

Fluid-flow apparatus as solar heat collector

TECHNICAL FIELD

5 This invention relates to an apparatus having a fluid-flow configuration for use, *inter alia*, as solar heat collector. Heat from the solar rays incident on the apparatus may be absorbed by the fluid flowing through the apparatus and collected as warm fluid. The apparatus may thus serve as a sunscreen or sunshade against the sun with the fluid flow cooling it while fluid warmed by the
10 sun rays may be recycled or stored for use as warm fluid.

BACKGROUND ART

15 It is well-known that water has a relatively high specific heat and even greater specific latent heat, i.e. capable of absorbing a large amount of heat before its temperature rises to that of boiling, and during changing its fluid form to gas form, i.e. steam at the boiling temperature. Below boiling temperature, i.e. in its fluid form, it is also well-known that a small amount of water may
20 evaporate from a wet surface to produce a cooling effect as the evaporating water molecules draw latent energy away from the surface.

Systematic use of water flow has been known to be used since ancient times for cooling purposes. For example, it has been recorded that the palaces

of the Tang Dynasty in China used water wheel to draw water up to the roof to allow it to flow down to cool the building. A similar technique is still effectively used today. For instance, Singapore Zoological Garden has a roof cooling system for its public toilets whereby water is pumped onto the roof to flow
5 downwardly.

As the water used for such cooling purposes is generally clean so as not to dirty the building roof or clog the water flow system, the running water is usually collected for recycling by a closed water flow system so as not to waste
10 water. The running water, whether in a closed or recycled water flow or an open discharge method which is more wasteful, eventually becomes warm as it continuously absorbs heat from the sun and as it becomes uniformly warm, the cooling effect due to heat conduction with the water contacting the surfaces of the roof and building becomes less and less until cooling effect is achieved only
15 by evaporation effect.

Hence, improvements to running water methods generally include providing means for better or more evaporation as the main cooling effect since there is a limit to cooling by surface contact and conduction. One such
20 improvement is to spray water onto the roof so that more evaporation may be achieved with the spray compares to normal evaporation of a running flow of water. With spraying, less amount of water is used. Examples of such systems may be found in U.S. Patents Nos. 1,831,880, 4,175,703 and 4,372,493. In these patents, water is dispersed by spraying onto the roof to

cool it through its evaporation.

In a hot but water-scarce environment, even the spraying of water for cooling purposes may not be acceptable as the evaporation rate may be too high such as in an arid or desert climate and the water loss rate would then be significant. In a tropical environment, the application of spray-cooling methods simultaneously by many buildings may lead to undesirable increase in local humidity.

In the second aspect of the cooling art is the solar energy, particularly solar heat, is merely absorbed by the cooling water flow or sprays to aid evaporation and is not reclaimed at all. Solar energy reclamation is thought to be the domain of solar heat collectors and heat storage systems. Typical systems may be found in U.S. Patent Nos. 6,814,070, 3,052,228 and 4,686,960. Some collectors in the form of pipes in a box or case may be found in U.S. Patent No. 4,552,125 and 6,769,427.

Another type of collector is the glass vacuum tube with reflective plates that axially focus the sunlight onto the tubes as recited in Chinese patents Nos. ZL96208627.4, ZL00234075.5 and ZL97236463.3. The devices in these inventions are designed mainly for heat collection and/or storage. The common drawback is the relative heavy weight of the solar collector which is due to either relatively large amount of water contained in the collector or the long and thick water pipes and other materials used in the devices. These

solar water heaters or solar collectors are only meant for installation on the roof of the building and not on the walls or windows.

While the roof of a building receives the most solar energy, the external
5 walls, particularly those west or east oriented, also receives vast amount of
solar energy, especially in the tropics. For a high-rise building, the total area of
the sidewall can be many times of that of the roof. When solar energy received
by the roof only heats up top rooms, that received by the sidewall heats up all
the rooms on that side of the building. Many buildings in the tropical area have
10 double layer ventilation roofs, even wall covers or sunlight or solar heat-
mitigating façade to reduce the heat absorption. It will be ideal if we could
block the sunlight from entering the building to reduce the electricity
consumption on air-conditioning.

