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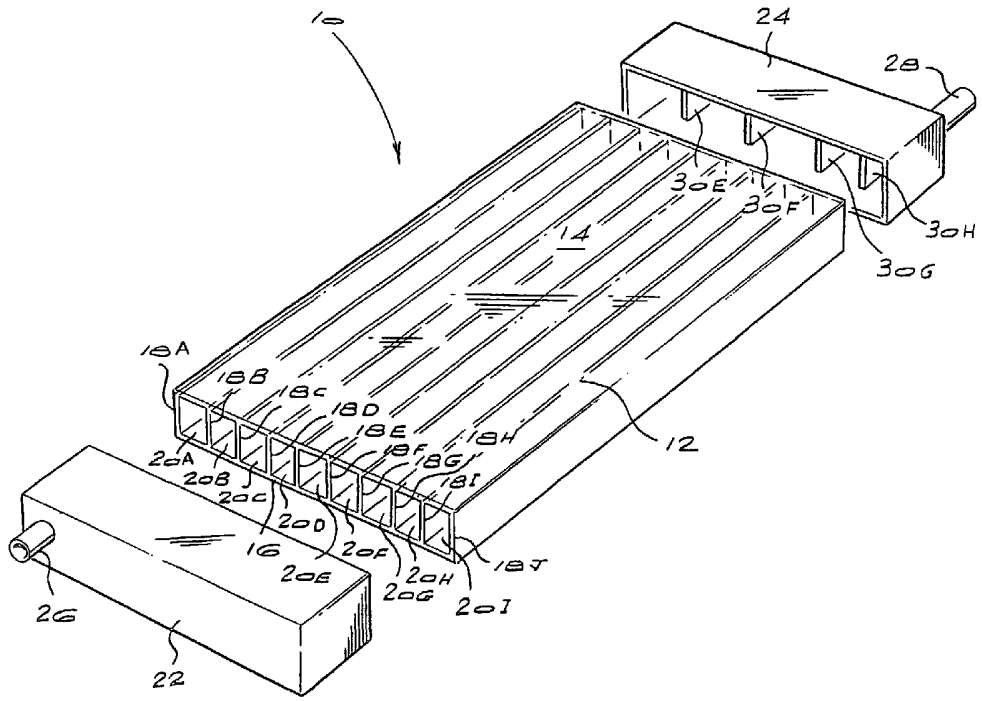
(54) **Title:** A SOLAR PANEL STRUCTURE



(57) **Abstract:** A solar panel (10) has an extruded panel (12) of thermoplastic material that defines a number of adjacent translucent channels (18). A dark liquid is directly heated by solar radiation as it flows from one end of the panel to the other.

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A SOLAR PANEL STRUCTURE

BACKGROUND OF THE INVENTION

THIS invention relates to a solar panel structure.

The use of renewable energy sources such as solar energy, for providing heating and in particular water heating, is commonplace. Typical solar panels comprise a glass or plastic cover, an insulating bottom layer and a plurality of channels or conduits provided between the cover and the bottom layer. The channels, and possibly the bottom layer, are usually black in colour so that the liquid in the channels is heated indirectly by solar energy.

The use of solar panels of the type described above, however, has several disadvantages. One disadvantage relates to the indirect heating of the fluid after the initial heating of the channel which is inefficient. Another disadvantage relates to relatively high fabrication and installation costs, which are to a significant extent caused by the numerous components that need to be manufactured separately and then assembled on site. It would therefore be desirable to provide a solar panel structure that addresses these problems. The present inventions consequently relates to a solar panel structure constructed from extruded translucent thermoplastic sheeting for heating a dark, heat absorbing fluid by solar radiation.

SUMMARY OF THE INVENTION

According to the invention there is provided a solar panel structure comprising:

an extruded panel of thermoplastic material that defines a plurality of adjacent transparent or translucent channels through which a dark liquid may flow;

two panel ends for directing the flow of the liquid at the ends of the channels;

an inlet provided on one of the panel ends; and

an outlet provided on the other panel end,

wherein a dark liquid may be introduced through the inlet and caused to flow through the plurality of adjacent channels, in which the dark liquid is directly heated by solar radiation prior to the dark liquid passing through the outlet.

