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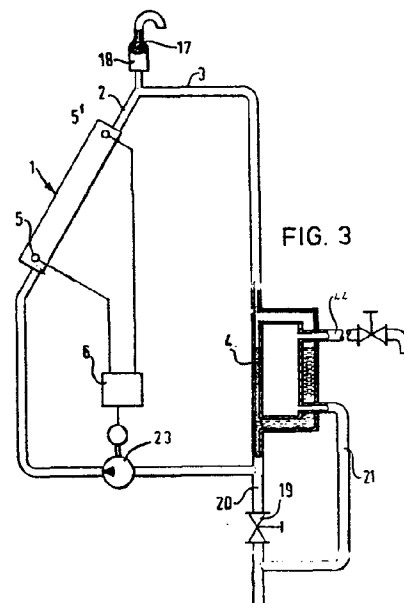
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64 **Solar energy system.**

57 A solar energy system for catching, accumulating and transferring solar energy and comprising a closed fluid circuit (2), in which at least a solar energy collector (1) and an expansion space are provided, and a protective device, which transports the fluid contained in the solar energy collector (1) to said expansion space each time when the temperature in the collector becomes too high or too low, to which purpose said expansion space lies mainly on a lower level than the collector.



"Solar energy system"

The invention relates to a solar energy system comprising a closed fluid circuit, of which a solar energy collector provided with at least one temperature sensor which is connected with control means forms part and connected with
5 which is an expansion space, said control means serving the purpose of transporting the fluid between the expansion space and at least the part of the circuit comprising the collector.

Such a system has been disclosed in the German patent specification 25.42.348 laid open for public inspection.

10 The use of known anti-freeze agents, e.g. glycol, to protect the system against freezing has the disadvantage that these chemical additives may, in a short time, give rise to so-called pit-corrosion. This damage occurs particularly when the collector is made of aluminium. It will be apparent
15 that thereby the life of the solar energy system is inadmissibly shortened.

In the system disclosed in the said German specification the risk of the mentioned damage is nil and protection against too high temperatures is obtained by
20 reversion of the fluid flow and transport of the fluid contained in the collector to a second reservoir or expansion

vessel which is positioned on a higher level. However, this known system requires the use of a pump which is able to carry, in a relatively short time, the fluid up to the required height and in this manner protection against interruption of the electric current cannot be obtained.

The invention has for its object to avoid the mentioned disadvantages of the known system and to provide to that end a system, in which the expansion space is positioned mainly on a lower level than the collector. Thereby an automatical discharge of the fluid is effected in case a too high or a too low temperature is imminent. Then the transport of fluid to the expansion space occurs at least mainly by gravity. In order to prevent waste of heated fluid the expansion space may be formed by a vessel which is divided by a movable member into two chambers, of which one is connected with the circuit.

To fill the closed circuit, to keep it under operating pressure and to discharge the fluid from the circuit, when the temperature is too high or too low, the chamber which does not communicate with the circuit is optionally connectable to a source of fluid under pressure and a fluid discharge conduit, respectively, the chosen connection being determined by the temperature measured by the or each sensor.

Advantageously the source of fluid under pressure may be the system of water mains.

The movable member may be formed by an elastic diaphragm adapted to effect such a displacement of volume, as to enable the chamber which is connected with the circuit to take up the fluid from the circuit.

In order to facilitate a quick filling and discharge the circuit may be connected with a fluid under atmospheric pressure through a valve acting on a pressure difference. The construction becomes very simple, when said fluid is atmospheric air. Should corrosive materials be used for the closed circuit it will be necessary to avoid contact with oxygen. In that case the said fluid may be nitrogen.

The invention will be further elucidated with the aid of the drawing of some embodiments thereof. In the drawing:

Fig. 1 is a diagrammatical view of a system for catching, accumulating and transferring solar energy, said system being provided with temperature protection and a protection against interruption of the supply of electric
5 current;

Fig. 2 is a diagrammatical view of another embodiment of such a system without complete protection against interruption of the supply of electric current, and

Fig. 3 is a variant of the system shown in
10 Fig. 2 including complete protection, also against interruptions of the supply of electric current.

In the Figures corresponding parts are indicated by the same reference numeral.