15 Contradictiously, people in summer or tropical area also use
electricity to heat water for bath, shower and the like. Such energy
consumption, including that for air-conditioning, counts for about half of the
domestic electric bill. The heat energy of the hot water plus the heat wasted in
the electricity generation eventually goes to and heats up the environment.
20 Furthermore, more greenhouse gases are emitted to the atmosphere as a
result of such heating.

In the third aspect of the cooling art, conventional sunshades are mainly
designed for the control of lift and tilt, and rolling or folding of the sunshade

assembly in shading the window or part of the building from direct sunlight. The sunshades are cooled through natural ventilation, and reflection of sunlight and emission of infrared waves back to the surroundings. Thus the solar energy is not recovered but goes back to the environment.

5

SUMMARY OF DISCLOSURE

Our invention endeavours to provide a solar heat collector that is light
10 but durable enough to be installed onto walls of a building or window, or installed in place of roof so that it may be used as a sunshade in addition to absorbing heat from the sunlight with water running in the collector so that the building is cooler and thus reduce energy consumption on air-conditioning.

15 Another aspect of our invention is to provide our solar heat collector with water flow means that enables water heated by the sunlight be channelled away to be stored and replaced with fresh cool water so that the absorbed solar heat is not released or reflected back to the environment. The stored hot water may then be used for hot shower or further heated to reach boiling point as
20 drinking water to save electricity.

In the general embodiment of our invention, it is provided a solar heat collector comprising a first plate, a second plate, a plurality of ribs (17) disposed between said first plate and said second plate, wherein said first and

second plates are arranged in parallel to each other with a narrow gap therein between, and wherein peripheral walls are provided to close off the gap between the edges of said first and second plates to form a fluid-proof enclosure. A fluid inlet and a fluid outlet to the enclosure are also provided.

5

Preferably, the solar heat collector is integrally formed to withstand enclosure pressure of at least 1.5 atmospheres (about 150 kPa). The first plate may be oriented to face solar ray incidence and which external surface is heat-absorbing. Preferably still, the first plate's external surface is resistant to ultra-
10 violet rays. The second plate's external surface may preferably be provided with heat-insulating material. As another preferred embodiment, the fluid is water which supply is admitted into said enclosure via the fluid inlet and flows out of said enclosure via the fluid outlet.

15 Mounting holes (18) may preferably be provided for mounting said collector to a building structure including any one of an outer wall, a roof, a window, door, building frame and the like.

In another preferred embodiment, the inlet is provided at a lower portion
20 of said collector with the water flowing evenly through the enclosure through said gap formed between said first and second plates separated by said ribs, wherein said water collects heat from said collector as it flows therethrough, and wherein said water flows out of the fluid outlet at an upper portion of said collector.

In yet another preferred embodiment, the solar heat collector may be configured to be installed on an inclined structure, including a gable roof, wherein the fluid inlet is provided at a lower portion of said collector and the
5 fluid outlet is provided at an upper portion of said collector.

One preferred configuration of the ribs is to dispose them to extend horizontally in parallel and alternately from an opposing vertical side walls to form a serpentine fluid flow pathway through the enclosure, wherein said fluid
10 flows in via an inlet provided at a lower portion of the collector and flows out via an outlet provided at an upper portion of the collector.

Yet another preferred configuration of the ribs is to disposed them to extend vertically in parallel leaving gap between the rib ends and the horizontal
15 walls to form common horizontal passages at the rib ends wherein the upper horizontal passage leads to the outlet, while the lower horizontal passages leads to the inlet.

In a second embodiment of our invention, a plurality of solar heat
20 collectors may be provided, each in vertically elongated enclosures wherein each collector is provided with a fluid inlet at a lower portion connected to a common fluid supply conduit and a fluid outlet at an upper portion connected to a common fluid discharge conduit. Preferably, the plurality of solar heat collectors are hanged from a horizontally slidable mechanism in the manner of

vertical blinds, which horizontally sliding positions and rotation along the respective vertical axes of the collectors is adjustable by a user.