The thermoplastic material is typically a translucent polycarbonate or polymethyl methacrylate (acrylic) material. The solar panel structure panel may be co-extruded with more than one thermoplastic material, each having different characteristics. Preferably, the top sheet is extruded from a transparent or translucent thermoplastic material and the bottom sheet is extruded from a dark or black thermoplastic material.

The panel ends are typically end caps that connect the channels in parallel, so that the liquid flows through the panel in a predefined direction. The end caps may be provided with stop elements that direct the flow of the dark liquid

through the channels in series, the flow of the dark liquid through the channels thereby alternating between the end caps as the flow progresses towards the outlet.

Generally, the solar panel structure forms part of a closed liquid heating system in which the dark liquid heated by the solar panel structure transfers heat through subsequent heat exchange with the object being heated. The dark liquid that flows through the solar panel structure is typically a dark heat transfer liquid, such as a dark oil or a coloured liquid.

The solar panel structure may comprise multiple layers of channels. The flow of the dark liquid will preferably move from the bottom layer through to the top layer. A solar radiation capturing layer may be provided above the top layer and an insulating layer may be provided beneath the bottom layer.

The panel may be a building element that forms part of a roof of a building.

Embodiments of the invention are described in detail in the following passages of the specification, which refer to the accompanying drawings. The drawings, however, are merely illustrative of how the invention might be put into effect, so that the specific form and arrangement of the features shown is not to be understood as limiting on the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows an exploded perspective view of a solar panel structure according to a first embodiment of the invention;

Figure 2 shows a cross-sectional plan view of the structure shown in Figure 1, once assembled;

Figure 3 shows an exploded perspective view of a solar panel structure according to a second embodiment of the invention;

Figure 4 shows a cross-sectional plan view of the structure shown in Figure 3, once assembled; and

Figures 5 to 7 show cross-sectional side views of different versions of the solar panel structure of the present invention.

DESCRIPTION OF EMBODIMENTS

Referring first to Figures 1 and 2, a solar panel structure 10 comprises a panel 12. The panel includes a top sheet 14, a bottom sheet 16 and a plurality of side walls 18A-J extending between the top sheet and the bottom sheet. The top sheet, bottom sheet and the side walls together define a plurality of adjacent channels 20A-I through which liquid may flow in the panel.

The panel 12 is constructed from extruded translucent polycarbonate or polymethyl methacrylate material. Alternatively, during the extrusion process, two or more different polycarbonate materials may be simultaneously co-extruded so that different sections of the panel may contain polycarbonate materials having different properties. In one instance, this form of construction

enables the top sheet 14 to comprise a clear transparent or translucent polycarbonate material, while the bottom sheet 16 comprises a different, preferably a black, polycarbonate material to provide enhanced heat absorption and heat transfer properties within the panel.

The liquid flowing through the translucent channels 20A-I is a dark or black heat transfer liquid, such as a coloured liquid, a silicone fluid or a dark oil or solvent. This enables the radiant solar energy to be primarily absorbed in the liquid directly, instead of indirectly being heated by conductive transfer through the panel. In this manner, the efficiency of the heating of the liquid in the system is expected to increase.

It is envisaged that the panel 12 will be sufficiently rigid and have sufficient strength that the roof of a building could be constructed from one or more of the panels, which could be manufactured as building elements. This would allow two functions to be performed simultaneously, providing a covering structure and a solar panel arrangement in a single structure.

A pair of panel ends in the form of end caps 22 and 24, which may be identical in structure, is secured to the ends of the panel 12. End cap 22 is provided with an inlet 26 for allowing liquid, which is to be heated by solar energy, to enter the panel. End cap 24 is provided with an outlet 28 for allowing the heated liquid to exit the panel. The end caps further include stop elements 30A-H for connecting the adjacent channels 20A-I in series, such that the flow of liquid through the channels alternates between the end caps, as indicated by the arrows in Figure 2.