The energy coming from the sun both as direct
15 radiation and heat from the ambient air is caught by the solar energy collector 1 which forms part of the circuit 2, through which a fluid 3 flows. A part of the circuit is also a heat accumulator 4 which is adapted to transfer its heat to an energy consuming apparatus. By means of two temperature
20 sensors 5, 5', of which one is provided near the fluid inlet and the other one near the fluid outlet of the solar energy collector, the temperature is measured in two places.

A valve 7 is provided in the supply conduit 10
of a reservoir 11 which is connected to the system of water
25 mains 9 and is divided by an elastic diaphragm 12 into a first chamber 13 and a second chamber 14.

During normal operation the valve 7 is in its open condition, so that the pressure of the water mains forces the diaphragm 12 against the opening, with which a connecting
30 conduit 15 extending between the circuit 2 and the reservoir 11 opens into the first chamber 13. This is possible, since a valve 8 provided in a discharge conduit 16 connected to the second chamber 14 of the reservoir 11 is, during normal operation, in its closed condition.

35 If the temperature measured by the temperature sensors falls below a predetermined value, say 5°C, or it rises to above a predetermined value, say 95°C, the electrical signal produced by at least one of the temperature sensors is passed

on to a control device 6 controlling the valves 7 and 8 so, as to close valve 7 and to open valve 8.

In this way the second chamber 14 which is completely filled with tap water is emptied through discharge conduit 16 when there is danger of damaging the system by freezing or boiling of the fluid 3. Owing thereto the diaphragm 12 is forced down by the weight of the fluid 3 contained in the circuit, so that the first chamber 13 is filled with fluid and the entire system of the circuit is emptied.

As soon as the temperature measured by the temperature sensors has come back into the safe range the valve 8 is closed and the valve 7 is opened, so that the water pressure coming from the water mains 9 pushes the diaphragm 12 up and the fluid 3 contained in the first chamber 13 is forced back into the circuit 2.

The circuit 2 is connected with the atmosphere through a device 18 provided with a float 17 which is adapted to let air in and out during the discharge of fluid 3 from the circuit 2 to the first chamber 13 and during the flow of fluid back to the circuit, respectively.

The circuit 2 is connected to the water mains 9 by a supply conduit provided with a valve 19. During the filling of the circuit the water level rises till the float 17 closes the air opening of the device 18. The consumer's circuit for taking off hot water from the system consists of the heat accumulator 4 which is connected to the water mains 9 through a conduit 21 and to a conduit 22 for the supply of hot water to the water consuming apparatuses, such as washing machines, taps and the like.

The flow of the fluid 3 is stimulated by means of a pump 23 provided in the circuit.

In Fig. 1 the direction of the fluid flow during normal operation has been indicated by arrows.

Safety means against overpressure and check valves to prevent the water of flowing back into the system of water mains have not been illustrated.

The system gives also protection against the event of the dropping out of the mains voltage. This protection is necessary since, when the pump 23 stops the flow of fluid is stopped or at least slowed down, owing to which the danger of extreme temperatures arises. As already has been said the valves 7 and 8 are open and closed, respectively, in normal operation, whereas they are closed and opened, respectively, by springs when the supply voltage drops out, so that the circuit 2 is emptied in the above described way.

The forces which are necessary to fill and to empty the circuit, when the safety function is brought into operation or becomes inoperative, are supplied by the pressure of the mains water and gravity, so that a great dependability is obtained.

In the system shown in Fig. 2 the accumulator 4 is constructed as a double-walled vessel. In this embodiment of the system according to the invention the fluid circuit is not entirely filled with fluid, so that an expansion space in the shape of a certain volume of gas, e.g. air or nitrogen, is left in the circuit. By the pressure exerted by the pump 23 on the fluid, the latter will be forced up in the collector 1, so that the highest point of the expansion space will be found permanently at the level of the "overflow" formed by the conduit 3. The expansion space extending there below must be at least sufficiently voluminous to take up completely the quantity of fluid contained, during normal operation, within the collector.

If the regulating means 6 are set in operation the pump 20 is reversed, so that also the flow of fluid is reversed. In that case the pump must be of the kind adapted to reverse its pumping direction. By means of the force of gravity and the pump the expansion-gasvolume is moved through conduit 3 to the collector, where it remains as a result of the liquid overflow action of conduit 3 till the normal pumping direction has been restored.

In a not-shown variant of the system illustrated in Fig. 2 a discharge conduit closed in normal operation by a

valve is connected to the conduit extending between the pump and the inlet opening of the solar energy collector, so that the part of the circuit provided with the solar energy collector can be emptied by the action of the regulating means 6 to protect the collector.