In one preferred embodiment, the plurality of solar heat collectors may
5 each be provided as horizontal elongated enclosures arranged as a series of parallel slats in the manner of horizontal blinds wherein each collector is provided a fluid inlet at a lower portion connected to a fluid outlet of the adjacent slat below, and a fluid outlet at an upper portion connected to a fluid inlet of the adjacent slat above. Preferably the slats are hung in a vertically
10 winding roll mechanism and include a mechanism for adjusting tilt of each slat along its horizontal axis, which mechanisms are adjustable by a user.

In one preferred embodiment, the horizontal slats are collapsible in the manner of Venetian blinds and wherein the slats are hung in a vertically
15 collapsible mechanism and include a mechanism for adjusting tilt of each slat along its horizontal axis. The foregoing embodiments may be used as water-cooled sunshade for a building structure including any one of an outer wall, a roof, a window, door, building frame and the like.

20

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood with reference to the accompanying drawings or figures, and the detailed description that follows

hereinafter wherein specific embodiments are described as non-limiting examples or illustrations, in which:

FIGURE 1 is a schematic layout view of the water-cooled sunshade cum
5 heated water collection system of this invention;

FIGURE 2 is a sectional view of one embodiment of the inner
structure of a water-cooled sunshade shown with parallel flow passages;

10 FIGURE 3 is a sectional view of a second embodiment of the inner
structure of a water-cooled sunshade with a serpentine flow passage;

FIGURE 4 illustrates one embodiment of the sunshade in the form of
a roll-up vertical sunblind assembly for window application;

15

FIGURE 5a illustrates another embodiment of the sunshade in front
elevation view in the form of a foldable sunshade with horizontal strips suitable
for window application; and

20 FIGURE 5b illustrates the embodiment of FIGURE 5a in side elevation
view.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As a general overview of the functional sunshade cum heat collection and storage system which comprises our solar heat collector, FIGURE 1 shows
5 an exemplary schematic layout view thereof.

Accordingly, the invention comprises a water-cooled solar heat collector (1) to absorb the solar radiation, a water tank (2) to recover and store both the water and heat energy, conduits (3, 9, 10, 11, 43) and valves (4, 5, 6, 7),
10 including water level ball valve (50) in the water tank (2) to control water flow and circulate the cool and hot water to and from the water tank (2). Temperature sensors (13, 12) may be provided linked to a control unit (not shown) which may be preset by the manufacturer or set by the user to operate a circulation pump (8) controlling water flow from the water tank (2) to the inlet
15 of the solar heat collector (1).

As shown in FIGURE 2, the solar heat collector (1) generally comprises a thin rectangular block in the shape of a window pane, or it may be as small as a slat of a sunshade or as large as a piece of roofing sheet, depending on
20 design application. A fluid inlet (19) is generally provided at the lower portion of the solar heat collector and a fluid outlet (16) is provided at the upper portion.

In the general embodiment, the solar heat collector (1) of our invention comprises a first plate (101) and a second plate (102) wherein a plurality of ribs

(17) is disposed between the first (101) and second (102) plate. The first and second plates are arranged in parallel to each other with a narrow gap therein between. Peripheral walls (103) are provided to close off the gap between the edges of said first and second plates to form a fluid-proof enclosure. At least a
5 fluid inlet (19) and a fluid outlet (16) is provided to said enclosure. The components such as the plates, ribs and peripheral walls forming the enclosure are preferably able to withstand the enclosure's internal pressure of at least about one and a half of the atmospheric pressure, or about 150 kPa.

10 It should be noted by a skilled person that any suitable fluid may be used in the fluid circulation system as shown schematically in FIG. 1. However, for the obvious reasons of abundance and cost, water is probably the preferred fluid and the present specification will refer to the application of water as an exemplary fluid used in the present invention.