The solar panel structure 10 is associated with a reservoir (not shown) containing liquid to be heated. In use, solar panels are generally connected to geysers, hot water tanks or swimming pools, or any other reservoir that needs to be heated although this is typically water. The solar panel structure would

provide primary or supplementary heating of the hot water being generated by appliances such as geysers and hot water tanks. In swimming pools, the solar panel structure would serve to heat the water in the swimming pool. In certain applications, the heated liquid in the channels may be arranged to heat the liquid directly, by passing the liquid through the channels. Alternatively, the item may be heated indirectly, by applying some form of heat exchange between the item to be heated and a closed circuit liquid passing through the channels.

The solar panel structure 10 is intended to form part of a closed heating system. The dark heat transfer liquid being circulated in the system, being heated as it flows through the solar panel structure, subjected to solar radiation, and then flowing through a conduit or heat exchanger, located within the reservoir, where indirect heat transfer with the water in the reservoir takes place.

Figures 3 and 4 show an alternative solar panel structure 32 comprising a translucent panel 34, which is the same as the panel 12 described above, and a pair of end caps 36 and 38. The end caps, however, differ from the end caps 22 and 24 described above, in that they do not include the stop elements 30A-H. As a result, the channels 20A-I are connected in parallel so that the liquid flowing through the channels 20A-I flows only in one direction, directly from the inlet end cap to the outlet end cap, as indicated by the arrows in Figure 4.

In Figure 5, and as indicated above, the bottom sheet 16 of panel 12 may be co-extruded from a black plastic, which it is believed would assist in absorbing heat in the channels 20, thereby more efficiently heating the liquid within the panel.

Although the panel 12 shown in Figures 1 to 5 is a single layer panel, the present invention extends to panels comprising multiple layers that have been

extruded in a single process, as will now be described with reference to Figures 6 to 8. Figure 6 shows a single solar panel structure 40 comprising two layers 42 and 44. In this embodiment, the top layer 42 consists of a transparent or translucent polycarbonate material, which may be co-extruded with a polycarbonate material having good heat absorption and transfer properties for the bottom layer 44.

Typically the bottom layer 44 is co-extruded from a black plastic. Alternatively, the bottom layer could be painted black or provided with a black lining or film. Although the panel structure 40 may be formed entirely of a transparent or translucent material, another reason that the bottom layer is preferably darkened is to ensure that the sunlight does not penetrate through into the roofing if the panel structure is emptied of the dark liquid.

The panel structure 40 is typically placed on a pitch roof with the channels orientated in line with the incline of the roof. In this arrangement, the dark liquid to be heated is directed from the inlet provided on the upper end cap (not shown) to the bottom layer 44. The dark liquid is then directed by the lower end cap to flow upwardly in the top layer 42. It is anticipated that the thermal gradient caused by the solar heating in the top layer will assist the dark liquid to flow up the channels. The heated dark liquid is then directed out of the outlet provided on the upper end cap. The advantage of this arrangement is that no piping is required to be provided to the lower end cap on the panel structure 40, which simplifies the installation of the structure as both the inlet and outlet are located in close proximity.

Figure 7 shows a panel structure 46 comprising three layers 48, 50 and 52, which is extruded in a single process. In this embodiment, the middle layer 50 may consist of a polycarbonate material that is co-extruded from a material that posesses good heat absorption and transfer properties. The bottom layer 52 may consist of polycarbonate material that is co-extruded and that possesses

good insulating properties. Again, the bottom layer is preferably black in colour, being formed in the co-extrusion process or blackened thereafter. A number of options are possible in this configuration. Generally, the flow of the dark liquid will be directed at the upper end cap to the bottom layer first and then back up the middle layer. As the top layer is transparent or translucent solar rays may be captured in the top layer in much the same manner as a green house operates. This is believed to enhance the efficiency of the system. Alternatively, the flow may be directed down the middle layer and then up the top layer, with the bottom layer providing insulation from the heat of the structure to the roof.

Figure 8 shows a panel structure 60, comprising four layers 62, 64, 66 and 68. In this embodiment, flow is directed down the third layer from the top 66, then up the second layer from the top 64. The top layer 62 captures the sun's rays, as described above, and the bottom layer 68 acts as an insulator.

