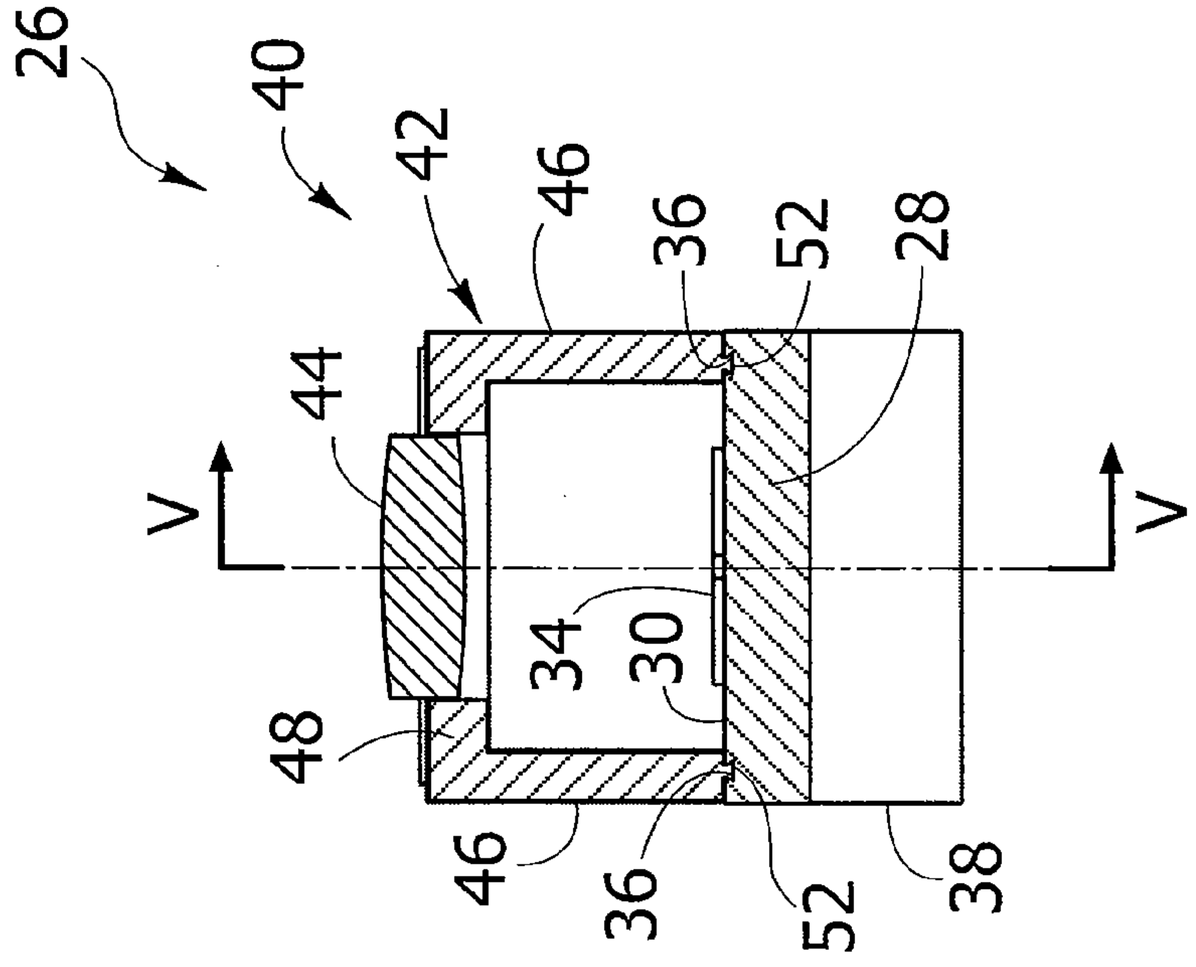

26
40
42
46
36
52
28
44
V
V
34
30
48
46
36
52
38

FIG. 4

SOLAR RECEIVER FOR A SOLAR CONCENTRATOR WITH A LINEAR FOCUS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of European Patent Application patent application serial number 09425303.6, filed Jul. 29, 2009, which is herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates in general to the production of energy by means of concentration of solar radiation on photovoltaic or solar receivers.

[0004] In solar concentration systems it is desirable to obtain a high concentration of solar energy both for increasing the efficiency and the yield of the solar concentration system and, in the case of photovoltaic systems, for reducing the amount of photovoltaic material.

[0005] 2. Description of the Related Art

[0006] To increase the efficiency of solar concentration systems it is necessary to carry out a pointing of the concentrators both according to the zenithal direction and according to the azimuthal direction. The document No. WO 2005/116534 describes a solar concentrator comprising one or more concave mirrors that are mounted rotatably on a supporting structure about a horizontal axis and are driven by a first motor for changing their zenithal angle, in which the concave mirrors concentrate the solar radiation in the direction of one or more receivers that are fixed with respect to the concave mirrors. The supporting structure is orientable about a vertical axis by means of a second motor designed to adjust the azimuthal angle of the concave mirrors.