15 The first plate (101) is preferably oriented to face solar ray incidence and which external surface is heat-absorbing. As such, due to the long hours that it may be subjected to solar ultra-violet (UV) rays in addition to the heat from the whole spectrum of sunlight (including UV and infrared wavelengths), it is
20 preferable that it is made of material that is resistant to UV aging. Accordingly, the preferred material would be material inert to the fluid such as stainless steel sheet, aluminium sheet, glass or polymeric material that has been UV-stabilised.

Depending on the design of the solar heat collector, the materials used to construct the components of the collector and the fluid, e.g. water, properties, the first plate (101) may be transparent or opaque depending on whether solar heat is to be absorbed directly by the water or by the first plate
5 (101) and conducted to the water flowing in the solar heat collector.

With the first plate's (101) external surface oriented to face the solar rays, the second plate's (102) external surface would face the inside of a building or living space. Accordingly, the second plate's external surface may
10 preferably be provided with a layer of heat-insulating material so that the heat transmitted by radiation into the living space from the solar heat collector is minimised. Preferably still, the inner surface of the second plate (102) may be provided with a light-blocking layer so that the living space may be shaded from the sun's light in addition to its heat.

15

The solar heat collector may have a fluid inlet (19) provided at a lower part of the collector (1) and outlet (16) provided at the upper part of the collector (1). In this manner, the water may be supplied to the collector (1) via the inlet (19) so that the lower part of the collector is filled up evenly and
20 gradually throughout the enclosure space of the collector formed from the gap between the first (101) and second (102) plates separated by ribs (17).

When exposed to sunlight, the water absorbs heat from the collector as it flows through the enclosure of the solar heat collector (1). Warm water flows out of the fluid outlet at an upper portion of said collector (1). This arrangement is applicable even when the collector is installed on an inclined structure, such as a gable roof, i.e. the fluid inlet (19) is provided at a lower portion of the collector (1) and the fluid outlet (16) is provided at an upper portion of the collector (1).

For ease of installing or mounting the solar heat collector (1) onto a building structure such as roof, wall or window, door, building frame, etc., the collector (1) may preferably be provided with mounting holes (18) such as that shown in FIG. 2. With such holes, the solar heat collector (1) may be fastened to the desired structure with bolt-and-nut and like means.

With reference to FIGURE 3, the solar heat collector (1) of our invention may be configured in such manner that the water flows through the enclosure space of the collector is a longer pathway so that each part of the water is in contact with more parts of the collector (1). One such embodiment of the solar heat collector (1) is to have a plurality of ribs (17) disposed to extend horizontally in parallel and alternately from an opposing vertical side walls to form a serpentine fluid flow pathway through the enclosure. The water, as in previous embodiments, flows in via an inlet (19) provided at a lower portion of the collector (1) and flows out via an outlet (16) provided at an upper portion of the collector. In this serpentine water flow configuration, the heat conducted to

and absorbed by the water is more efficient due to increase surface area of contact by the water as well as increase time available for absorption while within the enclosure before it flows out from the outlet (16).

5 A plurality of the solar heat collectors may be arranged to be interconnected with one another so that the collectors may have a common inlet pipe (21) supplying incoming water to each of the inlet (23a) of the respective collectors as shown in FIGURE 4. Water outlets (22) may be provided at the upper portion of each of the collector. Each of the outlets (23b)
10 may then join with a common outlet pipe (22).

 In one embodiment, the plurality of solar heat collectors may be provided as vertically elongated enclosures and are arranged horizontally in series in the manner of vertical blinds. Each of the collectors may be installed to hang from
15 a horizontally slidable mechanism which horizontal sliding positions may be actuated by an endless chain be rotated by pulling a chain to rotate a wheel. The vertical louvre action may be achieved by having a string attached to each of the collectors so that their angle of turning along the respective axes of the collector may be adjusted accordingly.

20

 In the second embodiment, the plurality of solar heat collectors may be provided as vertically elongated enclosures (24) and are arranged horizontally in series in the manner of vertical blinds. Each of the collectors (24) may be inlaid to a horizontal hollow bar (26) with a long wedge(s) (30). The horizontal

bar (26) may be rotated by pulling a chain (28) to rotate a wheel (27). The common outlet (22) is connected inside the hollow bar (26) to the outlet (29) that has a co-axis with the hollow bar (26). The vertical blind can be rolled-up when the water therein is discharged.