It will be appreciated that a number of the panels described in this specification may be connected together typically in series, prior to the heated dark liquid flowing to the object to be heated. In this manner, the present invention provides a unitary solar panel structure that can be easily and cost effectively manufactured and installed.

CLAIMS

1. A solar panel structure including:

an extruded panel of thermoplastic material that defines a plurality of adjacent transparent or translucent channels through which a dark liquid may flow;

two panel ends for directing the flow of the liquid at the ends of the channels;

an inlet provided on one of the panel ends; and

an outlet provided on the other panel end,

wherein a dark liquid may be introduced through the inlet and caused to flow through the plurality of adjacent channels, in which the dark liquid is directly heated by solar radiation prior to the dark liquid passing through the outlet.

2. A solar panel structure according to claim 1, wherein the panel includes a top sheet, a bottom sheet and one or more dividing walls extending between the top sheet and the bottom sheet, together defining the plurality of adjacent channels.

3. A solar panel structure according to claim 2, wherein the thermoplastic material is a transparent or translucent polycarbonate or polymethyl methacrylate material.

4. A solar panel structure according to either claim 2 or 3, wherein the panel is co-extruded with more than one thermoplastic material, each having different characteristics.

5. A solar panel structure according to claim 4, wherein the top sheet is extruded from a transparent or translucent thermoplastic material.

6. A solar panel structure according to claim 5, wherein the bottom sheet is extruded from a dark or black thermoplastic material.

7. A solar panel according to any one of claims 1 to 5, wherein the entire panel is extruded from a transparent or translucent thermoplastic material.

8. A solar panel structure according to any one of the preceding claims, wherein the panel ends are end caps.

9. A solar panel structure according to claim 8, wherein the end caps connect the channels in parallel, so that the liquid flows through the panel in one direction only.

10. A solar panel structure according to claim 8, wherein the end caps are provided with stop elements that direct the flow of the dark liquid through the channels in series, the flow of the dark liquid through the channels thereby alternating between the end caps as the flow progresses towards the outlet.

11. A solar panel structure according to any one of the preceding claims, wherein the solar panel structure is associated with a reservoir containing liquid to be heated.

12. A solar panel structure according to claim 11, wherein the solar panel structure forms part of a closed liquid heating system in which the dark liquid heated by the solar panel structure transfers heat through subsequent heat exchange with the object being heated.

13. A solar panel structure according to any one of the preceding claims, wherein the dark liquid that flows through the solar panel structure is a dark heat transfer liquid.

14. A solar panel structure according to claim 13, wherein the dark heat transfer liquid is a dark oil or solvent, a silicone fluid, or a coloured liquid.

15. A solar panel structure according to any one of claims 1 to 14, wherein the panel comprises multiple layers of channels.

16. A solar panel structure according to claim 15, wherein a top layer and a bottom layer are provided, the dark liquid flowing first in the bottom layer and then in the top layer.

17. A solar panel structure according to claim 15, wherein a top layer, a middle layer and a bottom layer are provided.

18. A solar panel structure according to claim 17, wherein the dark liquid flows first in the bottom layer and then in the middle layer, the top layer serving to capture solar radiation.

19. A solar panel structure according to claim 17, wherein the dark liquid flows first in the middle layer and then in the upper layer, the bottom layer serving to insulate the solar panel structure.

20. A solar panel structure according to claim 16, wherein an additional insulating layer is provided beneath the bottom layer and an additional solar radiation capturing layer is provided above the top layer.

21. A solar panel structure according to any one of the preceding claims, wherein the panel is a building element that forms part of a roof of a building.

