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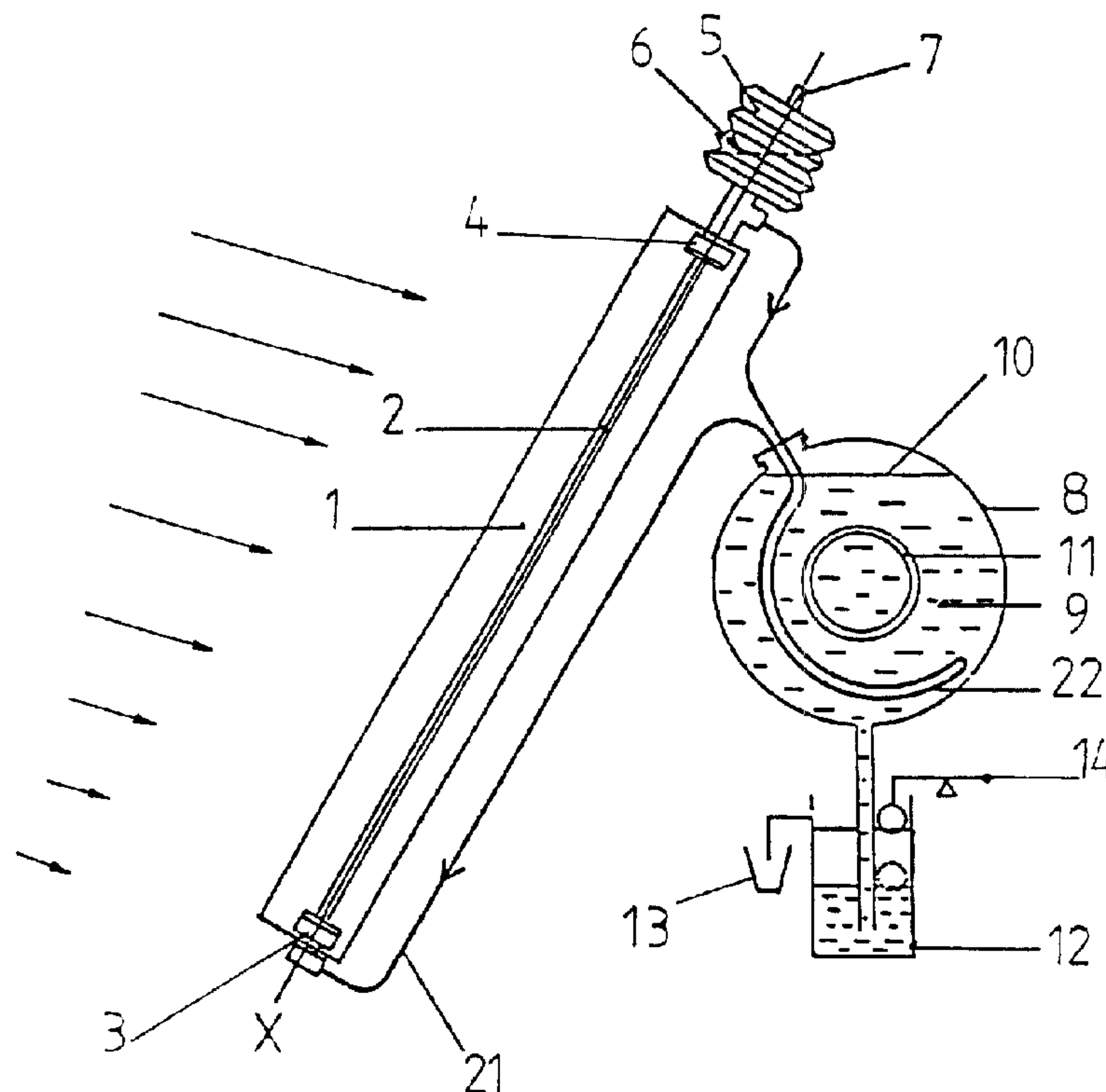
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(57) Abrégé/Abstract:

A collecting device of solar energy comprising an elongated reflecting element (1), which is parabolic in cross-section and mounted in an inclined position; and mutually parallel receiving pipes (2) placed in the focal point of the reflecting element and extending through the entire length of the element and connected to the circulation system (21, 22) containing liquid. The said system further operates to heat the liquid (9) in the accumulator (8). The piping (2) is provided, at the lower and upper ends thereof, with valves (3, 4) allowing only upward flow of liquid, whereby the device operates periodically in such a way that the liquid is discharged from the pipes (2) only after reaching its evaporation point, whereupon the piping (2) is refilled. A flexing bellows (5) is placed on top of the valve (4) for maintaining a certain counterpressure for the upper valve (4).