[0007] The solution described in the document No. WO 2005/116534 is affected by a wide range of drawbacks. A first drawback is that the concentration of solar energy that can be obtained depends exclusively upon the size of the concave mirrors, and to obtain high levels of concentration it is necessary to employ mirrors with large surfaces. A second drawback of the known solution 2005/116534 is that to vary the azimuthal orientation it is necessary to turn the supporting structure of the generator about a vertical axis.

SUMMARY OF THE INVENTION

[0008] The object of the present invention is to provide a solar receiver that will enable the problems of the known art to be overcome. In particular, the object of the present invention is to provide a solar receiver that will enable high levels of concentration of solar radiation to be obtained without an excessive increase of the surface of the concentrator. A further object of the present invention is to provide a solar receiver that will enable azimuthal tracking of the sun with a simple, compact, and inexpensive system that does not require vertical rotation of the concentrator.

[0009] According to the present invention, the above objects are achieved by a solar receiver comprising:

[0010] a base, which is elongated in a direction parallel to a focal line and carries an array of strip-shaped targets arranged orthogonal to said focal line and set at a distance apart from one another in a direction parallel to the focal line;

[0011] a focusing assembly including an array of optical elements arranged for focusing solar radiation on said strip-shaped targets, the focusing assembly being mobile with respect to the base of the photovoltaic receiver in a direction parallel to said focal line; and

[0012] an azimuthal pointing device, designed to move the focusing assembly with respect to said base as a function of the position of the sun.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will now be described in detail with reference to the attached drawings, which are provided purely by way of non-limiting example and in which:

[0014] FIG. **1** is a perspective view of a generator of solar energy, which uses a receiver according to the present invention;

[0015] FIG. **2** is a perspective view of the receiver indicated by the arrow II in FIG. **1**;

[0016] FIG. **3** is an exploded perspective view of the receiver of FIG. **2**;

[0017] FIG. **4** is a cross section according to the line IV-IV of FIG. **2**;

[0018] FIG. **5** is a cross section according to the line V-V of FIG. **4**; and

[0019] FIG. **6** is an enlarged detail of the part indicated by the arrow VI in FIG. **1**.

DETAILED DESCRIPTION

[0020] With reference to FIG. **1**, designated by **10** is a high-concentration solar-energy generator, which uses a solar receiver according to the present invention. The generator **10** comprises a supporting structure **12** fixed with respect to a stationary base **14**. In the example illustrated in the figures, the supporting structure **12** comprises two triangular side supports, each of which is formed by two legs **16** converging upwards. The bottom ends of the legs **16** are fixed to the base **14**. The top ends of each pair of legs **16** are fixed to a respective top support **18**. The shape of the supporting structure **12** that is illustrated is not, however, binding and may vary according to the applications.

[0021] The supporting structure **12** carries a reflector **20**, designed to concentrate the solar radiation on a focal line A. In the example illustrated in the figures, the reflector **20** comprises one or more mirrors with a reflecting surface **22** shaped like a parabolic cylinder. The focal axis of the reflecting surface **22** coincides with the focal line A. The reflector **20** is fixed to two side arms **24** that are articulated to the basic structure **12** about an axis of rotation coinciding with the focal axis A. The axis of rotation is defined by bearings (not illustrated) housed in the top supports **18**. In the example illustrated in the figures, the focal axis A, which coincides with the axis of rotation of the reflector **20**, is horizontal.

[0022] With reference to FIGS. **1** to **5**, the generator **10** comprises a solar receiver **26** having an elongated shape and extending parallel to the focal line A.

[0023] With reference to FIGS. **2** and **3**, the receiver **26** comprises a base **28** of an elongated parallelepipedal shape having two principal plane faces **30**, **32** opposite to one another. The base **28** is fixed between the side arms **24** that support the reflector **20**.

[0024] Applied on the first face **30** of the base **28** is an array of strip-shaped targets **34**. The targets **34** can be photovoltaic elements designed to convert solar radiation into electrical energy or else thermal absorbers designed to convert solar radiation into heat.

[0025] The targets **34** are in the form of thin parallelepipeds and are oriented in a direction orthogonal to the focal line A. The targets **34** are set at a distance apart from one another in

a direction parallel to the focal line A. The distance between adjacent targets **34** is substantially greater than the width of each target **34**.

[0026] Made on the first face **30** of the base **38** are two guides **36** parallel to the focusing line A and arranged on opposite sides of the array of targets **34**. Preferably a thermal collector **38** is applied on the second face **32** of the base **28**. In the case where the targets are formed by photovoltaic elements, the thermal collector is constituted, for example, by a finned body, designed to dissipate the heat produced by the receiver **26**. In the case where the targets **34** are formed by thermal absorbers, the thermal collector **38** is formed by a duct for the passage of a diathermic fluid.

[0027] The solar receiver **26** comprises a focusing assembly **40**, which comprises a support **42** and a plurality of optical elements **44**. In the example illustrated in the drawings, the optical elements **44** are formed by cylindrical lenses. Alternatively, the optical elements could be formed by mirrors.