22. A solar panel structure substantially as herein described with reference to any one of the illustrated embodiments.

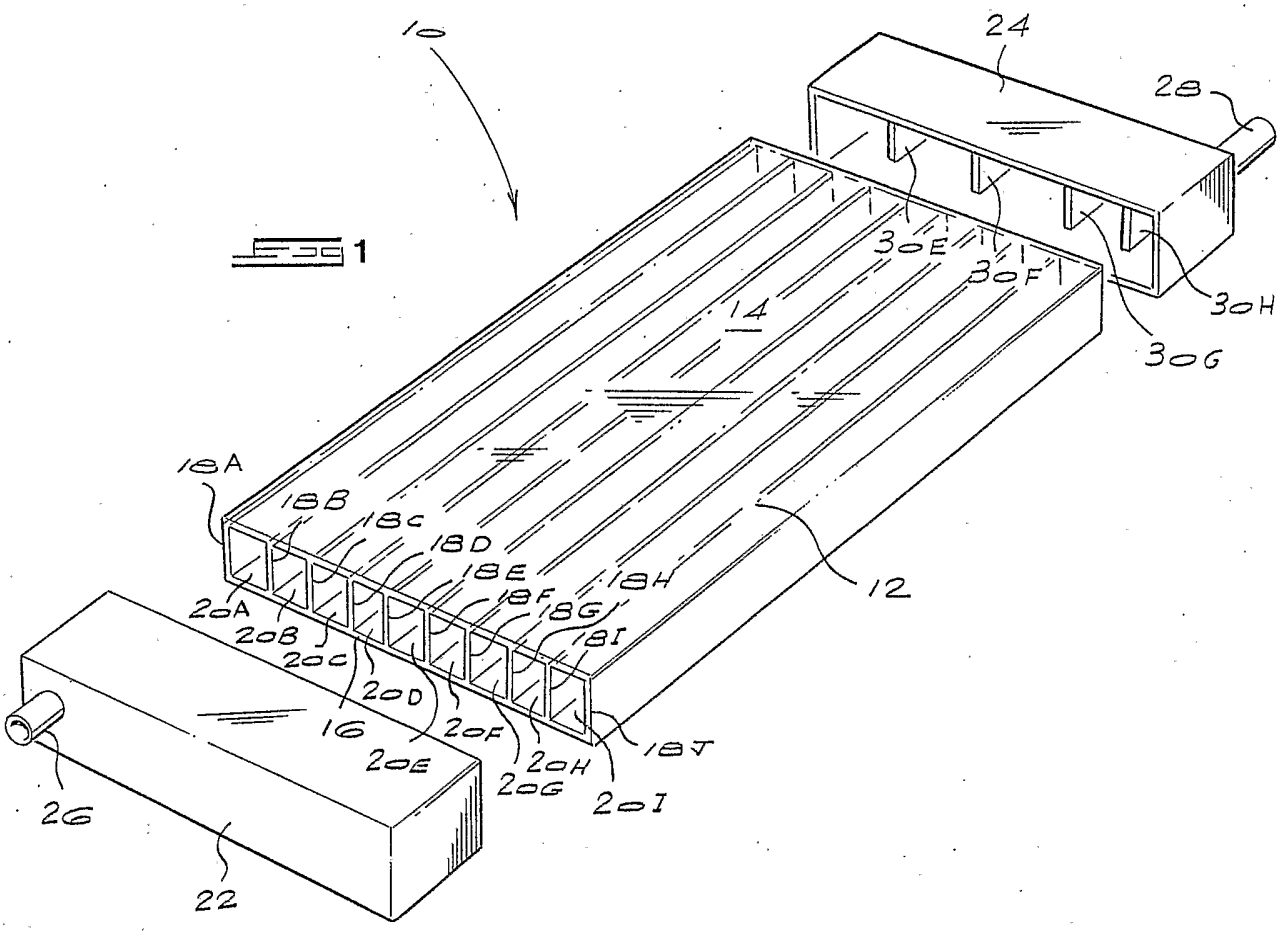
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Fig 1

