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㉑ Applicant: **Davidson, Maxwell Wingate, 34 Dreghorn Loan, Edinburgh, EH13 0DE Scotland (GB)**

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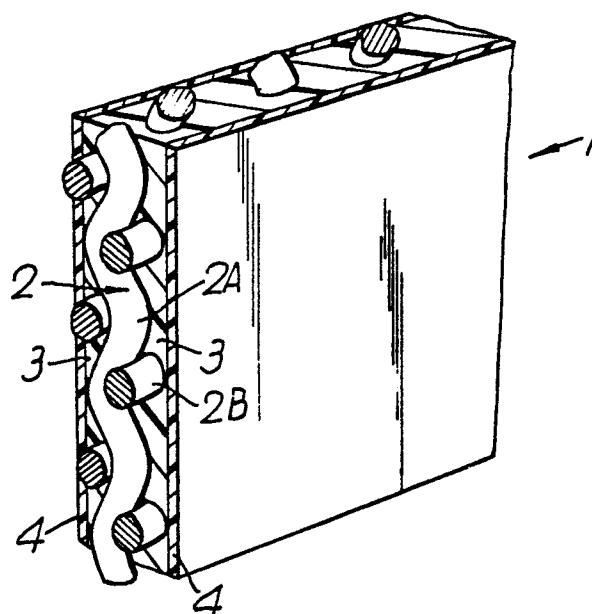
㉒ Inventor: **Davidson, Maxwell Wingate, 34 Dreghorn Loan, Edinburgh, EH13 0DE Scotland (GB)**

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㉒ Representative: **Fitzpatrick, Alan James et al, FITZPATRICKS 14-18 Cadogan Street, Glasgow, G2 6QW (GB)**

㉒ **Heat transfer elements and method for the manufacture of such elements.**

㉒ A heat transfer panels (1) comprises a wire mesh core (2) of high thermal conductivity metal, for example copper or nickel, and a closure layer of plastics material (3), for example a urethane. The wire mesh (2) extends to or substantially to an outer surface of the panel to conduct heat from the outer surface.



TITLE MODIFIED
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Improved Heat Transfer Elements

The present invention relates to heat transfer elements, and particularly to heat transfer panels or tubes serving for the conduction of heat on either side thereof.

5 More particularly, the present invention concerns an improvement or modification of the heat transfer elements disclosed in the Applicant's co-pending U.K. Patent Application No. 34122/76. Broadly, No. 34122/76 covers a heat transfer element comprising a composite wall member having
10 portions made from materials of different thermal conductivity, one portion of higher thermal conductivity extending transversely between the outer surfaces of the wall: with this arrangement the transversely extending higher thermal conductivity material serves for cross-transfer of the bulk
15 of the heat while the other portion having lower thermal conductivity serves basically as the barrier layer between the zones of the heat exchange fluids. The lower thermal conductivity portion can be of considerably cheaper material, e.g. plastics, than the transverse portion which may be for
20 example of copper or a noble metal.

According to the present invention a heat transfer element includes a composite wall member made from portions of different thermal conductivity, one portion of higher

thermal conductivity comprising a mesh of strip or strands while a further wall portion of lower thermal conductivity constitutes a closure layer, said mesh having transverse extent so as to extend across the depth of the wall member to or substantially to an outer surface thereof whereby said mesh conducts heat from the outer surface of the wall member.

A material of superior thermal conductivity is preferably chosen for the mesh. In particular, the thermal conductivity K (gramme calories cm. per sec. per square centimetre per °C) should be greater than 0.18 and preferably at least 0.20. Preferably, the mesh is in the form of a woven mesh: the undulating effect of the "warp" (and the weft) of the weave will impart the desired transverse extent to the mesh. As an alternative a plain cross-laid mesh could be used, with the mesh strands secured at the interstices for example by bonding.

In one preferred embodiment, the closure layer constitutes a core layer and the mesh is embedded therein. Thin covering layers could be applied to either side of the core layer. With this arrangement (since the mesh is slightly beneath the outer surfaces of the wall member) the mesh is protected from any corrosive effects of heat exchange fluids. However, the coatings could be made porous to deter the build-up of fouling films on the panel surfaces.