5

In another embodiment, a plurality of solar heat collectors (1) according to our invention, which are provided in horizontal elongated enclosures, may be arranged as a series of parallel slats (31) in the manner of horizontal or Venetian blinds as shown in FIGURE 5. Each of the collectors may be provided with a fluid inlet (32) at a lower edge portion and an outlet (34) at an upper edge portion corresponding to the lower edge portion of an adjacent slat above or below. A connector pipe (32a) may be provided to connect the outlet (34) of one slat to the inlet (32) of the adjacent slat so that a water flow is established serially and upwardly from slat to slat.

15

Each of the slats may be narrow enough as a solar heat collector to allow only one rib (33) which permits the water to flow from one end to the other end and back again before exiting via outlet (34) to enter the next slat immediately above it. Depending on the width of the slat, more than one rib (33) may be provided as long as a serpentine flow is established and preferably the water flow ends at the same end of the slats to facilitate ease of interconnecting the outlet (34) and inlet (32) of adjacent slats.

20

The slats (31) may be hung in a vertically winding or retractable roll

mechanism wherein a pair of strings or cables (38) may be retractable to pull up the slats. It may also include a mechanism (35) for adjusting tilt of each slat along its horizontal axis. Both mechanisms are adjustable by a user as in conventional Venetian blinds. One arrangement which allows the slats to be
5 pulled up and folded in a zigzag or collapsible arrangement is to provide a string or cable (38a) attached to a lower edge of the slats in an alternating manner along either side of the retractable cable (38).

It will be apparent for a skilled person that, with the above-described
10 plurality of solar heat collectors configurations, they may be used as a sunshade for or on a building structure such as an outer wall, roof, window, door, building frame and the like instead of a single large piece of solar heat collector in place of these building structures.

15 To be mounted on the wall or hanged outside the window, the solar heat collector must be thin, light and strong. Accordingly, a low-pressure system is used so that minimum thickness of materials may be used. The solar heat collector is therefore quite thin having a very large ratio of surface area over volume.

20

For wall application, the solar heat collector (1) may preferably be provided as an integrated cavity aluminium plate made by extrusion or other forming technology. The exemplary solar heat collector (1) is made of two sheets of galvanized plates (101, 102) bonded together with "liquid nail" (17)

[example - TEC7™ which comprises N-(3-(trimethoxysilyl) propyl)-ethylenodiamina, manufactured by Novatech of Belgium (www.novatech.be)] forming vertical parallel flat passages of not more than 5 mm thick at the middle part; horizontal plate passages linking the vertical passages in the upper and lower part of the sunshade may be provided as shown in FIG. 2. A plurality of the interconnected solar heat collectors which are made of aluminium may be arranged or configured to form a facade for the aesthetically covering or blocking sunlight from the building wall while serving as solar heat collector and sunshade.

10

For tent or shelter application, a roll-up water-cooled sunshade configured from the solar heat collector (1) is preferred. Plastic-coated aluminium sheet is preferred for the front plate and fibre-reinforced plastic sheet is preferred for the rear plate. Aluminium can resist ultraviolet effect much longer. The rear plastic coating also enables the convenient heat-sealing. A roll-up assembly of the sunshade or solar heat collector (1) may also be provided as shown in FIG. 4.

For window application, roll-up vertical sunblinds and collapsible Venetian sunshade are preferred. It is important to have gaps among strips for light beams and wind to pass through. Alternatively, transparent or translucent material may be used to enable sunlight to pass through water medium contained in the solar heat collector (1).

20

In an exemplary embodiment of the vertical sunblind, the sunshade is made from a whole sheet of plastic coated aluminium and a whole sheet of plastic film. The two sheets are heat-sealed to form passage pattern illustrated in Fig. 4. Vertical narrow gaps between adjacent strips are formed by cutting-
5 off. A PVC pocket for thermo sensor may be attached by heat-sealing on the rare side near the common outlet prior to heat-sealing to the aluminium foil.