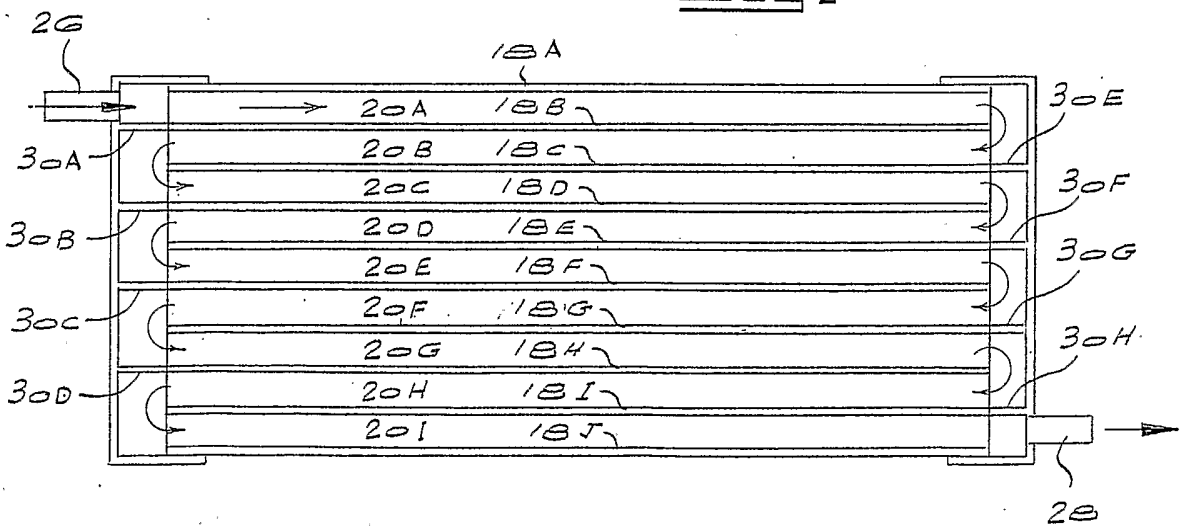
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Fig 2