In an alternative embodiment, the closure layer constitutes a filler layer closing the spaces in the mesh; the mesh projecting laterally from at least one side of the filler layer to present good heat conducting surfaces. The mesh will therefore be in direct contact with a heat exchange fluid through these heat conducting surfaces, but the later-

ally projecting mesh portions will create a turbulent effect which should assist the heat transfer performance of the panel.

According to a further aspect of the present invention a
5 heat-exchange ducting panel comprises a heat conducting mesh core bounded on either side by closure layers, the mesh core permitting longitudinal fluid flow therein between the closure layers. This panel is particularly (but not exclusively) intended for use as a solar energy absorbing panel, at least
10 one outer closure layer being suitably absorbent to radiant energy.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:-

15 Fig. 1 shows a schematic view of a heat exchange panel according to one embodiment of the present invention;

Fig. 2 shows a schematic view of a heat exchange panel according to a second embodiment of the present invention;

Fig. 3 shows a heat ducting wall for use in a solar
20 energy panel;

Fig. 4 shows a fluid circuit of a solar energy system and including a heat ducting wall according to the present invention; and

Figs. 5 and 6 show end views of modified heat exchange
25 panels.

Referring to Fig. 1, by way of example, a heat transfer panel or wall portion 1 has a metal/plastics matrix comprising a woven (or knitted) openwork wire mesh 2 or cloth embedded in a plastics core layer 3. In this example, the
30 mesh 2 is made from strands of copper, but aluminium, nickel,

bronze or other strand material of high thermal conductivity could be used; and the core layer 3 is a thermoplastic or thermosetting plastic having suitable flexibility to permit thermal stressing during operation of the panel. The plastics
5 should be able to withstand the highest operational temperature. A urethane or other elastomer is a suitable material for the core layer. The plastics can be applied in the molten state to the woven mesh 2 or alternatively the mesh 2 can be immersed or dipped in a bath of molten plastics material:
10 in both cases the plastics closes the spaces of the mesh 2.

The undulating "warp" strands 2A (and also the undulating weft strands 2B) of the woven mesh 2 extend transversely across the depth of the matrix 1 to or substantially to the outer surfaces of the matrix. To ensure that the mesh is
15 fully embedded, thin polyester coating layers 4 say of 0.1 mm thickness are applied to the outer surfaces of the matrix 1. It will be understood that other plastics material could be used for the coatings 4. The wire mesh 2 is thus shielded from any corrosive effects of the heat exchange fluids, but
20 the outer coatings 4 may be made porous to deter the build-up of fouling films on the panel surfaces, particularly if a copper mesh is used. The thermal conductivity K should be 0.2 or more.

By way of example, a 30 mesh plain weave wire mesh
25 could be used with 0.28 mm diameter wire, so that 18.75% of the normal area of the panel is provided by the mesh with the balance (81.25%) made up by the plastics core. In operation, the metal mesh 2 conducts heat across the depth of the panel, for heat exchange between fluids on either side of
30 the panel. The above panel should have a heat transfer per-

formance superior to that of a similarly dimensioned steel sheet panel.

The flat panel can be formed with the outer surfaces having a corrugated, ridged or other patterned effect:

5 but the whole panel could be corrugated uniformly and set in the required form. The panel could be rolled and closed to form a tube (with or without corrugations etc.), or alternatively the panel in strip form and prior to curing could be wound helically on a mandrel and allowed to set
10 to form a tube. Mesh is generally formed in elongate strips or bands and an initial metal/plastics matrix could be formed 2 metres wide and 1000 metres long. If a suitable plastics is chosen for the matrix, then the metal/plastics matrix may be conveniently machined or cold worked.

15 In the second embodiment of the present invention shown in Fig. 2, the metal/plastics matrix 1 is formed substantially as before and so that there is provided a plastics barrier in the mid-plane P - P of the matrix, but in this case the warp 2A of the woven mesh projects laterally from
20 the side surfaces of the plastics barrier 3 and also parts of the "weft" 2B is exposed. The mesh 2 will therefore be exposed to the heat exchange fluids via good heat conducting surfaces: it may be desirable however, to treat the mesh to mitigate any corrosion effects of the fluids. However, the
25 projecting mesh will create a turbulent effect at the panel surfaces and this should assist the panel's heat exchange performance. It would be possible to have the mesh 2 project from only one surface of the plastics barrier layer.