[0028] The support **42** has a shape elongated in the direction of the focal line A and is substantially U-shaped in cross section, with two side walls **46** set parallel to one another and a bottom wall **48**. The bottom wall **48** has a through opening **50** of a flattened rectangular shape, in which the lenses **44** arranged in contact with one another are mounted.

[0029] Each lens **44** is set for focusing solar radiation onto a respective target **34**. The side walls **46** of the lens support **42** have guides **52** that slidably engage the respective guides **36** of the base **28**. Thanks to the engagement between the guides **36** and **52**, the focusing assembly **40** is mobile with respect to the base **28** of the receiver **26** in a direction parallel to the focusing line A. In FIGS. **2** and **3**, the direction of movement of the lens support **42** with respect to the base **28** is indicated by the arrows B.

[0030] With reference to FIG. **1**, the generator **10** comprises a zenithal-pointing device for varying the orientation of the reflector **20** as a function of the zenithal angle of the sun. The zenithal-pointing device comprises a photocell sensor **54** fixed with respect to the receiver **26** and to the reflector **20** and designed to detect the position of the sun. The photocell sensor **54** is, for example, fixed to one of the side arms **24**. The zenithal-pointing device moreover comprises an electric motor **56** that governs rotation of the reflector **20** about the axis A as a function of the signals coming from the sensor **54**. The zenithal-pointing device **54**, **56** orients the reflector **20** according to the zenithal direction of the sun.

[0031] The receiver **26** comprises an azimuthal-pointing device including an actuator **58**, designed to move the focusing assembly **40** with respect to the base **28** of the receiver **26**. As illustrated in FIG. **6**, the actuator **58** can, for example, be set between one of the side arms **24** and the corresponding front end of the support **42**. The actuator **58** is governed by a sensor designed to detect the azimuthal position of the sun. Said sensor may, for example, be made up of two photodiodes **60** (FIG. **5**) arranged on opposite sides of a target **34** in a direction parallel to the focal line A.

[0032] As illustrated schematically in FIG. **5**, the solar radiation reflected by the reflector **20** is concentrated on the lenses **44**. Each lens **44** focuses the solar radiation onto a respective target **34**. The actuator **58**, on the basis of the signals coming from the photodiodes **60**, moves the support **42** with respect to the base **28** of the receiver **26** so as to keep the radiation focused by the lenses **44** centred on the target **34**. The movement of the focusing assembly **40** with respect to the base **28** replaces the azimuthal orientation of the reflector **20**. It is possible to reduce the travel of the focusing assembly **40** with respect to the base **28** by controlling the movement of the focusing assembly **40** so that, when the distance between the centre of each lens **44** and the respective target **34** exceeds a pre-set value, the focusing assembly **40** is displaced in such a way that each lens **44** focuses the solar radiation on a target **34** adjacent to the target previously associated to the lens **44** in question.

[0033] The focusing assembly **40** enables considerable increase in the level of concentration of the solar radiation on the targets **34**, which in turn enables high levels of efficiency to be obtained. In addition, the axial movement of the focusing assembly **40** replaces the azimuthal orientation of the reflector **20** and enables simplification of the structure and reduction of the cost of the generator **10**.

[0034] The azimuthal tracking obtained by movement of the focusing assembly **40** moreover enables an improvement in exploitation of the surface available.

[0035] The solar concentrator associated to the receiver could form the subject of numerous variants with respect to what has been described previously. For example, the reflector **20**, instead of being formed by a parabolic mirror that is able to turn about its own focusing axis, could be formed by a plurality of strip-shaped mirrors arranged parallel to the focusing line A in a way similar to what is described in the international patent application No. PCT/IT2008/000539.

[0036] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

1. A solar receiver for a linear-focusing solar concentrator, comprising:

a base, which is elongated in a direction parallel to a focal line and carries an array of strip-shaped targets arranged orthogonal to said focal line and set at a distance apart from one another in a direction parallel to the focal line;

a focusing assembly including an array of optical elements arranged for focusing solar radiation on said strip-shaped targets, the focusing assembly being mobile with respect to the base of the photovoltaic receiver in a direction parallel to said focal line; and

an azimuthal pointing device, designed to move the focusing assembly with respect to said base as a function of the position of the sun.

2. The solar receiver according to claim **1**, wherein each of said optical elements is associated to a respective strip-shaped target.

3. The solar receiver according to claim **1**, wherein said strip-shaped targets are set at a distance apart from one another in a direction parallel to said focusing line by a distance substantially greater than the width of each strip-shaped target in said direction.

4. The solar receiver according to claim **1**, wherein said azimuthal pointing device comprises at least two photodetectors fixed to the base of the receiver on opposite sides of a strip-shaped target in a direction parallel to said focal line.

5. The solar receiver according to claim **1**, wherein the base has the shape of an elongated parallelepiped with two principal faces set parallel to one another, on a first face there being fixed strip-shaped photovoltaic targets and on a second face there being fixed a thermal collector.

6. The solar receiver according to claim **5**, wherein said focusing assembly comprises a support carrying said optical elements and slidably coupled to said base by means of guides.

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