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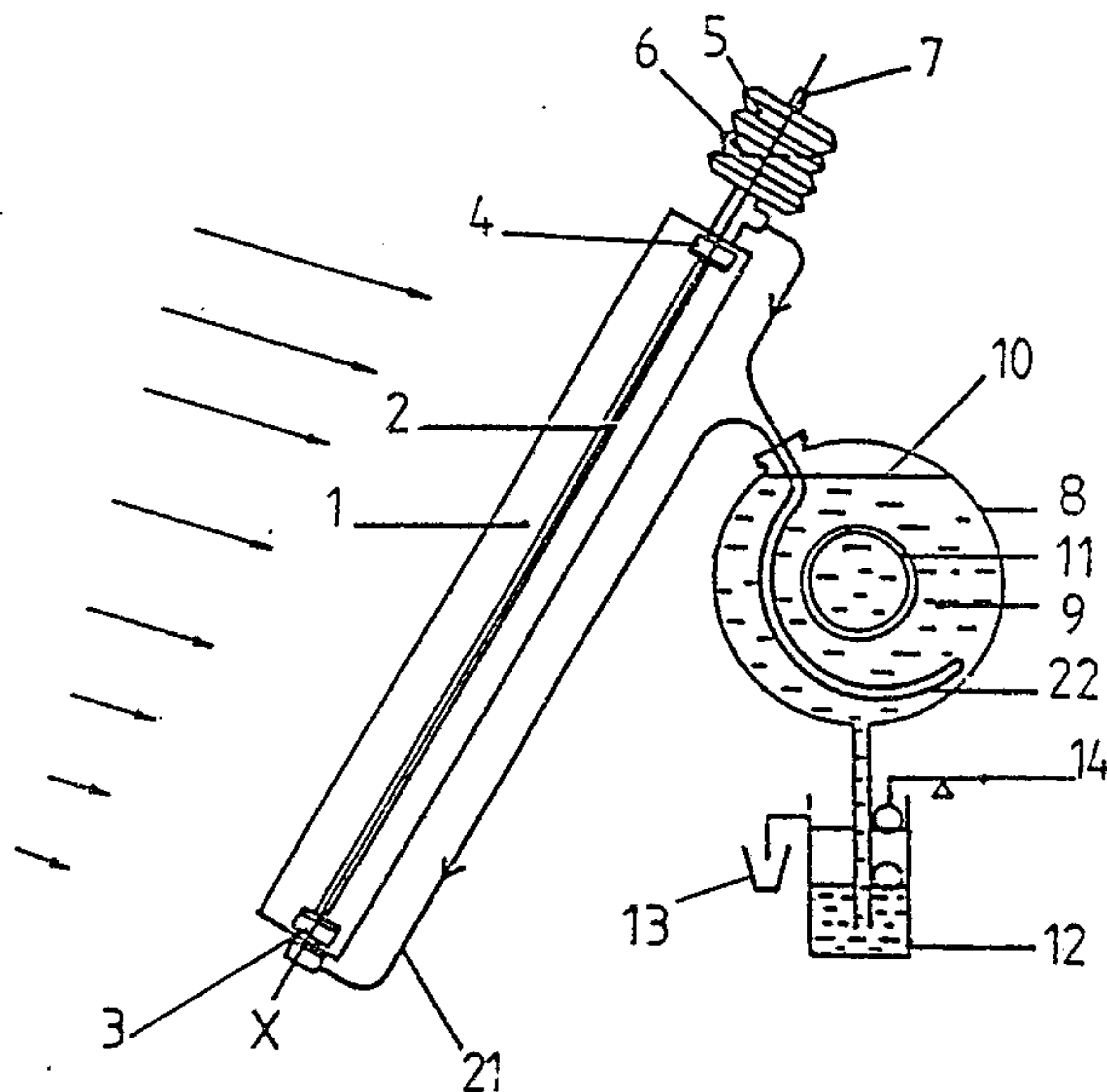
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(57) Abstract

A collecting device of solar energy comprising an elongated reflecting element (1), which is parabolic in cross-section and mounted in an inclined position; and mutually parallel receiving pipes (2) placed in the focal point of the reflecting element and extending through the entire length of the element and connected to the circulation system (21, 22) containing liquid. The said system further operates to heat the liquid (9) in the accumulator (8). The piping (2) is provided, at the lower and upper ends thereof, with valves (3, 4) allowing only upward flow of liquid, whereby the device operates periodically in such a way that the liquid is discharged from the pipes (2) only after reaching its evaporation point, whereupon the piping (2) is refilled. A flexing bellows (5) is placed on top of the valve (4) for maintaining a certain counterpressure for the upper valve (4).

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A solar energy collector

5 The object of the invention is a solar energy collector including an elongated reflecting element the cross-section of which is curved and which has a reflecting inner surface, the reflecting element being mounted in an inclined position with the reflecting inner surface towards the sun; a receiving element placed in the linear focal point of the reflecting
10 element and extending essentially through the whole length of the reflecting element and receiving the reflected solar radiation and connected to a circular system containing liquid and operating to heat the said liquid.