The above heat exchange panels or walls can be used in
30 a wide variety of heat exchangers, and will be particularly

suitable for use in desalination apparatus. The panels could be advantageously used in the manufacture of radiators, particularly domestic radiators due to the relatively inexpensive construction of the panel.

5 The further embodiment of the present invention shown in Fig. 3 is particularly intended for use in solar energy systems. In this embodiment a ducting panel 1 comprises a central core constituted by an openwork woven mesh 2 of high thermal conductivity strands e.g. copper, and plastics
10 closure layers 4A, 4B located at opposed sides of the mesh 2 with the nodes 5 of the mesh warp 2 embedded in the plastics layers 4A, 4B to bond the layers to the mesh. Thus a central duct 6 is formed between the layers 4A, 4B with the mesh warp 2A extending longitudinally in this duct. At least one of
15 the layers i.e. layer 4A exposed to the sunlight is highly absorbent to radiant energy. In operation, the highly absorbent layer 4A picks up heat energy of the sun rays. This heat is conducted from the surface by the mesh 2, and heat exchange fluid (liquid, or air or gas) flowing longitudinally
20 in the central duct 6 is consequently heated. In a modification (Fig. 4) the layer 4A exposed to the sunlight comprises a transparent or translucent plastics layer, while the other closure layer 4B comprises a double-layer 7/8 one layer 7 of which is a heat absorbent layer adjacent the mesh 2 cover-
25 ed by an outer insulating layer 8.

Fig. 4 shows the fluid heating circuit of the solar energy system: this circuit includes a recirculation line 9, 10 for the flow of heat exchange fluid between a heat exchanger 11 and the duct 6 of panel 1. This recirculating
30 fluid serves to heat a secondary fluid in the heat exchanger

11 which is supplied and discharged via lines 12 and 13 respectively. The ducting panel 1 of Figs. 3 (and 4) particularly intended for use with a recirculating heat exchange liquid or fluid having a dark colour characteristic giving
5 good heat absorbent properties. A particularly suitable heat exchange fluid of this type comprises a colloidal suspension of liquid (e.g. water) with fine carbon black particles: this may be referred to as "black water".

Further modifications are of course possible in the
10 various embodiments. For example, the mesh could be formed from a plain cross-laid array of strands (as shown in Figs. 5 and 6) with the interstices 14 of the mesh 2 secured for example by bonding.

In Fig. 5 the mesh 2 is embedded in a plastics core to
15 form a matrix and plastics covering layers 4 cover the matrix as in Fig. 1, while in Fig. 6 the openwork of the mesh 2 is simply closed by a plastics filler layer 3 with the mesh presenting lateral projecting portions of good heat conducting property as in Fig. 2. In the embodiments of
20 Figs. 1 and 5 a metal coating could be applied to the metal/plastics matrix.

The present invention therefore provides a heat exchange panel or duct which will exhibit a very satisfactory heat exchange performance due to the high thermal conductivity
25 mesh but which can be relatively inexpensive to manufacture since the bulk of the panel is made from less costly plastics material.

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Claims:

1. A heat transfer element including a composite wall member made from portions of different thermal conductivity, characterised in that one portion of higher thermal conductivity comprises a mesh (2) of strip or strands while a further wall portion of lower thermal conductivity constitutes a closure layer (3, 4), said mesh (2) having transverse extent so as to extend across the depth of the wall member (1) to or substantially to an outer surface thereof whereby said mesh (2) conducts heat from the outer surface of the wall member.
2. A heat transfer element as claimed in Claim 1, characterised in that, the mesh (2) comprises high thermal conductivity metal.
3. A heat transfer element as claimed in Claim 3, characterised in that the metal is copper, aluminium, nickel or bronze.
4. A heat transfer element as claimed in any one of the preceding claims, characterised in that the closure layer (3) comprises a plastics material.
5. A heat transfer element as claimed in Claim 4, characterised in that the plastics material is a urethane.
6. A heat transfer element as claimed in any one of the preceding claims, characterised in that the mesh (2) is in

the form of a woven mesh (Figs. 1 to 3).

7. A heat transfer element as claimed in any one of claims 1 to 5, characterised in that the mesh (2) is a plain cross-laid mesh (Figs. 5, 6).

5 8. A heat transfer element as claimed in any one of the preceding claims characterised in that the closure layer (3) constitutes a core layer and the mesh (2) is embedded therein (Figs. 1 and 2).

