Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2462334 A1 2005/09/24

(21) 2 462 334

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2004/03/24

(41) Mise à la disp. pub./Open to Public Insp.: 2005/09/24

(51) Cl.Int.^{7}/Int.Cl.^{7} F24J 2/04, H01L 31/042

(71) Demandeur/Applicant:
YOURSOLARHOME INC., CA

(72) Inventeurs/Inventors:
NIKIFOROV, VLADIMIR, CA;
KIRKPATRICK, RICHARD, CA

(74) Agent: DIMOCK STRATTON LLP

(54) Titre : PANNEAU SOLAIRE THERMIQUE ET PHOTOVOLTAIQUE INTEGRE ET METHODE D'UTILISATION ET DE MONTAGE D'UN RESEAU DE PANNEAUX SOLAIRES

(54) Title: INTEGRATED THERMAL AND PHOTOVOLTAIC SOLAR COLLECTOR AND METHOD FOR OPERATION AND MOUNTING AN ARRAY OF SOLAR COLLECTORS

(57) Abrégé/Abstract:
An integrated, modular solar collector comprising an array of solar collection devices, wherein the array of solar collection devices is mounted in a frame providing for air flow between the devices.

ABSTRACT

An integrated, modular solar collector comprising an array of solar collection devices, wherein the array of solar collection devices is mounted in a frame providing for air flow between the devices.

INTEGRATED THERMAL AND PHOTOVOLTAIC SOLAR COLLECTOR AND METHOD FOR OPERATION AND MOUNTING AN ARRAY OF SOLAR COLLECTORS

Field of the Invention

This invention generally relates to solar collectors, and specifically to an apparatus and method for assembling and mounting an integrated solar collector on or as a part of a structure.

Background of the Invention

Solar collectors, such as air transpired collectors, solar water heating collectors, and photovoltaic (PV) cell arrays are widely known in the art and are used on houses, multiple dwelling units, commercial buildings, and other structures as a means to efficiently provide ventilation, heating and cooling, hot water, and electricity by harnessing solar energy rather than consuming non-renewable or environmentally damaging power sources.

It is desirable to provide a system and method for efficient mounting solar collectors on a building, allowing for modular construction of an array of solar collectors that may be tailored to the particular requirements of the building serviced by the solar collectors. It is also desirable to provide a frame having a complementary profile for mounting solar collectors that can be used to mount solar collectors on a building in an array that provides for common channels for air flow, thereby increasing the efficiency of the collectors.

Transpired collectors having a PV cell-powered fan to induce airflow from the collector to the building interior through a duct are also known in the prior art. It is desirable to provide such a transpired collector that is configured to provide optimal performance of both the PV cell and the collector surface, and furthermore to provide an assemblage of transpired collectors with interconnected air flow routes utilizing a single duct through the exterior wall of the building.

Description of the Invention

An array of solar collectors, as they would be mounted on a wall or roof of a building, or as a part of a building envelope structure, is shown in Figure 6. The array may be comprised of transpired collectors 30, solar water heating collectors 32, or arrays of photovoltaic cells 34, or a combination of two or more of the foregoing in accordance with the building's particular heating, ventilation, hot water supply, and electrical load requirements. Preferably, the array has a uniform appearance, being comprised of differently functioning solar collectors of similar appearance, located on different solar exposed and orientated building surfaces, thus optimizing the usage of non-south exposed building surfaces. Exposed building surfaces facing non-optimal directions, for example, can be covered by appropriate solar collectors working for the lower portion of building thermal load. Each collector 30, 32, or 34 is mounted on the building by means of frame segments 40, which are used to frame each collector on each edge and to hide electrical and water collector-to-collector piping connection, as well as reduce thermal losses and provide air flow channels connecting the solar collectors as necessary.

The frame 40, as shown in Figure 1, is preferably formed of extruded aluminum and is cut to the appropriate length to fit along an edge of the solar collector 30, 32, or 34, as described below. The frame 40 comprises a transverse wall 42, provided with slotted beads 44, 46 at either edge of the wall 42. The beads 44, 46 are preferably inclined towards one face of the transverse wall 48, which for convenience is referred to here as the interior face 48. Provided on the interior face 48 are shelves 8, 9, which are disposed at a substantially right angle to the interior face 48, and each an equal distance from its proximal bead 44, 46 respectively. Within the vertex formed between the shelf 8, 9 and the interior face 48, opposite from the proximal bead 44, 46, there is provided an open bore 6, 15, which serves the dual purpose of retaining collector components and providing a screw chase, as described below. Preferably the shelves 8, 9 are of equal depth.