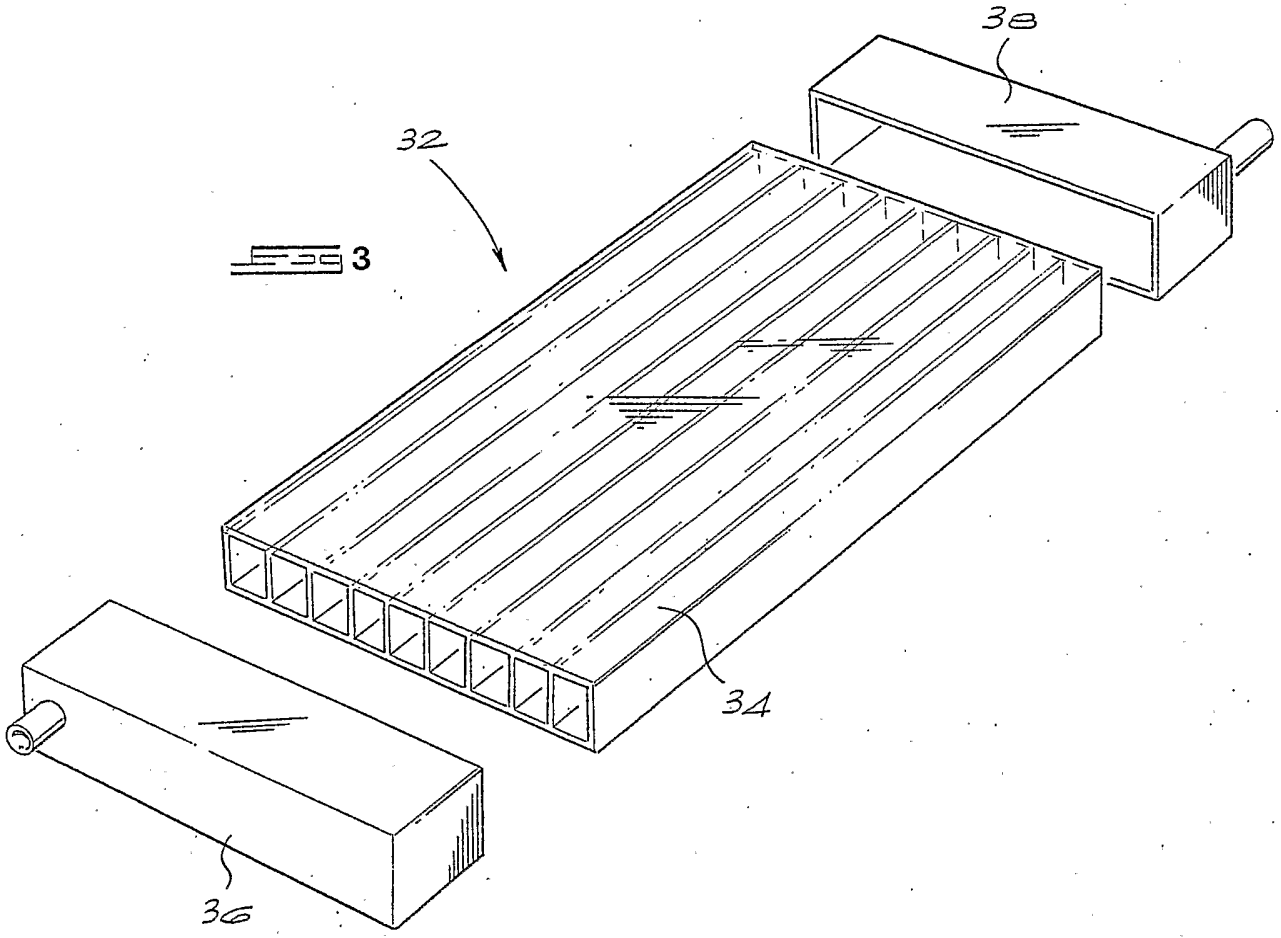


Fig 3

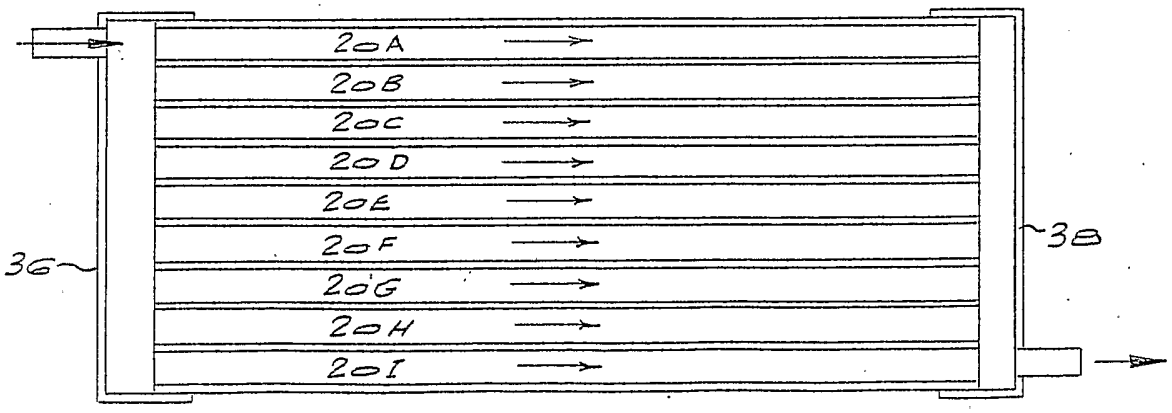


Fig 4

Fig 5

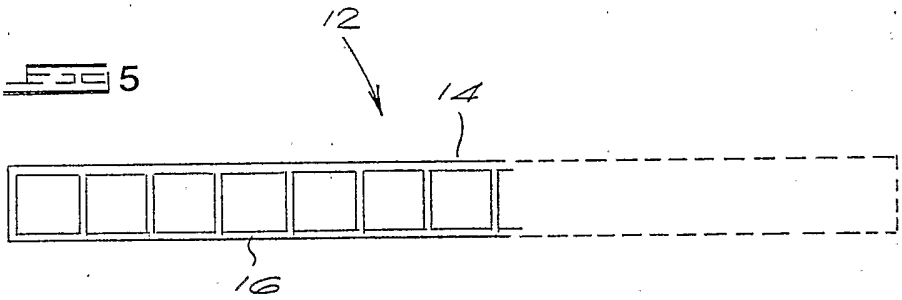


Fig 6

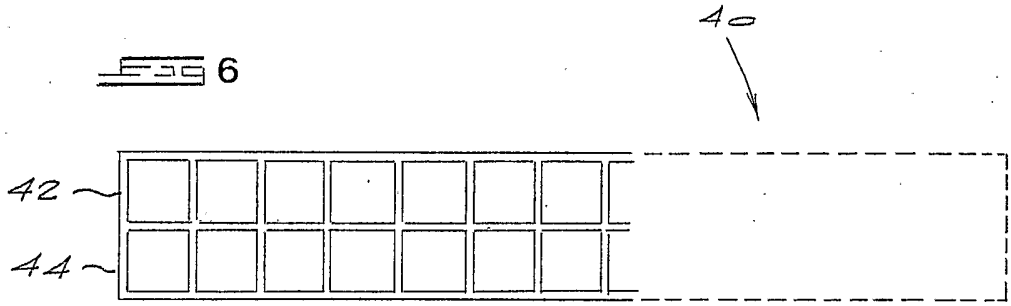


Fig 7

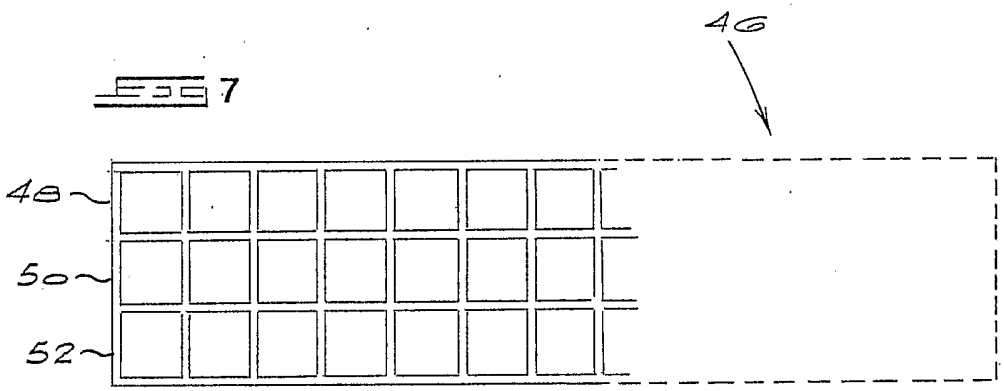
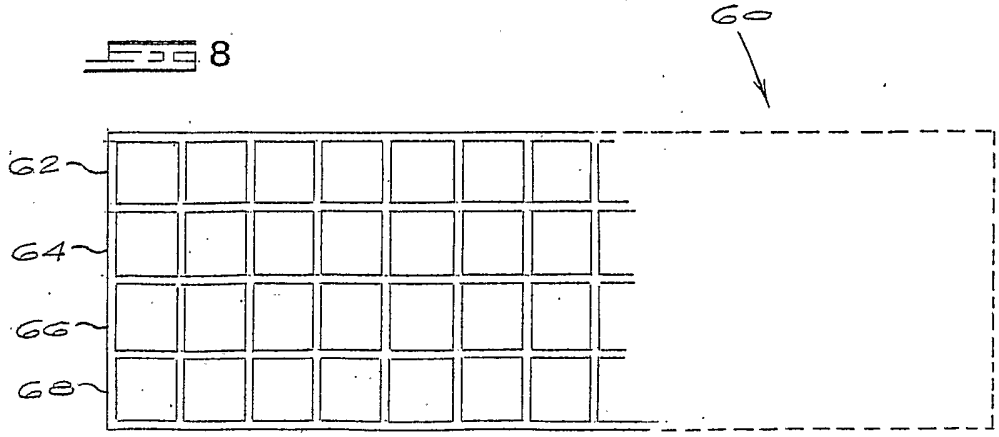


Fig 8



INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/IB 03/01315

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F24J2/24 F24J2/46 F24J2/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F24J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
18 July 2003	01/08/2003

Name and mailing address of the ISA	Authorized officer
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