The efficiency in cooling and the efficiency in heat absorbing in a solar heat collector are inter-related parameters. To increase the efficiency, the
10 temperature of the solar heat collector is kept low by transferring its heat to the water flowing therein. One way to achieve this is to maximize the contact surface area between the absorber and the cooling water so that the heat is transferred to the water to the maximum possible. Another way is to remove the heated water from the solar heat collector and replace it with cool water
15 quickly, such as cool water from the tap.

The solar heat collectors may have their respective outlets (16) connected to a common outlet pipe (11) which delivers the heated water to a hot water tank (2) as shown in FIG. 1. The water tank (2) may initially be empty
20 and is gradually filled with hot water from the common outlet pipe (11) as the hot water from the solar heat collectors are channelled to the common outlet pipe (11). Fresh, cool tap water may then be channelled via a common inlet pipe (10) to inlets (19) of each of the solar heat collectors.

Preferably, temperature sensors (13) such as a thermocouple is provided to monitor the temperature of the hot water leaving the solar heat collector. The temperature sensor (13) may, for example, arranged to provide electronic signal to a controller unit which operates a circulation pump (8) which operation may be determined upon signal being received to indicate a particular temperature value is attained, thereby pumping in fresh cool water and/or open valve (6) to allow water to flow into the common supply or inlet pipe (10). Additional temperature sensor (12) may be provided to jointly control a circulation pump (8) together with temperature sensor (13) so that the circulation of water between the solar heat collector and the water tank only occurs when the outlet temperature of the collector is higher than that of the water tank for a preset surplus to prevent the water in the tank from cooling when the weather changes. This includes monitoring the temperature of warm water flowing into, and/or cool water flowing out of, tank (2).

15

The preset surplus feature may be explained as follows. The water temperature at the bottom of the tank is the lowest. If the temperature at the outlet of the collector is equal to that of the tank bottom, circulation by convection will no longer further heat the water. However, mixing the water in the tank when cooler water (compared to the average temperature in the tank) is introduced is not desirable. When the temperatures at the outlet of the collector is only slightly higher, it indicates that the energy obtainable from circulation is limited and the temperatures will be equalized very soon after circulation, which will lead to too frequent switching on-and-off of the pump. It

20

is also a waste of power. A preset surplus can solve this problem so that the pump is switched on at a preset surplus or flow of amount of water.

It is known that, the higher the temperature differential the faster heat is
5 conducted or transferred from a hotter region to a cooler region. After the
water tank (2) is full, the coolest water near the bottom of the tank is withdrawn
from the tank and circulated to the solar heat collector to achieve maximum
efficiency of heat absorption and transfer. The warmed water from the solar
heat collector is discharged through the discharging pipe to just below the
10 water surface to prevent it from mixing with the cooler water at the lower layer
of the tank.

If the reservoir of warm water in the tank (2) is to be withdrawn to be
used for some other purposes, for warm water shower, a second outlet (43)
15 may be provided at just below the water level of the tank so that only the
warmest water is withdrawn and which is not mixed with the cooler water at the
bottom of the tank (2).

It will be appreciated that a number of the above-described features of
20 our invention may be adopted modularly, modified, reconfigured, or
alternatively adapted according to the required heat exchange efficiency or
demands by users which are still based on the same general concept, features
and working principles of the present invention.

These variations and alternative embodiments may be used in substitution of the aforesaid parts, components, materials, steps or processes as alternative configurations or embodiments not specifically described herein but which may still be used to effectively work the concept and working principles of this invention. Accordingly, they are not to be considered as departures from the present invention but shall be considered as falling within the letter and scope of the following claims.