On the opposing face of the transverse wall 42, referred to here as the exterior face 50, are complementary shelves 10, 11, which are of equal depth and positioned substantially at a right angle to the transverse wall 42 such that one of the complementary shelves (for example, shelf 10) is located closer to its proximal edge of the wall 42, than the other complementary shelf (for example, shelf 11) is to its proximal edge of the wall 42. This can be seen in Figure 1. The locations of the complementary shelves 10, 11 are determined such that when a separate segment of the frame 40' is rotated 180° around its axis 12, its complementary shelves 11 and 10 may be aligned and fit together with the complementary shelves 10 and 11 of the frame 40 to create a channel 7, defined by the exterior faces 50, 50' and the shelves 11, 11' (as shown in Figure 1). Preferably, an airtight channel is provided by placing a sealant such as silicon or adhesive tape between the shelves 10, 11' and 10', 11.

Referring to Figure 10 a prior art transpired collector may be mounted using frame segments 40 as follows: The edges of a collector panel 5, which panel typically comprises a plate having an air intake and adapted to absorb heat energy, is slip-fit into the open bores 6. Preferably, the collector panel 5 is fixed in place by means of screws or other fasteners fixed through both the collector panel 5 and the shelf 8. The back plate 20 of the collector is disposed against the side of shelf 9 proximal to the bead 46 and similarly fixed in place. Thermal insulation 19 is mounted between the back plate 20 and the panel 5, thus defining an airspace between the thermal insulation 19 and the panel 5. Air thus flows into the transpired collector through its intake, preferably a series of perforations as shown in Figure 10 and is heated by the panel 5. The thermal insulation 19 and the panel 5 may comprise content phase change material for the purpose of energy storage. In accordance with prior art transpired collectors, the heated air may be introduced into the building through a duct and by means of a fan disposed in the collector in front of the duct opening.

Similarly, the frame segments 40 may be used for mounting a solar water heating panel as shown in Figure 3, or a photovoltaic panel. If the collector panel requires protective glazing, the frame 40 provides a means for securely mounting the glazing

in place over the collector. Referring to Figure 3, glazing 21 is wrapped on all edges with a gasket 60 formed of rubber or some other suitably resilient medium. The glazing is fit within the frame 40, resting on the shelf 8 on the surface proximal to the bead 44; to fix the glazing in place, a lock 17 is provided. The lock 17 is preferably extruded from aluminum and is shaped at a first end to snap-fit over the bead 44 with a first detent 62, and at a second end with a second detent 64. To fix the glazing 21 in place against the frame 40, the lock 17 is snap fit around the bead 44 and rotated until the second detent 64 is depressed against the gasket 60, thus securing the gasket 60 against the shelf 8, and the first detent 62 is retained by the slot in the bead 44.

To fit around the corners of a collector panel, which is typically rectangular, the ends of the frame segments 40 may be bevelled at a 45° angle, and secured against a similarly bevelled frame segment 40 to form a right angle, as shown in Figure 4. The screws are fixed within the bores 6, 15 of both frame segments 40. As can be seen in Figures 4, 5, and 6, by fitting frame segments around each collector panel, and by fitting complementary frame segments to each other as described above, an array of collectors can be provided that is networked by interconnecting channels 7 that allow for air flow between each collector. This arrangement is an improvement over traditionally-mounted solar collectors, which are provided with separate air ducts or piping, as the air flow channels created by the frames 40 do not require additional ductwork that results in heat loss. Closed-cell foam 65, or another resilient material, may be inserted into channel openings or junctions as shown in Figure 2 to prevent the flow of air from one collector to another, or from the collector to the outside environment.

Referring to Figures 6 and 9, if the collectors within the array are all air transpired collectors, then the collectors may be assembled in an array as described above with a single duct 16 leading to the interior of the building with a single fan providing negative pressure inducing air intake from the outside through the collector panel, and into the building. Effectively, the panels in the array provided without their own fans are "dumb" panels that are serviced by the single fan in the "master" collector.