15 In known collecting devices like this, i.e. in solar panels, the circulation of the liquid is effected in a continuous and uniform manner while the liquid becomes heated in the receiving element. However, the temperature generally remains so low that an effective operation of the collector together with a salt
20 solution and phase change heat exchanger is of no use unless a heat pump or additional energy sources, such as oil or electric energy, are utilized. This is due to the fact that the water fed to the accumulator should at least meet the minimum temperature requirement of 95° C.

25 The pipe elements of the known solar energy collecting devices are also complex and expensive and generally require maintenance because of narrow conduits and poor circulation.

30 Generally, it can be stated that sufficient attention has not been given to the primary drawback, the poor heat acceleration, of such collecting devices. If, for instance, on a partly cloudy day the sun comes out from behind the clouds, the circulation during the next 10 minutes will be marginal and underheated, and
35 thus the output of the collecting device will remain unsatisfactory.

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The purpose of the above invention is to eliminate these drawbacks and to provide a collecting device capable of achieving sufficient heat acceleration and a sufficient temperature of the circulation liquid under relatively
5 disadvantageous conditions of solar radiation and which also provides a rather cost-effective and maintenance-free construction.

The basic idea of the invention is that the circulation liquid of the collecting device operates in two
10 phases in such a way that the liquid is allowed to discharge periodically from the receiving element only after reaching its evaporation temperature. To achieve this, the invention is characterized in that the receiving element is provided both in its upper and lower end with a liquid valve allowing only an
15 upward flow of liquid, whereby the liquid valves operate periodically under the effect of solar heat radiation in such a way that the upper valve is opened when the liquid in the receiving element reaches its evaporating point and the lower valve lets more liquid into the receiving element only when the
20 element is essentially discharged.

A container for liquid to maintain a certain counterpressure, for instance a spring loaded bellows, is arranged advantageously on top of the upper valve from which the liquid is further guided to circulate through a relatively
25 thin circulation pipe.

The receiving element itself is preferably comprised of a number of relatively thin parallel pipes, where the valves can be situated on respective collecting bodies at the ends of the pipes.

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The circulation liquid can comprise a solution having a good heat conductivity with a boiling point in the range of 120° to 140°C.

In accordance with the present invention, there is
5 provided a collecting device for solar energy including an elongated reflecting element the cross-section of which is curved and which has a reflecting inner surface, the reflecting element being mounted in an inclined position with the reflecting inner surface towards the sun; and a receiving
10 element placed in the linear focal point of the reflecting element and extending essentially through the entire length of the reflecting element and receiving reflected solar radiation and connected to a circulation system containing liquid, and the receiving element operating to heat the said liquid,
15 characterized in that both the upper and the lower ends of the receiving element are provided with a fluid valve allowing upward flow of liquid only a liquid space maintaining a certain counterpressure being arranged above the upper valve from which space the liquid is further guided to the circulation system,
20 whereby the fluid valves operate periodically under the effect of solar heat radiation in such a way that the upper valve opens up, when the liquid in the receiving element reaches its evaporation point and the lower valve allows more liquid to flow into the receiving element only after the element is
25 essentially discharged.

The invention and its other features and advantages are

described in the following by an example and with reference to the enclosed drawing, in which:

Fig. 1 shows partly schematically the collecting device according to the invention, as viewed from the side,

5 Fig. 2 shows the construction of the collecting element as viewed from the end thereof, and

Figs. 3 and 4 show the liquid valve of the device on a larger scale as viewed from the side and as a cross section.

10 The essential part of the collecting device is reflecting element 1 which is elongated and parabolic in cross section, as best seen in Fig. 2. The inner surface of the reflecting element has a coating which reflects solar radiation very well.

15 Receiving element 2 situated in the linear focal point of the reflecting element is, according to the invention, comprised of a number of parallel thin pipes, where a major part of the radiation can be trapped in the gaps within the bundle of pipes when heat radiation is focused on the bundle of pipes. This has
20 the advantage of both a large, effective target surface and a minimum of radiation reflected back to the environment. The upper surface 2a of the pipes can be polished.

The swivelling axis x of the reflector joins the bundle of pipes
25 2 and the pipes remain in place when the reflector is turned according to the position of the sun.

The receiving element (pipes 2) contain a circulation solution with a boiling point of, for example, about 130° C. The
30 circulation is effected through a relatively thin circulation pipe 21 which forms heating element 22 in heat accumulator 8. Heat accumulator 8 is also filled with a solution having good heat conductivity. The heat accumulator is a closed space and underpressure is predominant above liquid surface 10.