5

CLAIMS

1. A solar heat collector comprising
 - a first plate;
 - 5 - a second plate;
 - a plurality of ribs (17) disposed between said first plate and said second plate;wherein said first and second plates are arranged in parallel to each other with a narrow gap therein between;
- 10 and wherein peripheral walls are provided to close off the gap between the edges of said first and second plates to form a fluid-proof enclosure;
 - at least a fluid inlet to said enclosure; and
 - at least a fluid outlet to said enclosure.
- 15 2. A solar heat collector according to Claim 1 which is integrally formed to withstand enclosure pressure of at least 1.5 atmospheres (about 150 kPa).
3. A solar heat collector according to Claim 1 wherein the first plate is oriented to face solar ray incidence and which external surface is heat-
20 absorbing.
4. A solar heat collector according to Claim 1 wherein the first plate's external surface is resistant to ultra-violet rays.

5. A solar heat collector according to Claim 1 wherein the second plate's external surface is provided with heat-insulating material.
6. A solar heat collector according to Claim 1 wherein the fluid is water
5 which supply is admitted into said enclosure via the fluid inlet and flows out of said enclosure via the fluid outlet.
7. A solar heat collector according to Claim 1 wherein mounting holes (18)
are provided for mounting said collector to a building structure including any
10 one of an outer wall, a roof, a window, door, building frame and the like.
8. A solar heat collector according to Claim 6 wherein the inlet is provided
at a lower portion of said collector with the water flowing evenly through the
enclosure through said gap formed between said first and second plates
15 separated by said ribs, wherein said water collects heat from said collector as it
flows therethrough, and wherein said water flows out of the fluid outlet at an
upper portion of said collector.
9. A solar heat collector according to Claim 6 installed on an inclined
20 structure, including a gable roof, wherein the fluid inlet is provided at a lower
portion of said collector and the fluid outlet is provided at an upper portion of
said collector.

10. A solar heat collector according to Claim 1 wherein the plurality of ribs are disposed to extend horizontally in parallel and alternately from an opposing vertical side walls to form a serpentine fluid flow pathway through the enclosure, wherein said fluid flows in via an inlet provided at a lower portion of the collector and flows out via an outlet provided at an upper portion of the collector.

11. A solar heat collector according to Claim 1 wherein the plurality of ribs are disposed to extend vertically in parallel leaving gap between the rib ends and the horizontal walls to form common horizontal passages at the rib ends wherein the upper horizontal passage leads to the outlet, and the lower horizontal passages leads to the inlet.

12. A solar heat collector according to Claim 1 wherein the plurality of ribs are disposed to extend horizontally or vertically in parallel wherein the plates, peripheral walls and ribs are made from flexible material thus enabling the collector to be rolled up.

13. A plurality of solar heat collectors, each according to any one Claims 1 - 12, in vertically elongated enclosures wherein each collector is provided with a fluid inlet at a lower portion connected to a common fluid supply conduit and a fluid outlet at an upper portion connected to a common fluid discharge conduit.

14. A plurality of solar heat collectors according to Claim 13 hanging from a horizontally slidable mechanism in the manner of vertical blinds, which horizontally sliding positions and rotation along the respective vertical axes of the collectors is adjustable by a user.

5

15. A plurality of solar heat collectors, each according to any one Claim 1 - 11, in horizontal elongated enclosures arranged as a series of parallel slats in the manner of horizontal blinds wherein each collector is provided a fluid inlet at a lower portion connected to a fluid outlet of the adjacent slat below, and a fluid
10 outlet at an upper portion connected to a fluid inlet of the adjacent slat above.

16. A plurality of solar heat collectors according to Claim 15 wherein the slats are hung in a vertically winding roll mechanism and include a mechanism for adjusting tilt of each slats along its horizontal axis, which mechanisms are
15 adjustable by a user.

17. A plurality of solar heat collectors according to Claim 15 wherein the horizontal slats are collapsible in the manner of Venetian blinds and wherein the slats are hung in a vertically collapsible mechanism and include a
20 mechanism for adjusting tilt of each slat along its horizontal axis.

18. A plurality of solar heat collectors according to any one of Claims 12 - 17 used as water-cooled sunshade for a building structure including any one of an outer wall, a roof, a window, door, building frame and the like.