If the fan is powered by high-efficiency PV cells during daylight hours, preferably, the area of photovoltaic panel should be at least 3.5% of the surface area of collector surface. The front panel of an air collector can be transpired with porosity ratio (opening vs. gross area) preferably between 0.2% to 1% of the total area; or, the panel may comprise a flat plate covered preferably with a selective paint or cover with an emissivity ratio of less than .35.

Preferably the surface area covered by the PV cells powering the fan is 10-15% of the total exposed surface area of the transpired collectors serviced by the fan to provide the most efficient use of the installed solar collectors. (If night time ventilation is required, then an additional power source will be required for the fan.) Furthermore, to increase the turbulent air flow within an transpired collector and to reduce the proportion of laminar air flow, a pulsation device is introduced within the collector. This pulsation device may be mechanical in nature, for example a helical blade mounted between the fan and the collector panel, which is rotated at a rate proportional to the velocity of the fan so as to change the air speed and direction to maintain more efficient turbulent air flow. The pulsation device may also realized by modulation of the current provided to the fan, causing the fan to operate at regularly or irregularly varying speeds by electronic current amplification proportional to the unstable solar radiation on the PV surface.

If the collectors in the array serve different functions, by mounting them on the building in accordance with the present invention, an aesthetically uniform and attractive appearance may be achieved. If an array is designed to cover an entire exterior surface of a building, or it is intended to substitute as a wall of a building, if desired some panels of the array may be substituted with decorative glazing or other wall or roof finishing treatments.

Various embodiments of the present invention having been thus described in detail by way of example, it will be apparent to those skilled in the art that

variations and modifications may be made without departing from the invention. The invention includes all such variations and modifications as fall within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. An integrated, modular solar collector comprising an array of solar collection devices, wherein the array of solar collection devices is mounted in a frame providing for air flow between the devices.

2. A frame for mounting solar collectors panels in a modular fashion, comprising

a transverse wall;

a pair of shelves for mounting panels extending from a first surface of the transverse wall; and

a complementary pair of shelves extending from a second surface of the transverse wall;

such that a channel is defined by fitting the pair of complementary shelves against a pair of complementary shelves provided by a second frame.

3. A transpired collector having a fan for controlling air intake and an absorber panel, wherein the fan is powered by a photovoltaic cell and the ratio of the surface area of the photovoltaic cell to the surface area of the absorber panel is at least 3.5 to 96.5.

4. Air stream oscillating devise and method of operation

5. Modular principles of formatted solar collectors array in proportion of various building load demand

6. Configuration - "dumb" panels that are serviced by the single fan in the "master" collector.

Application number numéro de demande: 2462334

Figures: 1, 2, 3, 4, 5, 6, 8, 10

Pages:

Drawing

Unscannable items
received with this application
(Request original documents in File Prep. Section on the 10th floor)

Documents reçu avec cette demande ne pouvant être balayés
(Commander les documents originaux dans la section de préparation des dossiers au 10ème étage)