In the embodiment shown in Fig. 3 the collector is placed relatively high, so that the fluid contained therein can flow by gravity to the expansion space contained in the right hand part of the illustrated circuit. To that end a pump 23 of the kind is used which lets, in its inactive condition, the fluid pass. In this case it is, in contrast to the system described with reference to Fig. 2, only necessary to interrupt the current supply to the pump 20. It will be obvious, that in this manner also protection against interruption of the voltage supply is obtained. The fluid level in the left hand part and that in the right hand part of the circuit will become the same in accordance with the principle of communicating vessels. It will be apparent that the said level then must be found below the lowest point of the solar energy collector, so that the volume of the expansion space must be designed accordingly.

CLAIMS

1. A solar energy system comprising a closed fluid circuit, a solar energy collector forming part of the circuit, at least one temperature sensor which is connected with control means and is provided in the collector and an expansion space connected with the circuit, the control means serving the purpose of transporting the fluid between the expansion space and at least the part of the circuit comprising the collector, and the expansion space being positioned mainly on a lower level than the collector.

2. A solar energy system according to claim 1, in which the expansion space is formed by a vessel which is divided by a movable member into two chambers, of which one is connected with the circuit.

3. A solar energy system according to claim 2, in which the chamber which does not communicate with the circuit is optionally connectable to a source of fluid under pressure and a fluid discharge conduit, respectively, the chosen connection being determined by the temperature measured by the or each sensor.

4. A solar energy system according to claim 3,
in which the source of fluid under pressure is the system
of water mains.

5. A solar energy system according to claim 2,
5 3 or 4, in which the movable member is formed by an elastic
diaphragm adapted to effect such a displacement of volume,
as to enable the chamber which is connected with the circuit
to take up the fluid from the circuit.

6. A solar energy system according to claim 1,
10 in which the expansion space forms part of the circuit and
a reversible pump is provided in the circuit.

7. A solar energy system according to claim 1,
in which the expansion space forms part of the circuit and
provided in the circuit is a pump which in its inactive
15 condition lets the fluid pass.

8. A solar energy system according to anyone of
the foregoing claims, in which the circuit is connected with
a fluid under atmospheric pressure through a valve acting on
a pressure difference.