35 Coiled pipe 11 for service water providing the warm service water is placed inside the heat accumulator. Equalizing basin 12

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is placed under the heat accumulator and is further provided with overflow 13 and limit switch 14 which, when the temperature is raised too high and liquid 9 expands, starts a forced discharge from element 11 or, alternatively, turns the reflector away from the sun.

It is essential for the invention that the circulation liquid operates in two phases in such a way that it is allowed to discharge periodically from receiving element 2 each time only when it reaches its evaporation point. Therefore, both the lower and the upper parts of element 2 are provided with fluid valves 3 and 4 respectively allowing only an upward flow. In addition, the upper end of the element is provided with a space maintaining a counter pressure, in this case spring-loaded bellows 5. In the figure the upper surface of the liquid in the bellows is marked with number 6 and the maintenance valve in the upper end of the bellows is marked with number 7.

The collecting device operates in such a way that when the liquid in receiving element 2 reaches its evaporation temperature, valve 4 opens and the steam discharges into bellows 5. Thus lower valve 3 remains shut under the effect of the pressure.

After the receiving element has discharged, valve 4 closes and lower valve 3 opens and allows the liquid to flow again into element 2. The hot liquid simultaneously continues to discharge from bellows 5 into heating element 22. In this way it is ensured that the circulation liquid cannot escape the receiving element under-heated, which is essential to the entire operation of accumulator 8.

Figs. 3 and 4 show a possible realization of the valves. Valve member 17 is simply float 17 placed in receptacle 15 at the ends of pipes 2 and made of material with a specific weight of the same magnitude as that of the circulation liquid. The conical surface of valve member 17 compresses receptacle 15 against

conical surface 16 preventing the solution from flowing downwards in receptacle 15. The upper part of valve member 17 is provided with ribs 19 and the lower part thereof is provided with ribs 18 which are guided against the inner wall of receptacle 15 but allow the upward flow of the solution therebetween. Internal shoulder 20 in receptacle 15 limits the upward movement of valve member 17.

It was observed in a practical test that, for example, when the collecting device started to operate using cold circulation solution, the time duration to the first discharge of receiving element 2 or to the opening of valve 4 was about 70 seconds. After the collecting device reached its operating temperature, the duration of the cycle was correspondingly about 10 seconds. Pipes 2 as well as circulation pipe 21 were made of conventional thin-walled stainless steel with an outer diameter of 7 to 8 mm and wall thickness of 0.15 mm. The boiling point of the circulation liquid was about 130° C.

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CLAIMS:

1. A collecting device for solar energy including an elongated reflecting element (1) the cross-section of which is curved and which has a reflecting inner surface, the reflecting element being mounted in an inclined position with the reflecting inner surface towards the sun; and a receiving element (2) placed in the linear focal point of the reflecting element (1) and extending essentially through the entire length of the reflecting element and receiving reflected solar radiation and connected to a circulation system containing liquid, and the receiving element (2) operating to heat the said liquid, characterized in that both the upper and the lower ends of the receiving element (2) are provided with a fluid valve (3, 4) allowing upward flow of liquid only a liquid space (5) maintaining a certain counterpressure being arranged above the upper valve (4) from which space the liquid is further guided to the circulation system, whereby the fluid valves (3, 4) operate periodically under the effect of solar heat radiation in such a way that the upper valve (4) opens up, when the liquid in the receiving element reaches its evaporation point and the lower valve (3) allows more liquid to flow into the receiving element (2) only after the element (2) is essentially discharged.

2. A collecting device according to claim 1, characterized in that the said space of liquid is a spring loaded bellows (5) and that a circulation pipe (21) connected to the bellows (5) is so thin that the counterpressure is maintained in the bellows (5).

3. A collecting device according to claim 1 or 2, characterized in that the receiving element (2) is comprised of a number of relatively thin parallel pipes, where the valves

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(3, 4) are situated in the collecting members at the ends of the pipes.

4. A collecting device according to claim 2, characterized in that the receiving element (2) comprises 5 to 7 thin-walled metal pipes which are spaced apart from each other.

5. A collecting device according to claim 1, characterized in that the valve (3, 4) consists of an axially moving valve member (17) having a sealing face shaped like a frustum of cone.

6. A collecting device according to claim 4, characterized in that the valve member (17) comprises ribs (18, 19) guided at least partly against the inner surfaces of the valve housing enabling the liquid to flow past the valve member (17).

7. A collecting device according to claim 1, characterized in that a solution having a good heat conductivity and a boiling point of about 120°C is used as the circulation liquid.

8. A collecting device according to claim 6, characterized in that the circulation system includes a heating element (22) placed in a heat accumulator (8).

9. A collecting device according to claim 8, characterized in that the heat accumulator (8) is a heat exchanger with a service-water coil (11) or a similar device placed in it.

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PATENT AGENTS