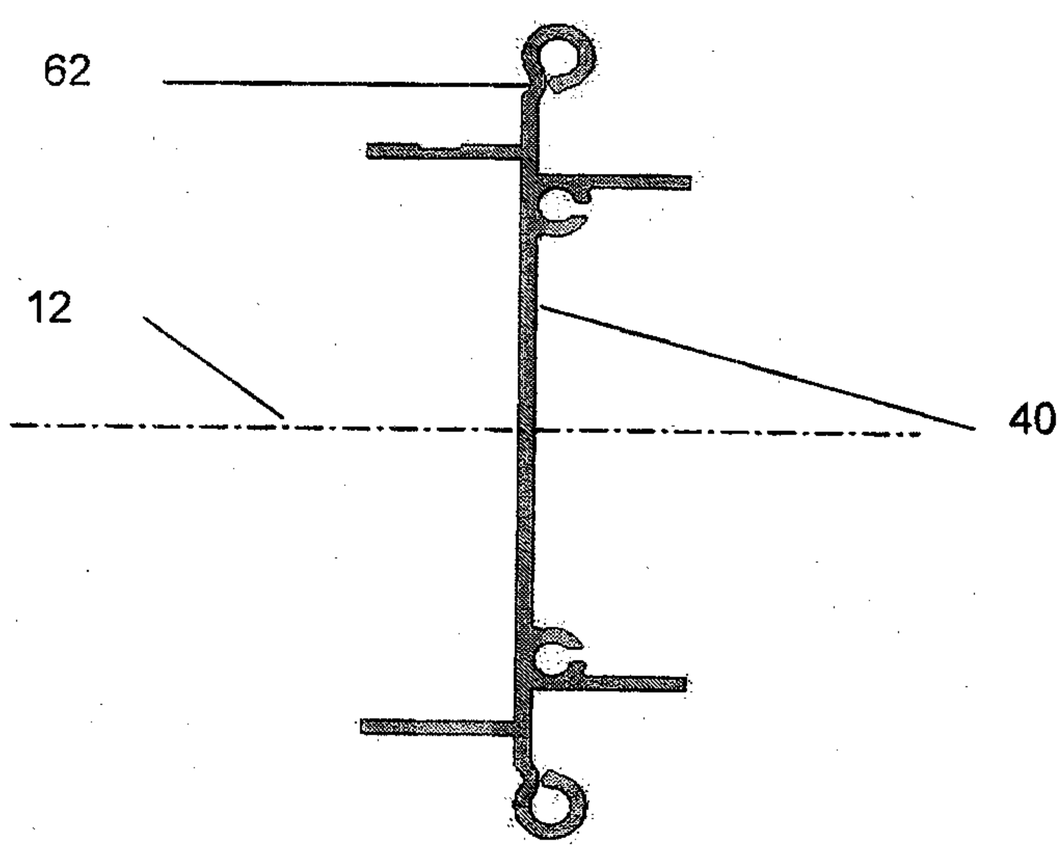

Fig. 7

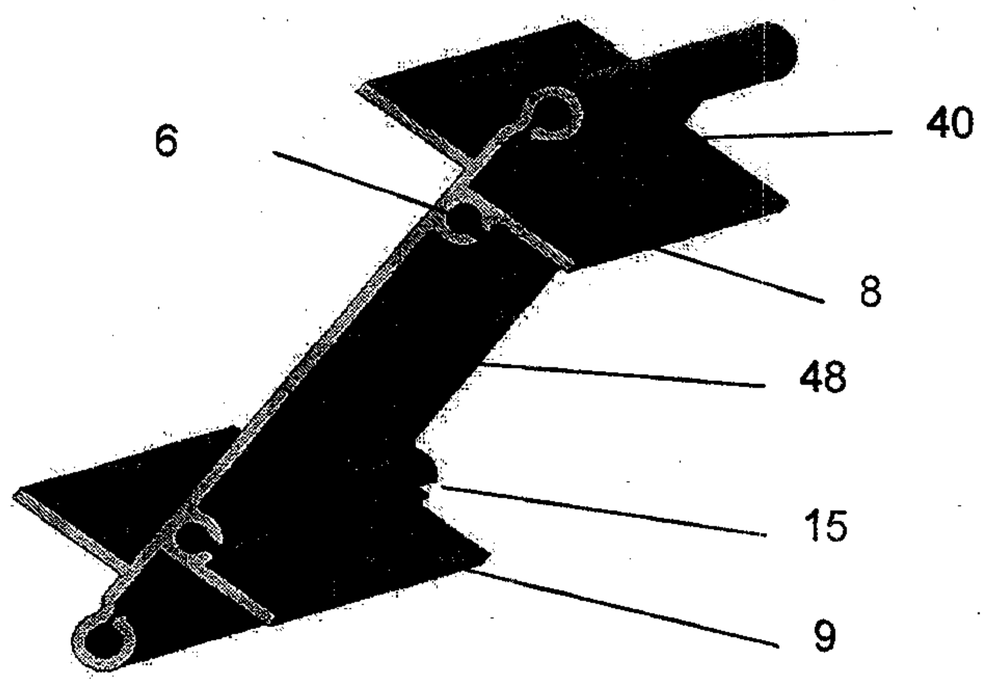

Fig. 8

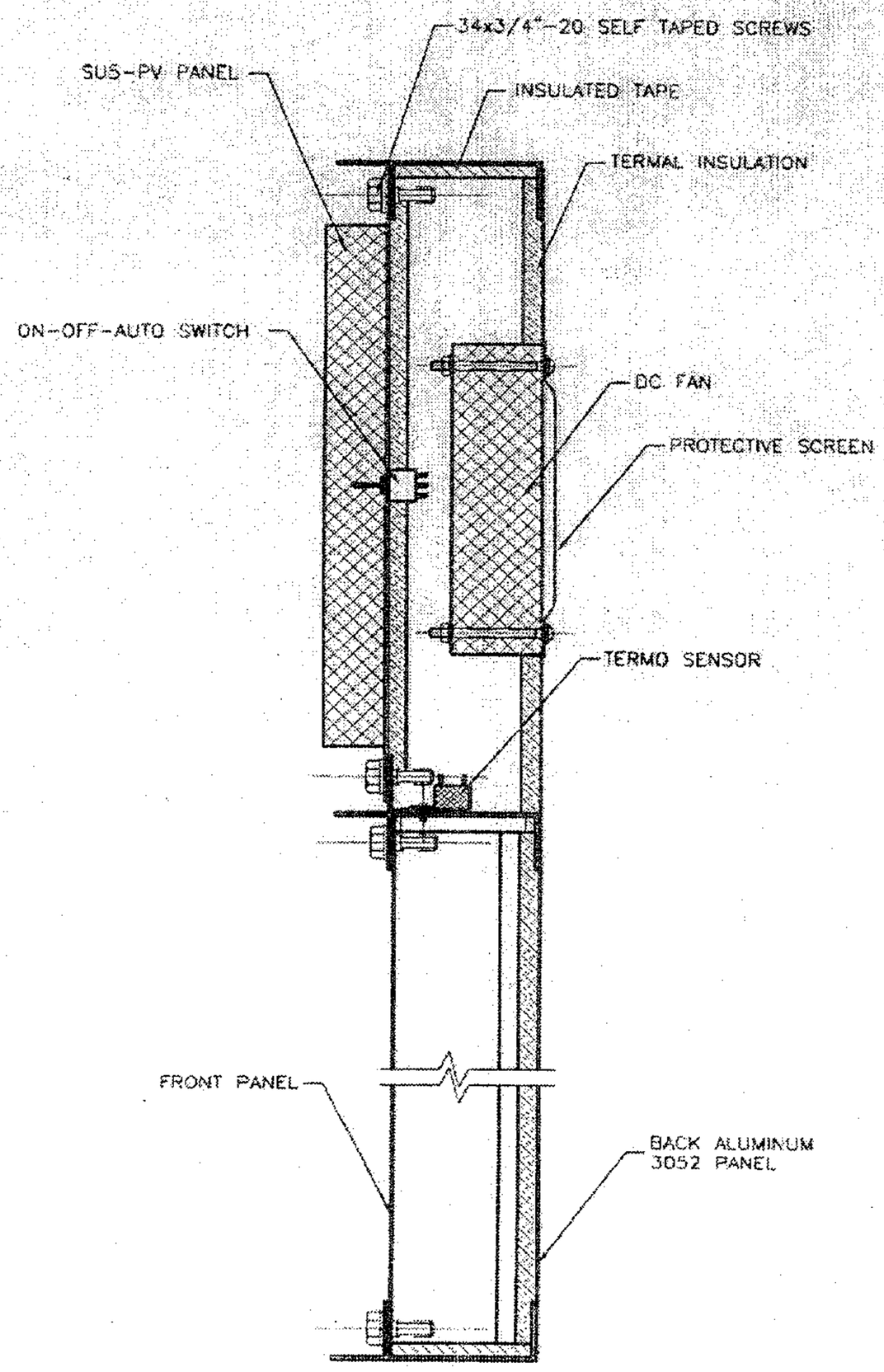
34x3/4"-20 SELF TAPED SCREWS
SUS-PV PANEL
INSULATED TAPE
TERMAL INSULATION
ON-OFF-AUTO SWITCH
DC FAN
PROTECTIVE SCREEN
TERMO SENSOR
FRONT PANEL
BACK ALUMINUM
3052 PANEL

Fig. 9