9. A solar energy system according to claim 8,
20 in which the fluid is the atmospheric air.

10. A solar energy system according to claim 8,
in which the fluid is nitrogen.

FIG. 1

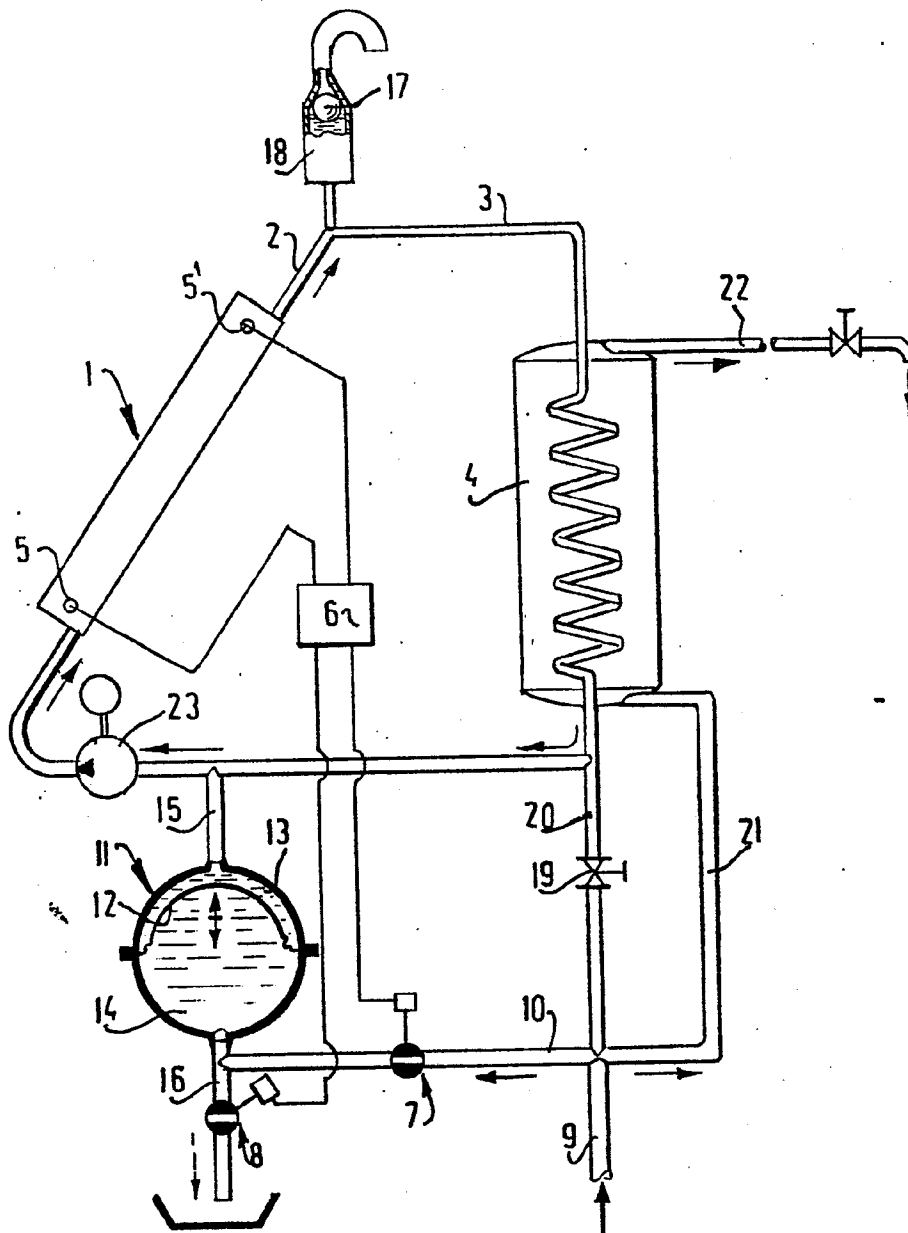


FIG. 2

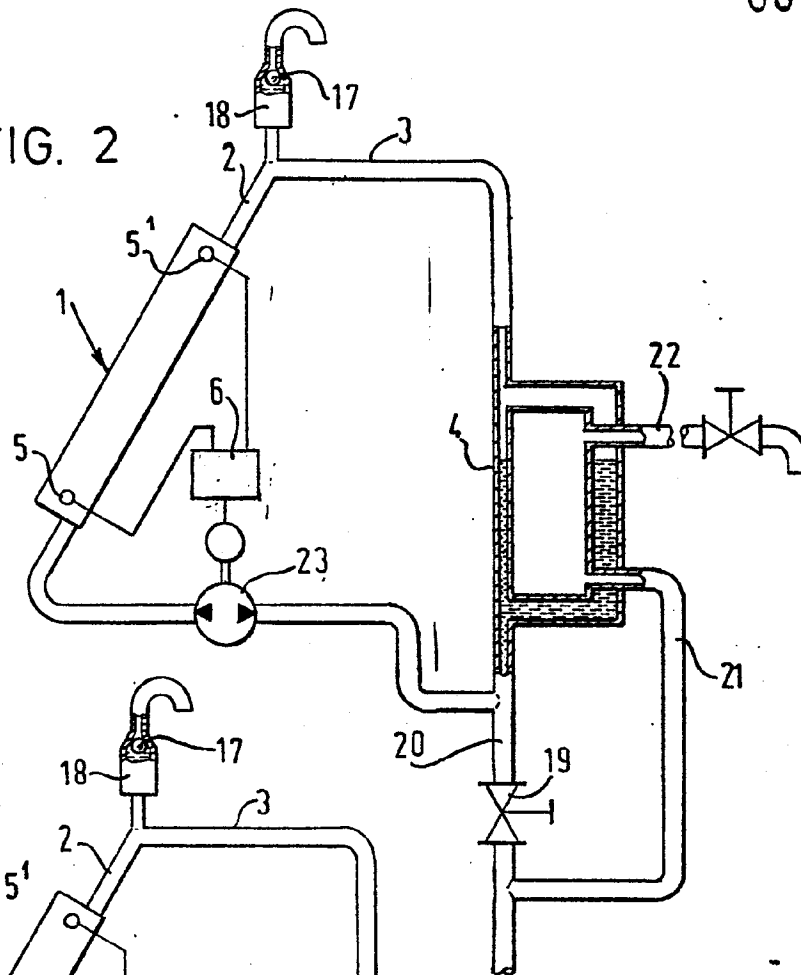
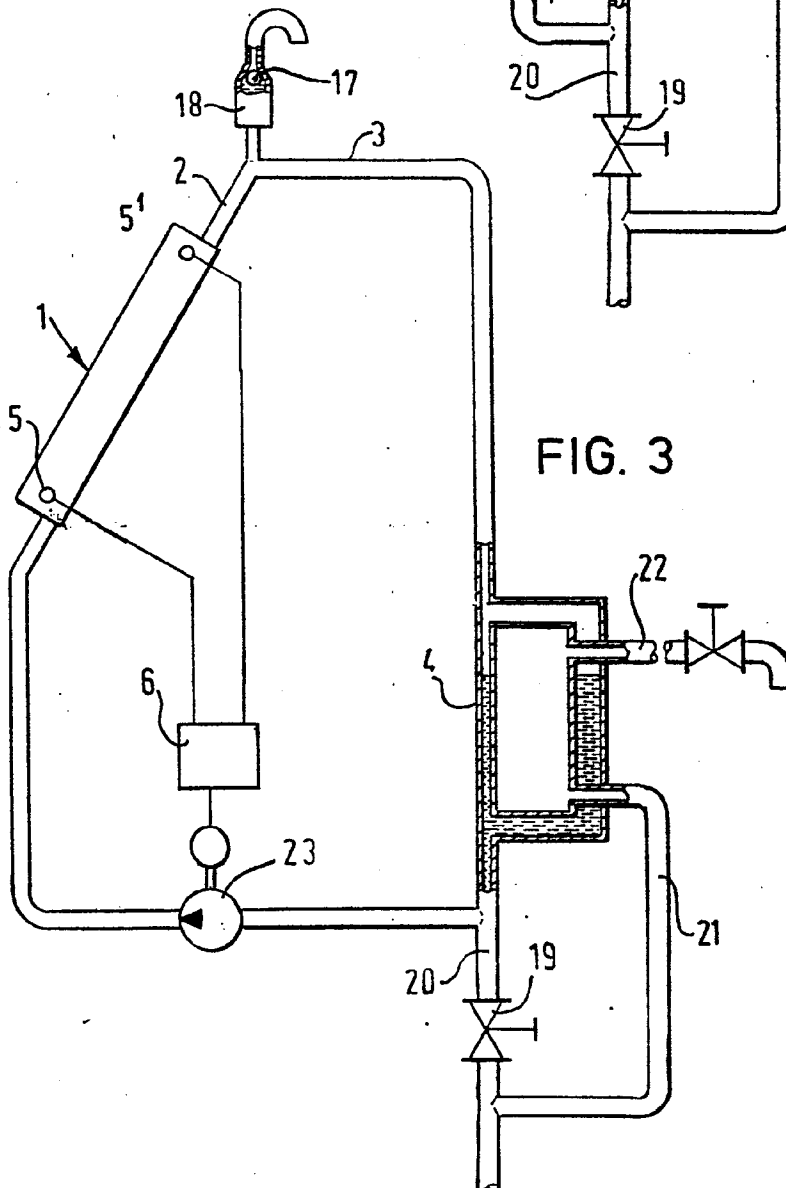


FIG. 3





European Patent
Office

EUROPEAN SEARCH REPORT

0000803

Application number

EP 72 00 000

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
XD	<u>DE - A - 2 542 348</u> (WELLER) * Pages 6,7; claims 27-33; pages 16,17; claims 79-83; page 53, paragraphs 2,3; page 54, paragraph 2; page 8, paragraph 3; page 81, paragraph 1; page 84, paragraphs 4,5; page 85, paragraph 1; figures 16,34 *	1,2,5, 7-9	F 24 J 3/00
	<u>US - A - 2 838 043</u> (BLISS) * Column 1; column 2, lines 1-26; column 4, lines 7-72; figures 1,3 *	1,4,7	TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
A	<u>US - A - 3 986 489</u> (SCHLESINGER) * Column 2, lines 47-58; column 4, lines 30-45; figure 1 *		F 24 J 3/00
A	<u>FR - A - 2 313 644</u> (EXENERSOL)		
PA	<u>DE - A - 2 624 677</u> (BODERUS)	1,2,5, 7	CATEGORY OF CITED DOCUMENTS
			A: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search The Hague		Date of completion of the search 06-11-1978	Examiner J. S.