9. A heat transfer element as claimed in Claim 8, character-
10 ised in that a covering layer (4) is applied to at least one side of the core layer.

10. A heat transfer element as claimed in Claim 9, characterised in that the covering layer (4) is porous.

11. A heat transfer element as claimed in any one of Claims
15 1 to 7, characterised in that the closure layer (3) constitutes a filler layer closing the spaces in the mesh (2), the mesh (2) projecting laterally from at least one side of the filler layer to present good heat conducting surfaces.

12. A heat exchange panel comprising a composite wall
20 structure characterised in that a heat conducting mesh core (2 Fig. 3) is bounded on either side by closure layers (4A, 4B), the mesh core (2) permitting longitudinal fluid flow therein between the closure layers (4A, 4B).

13. A panel as claimed in Claim 12, characterised in that
25 the mesh core (2) comprises a woven mesh.

14. A panel as claimed in Claim 12, characterised in that one of the closure layers (4A) is absorbent to radiant energy to enable the panel to be used as a solar energy panel.

Fig. 1.

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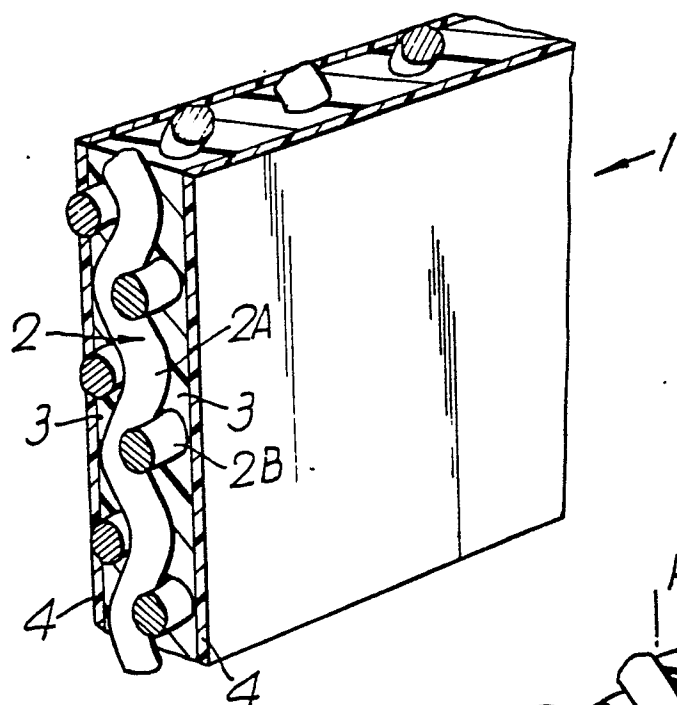


Fig. 2.

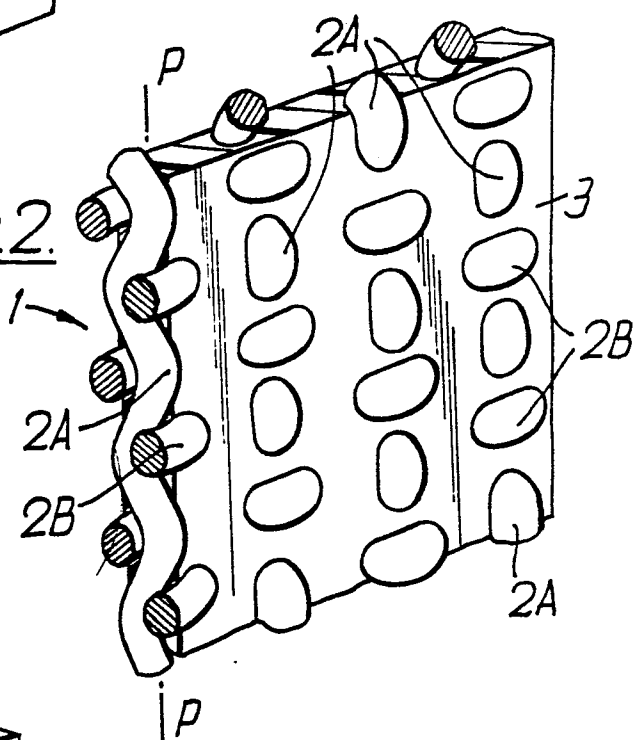


Fig. 3.

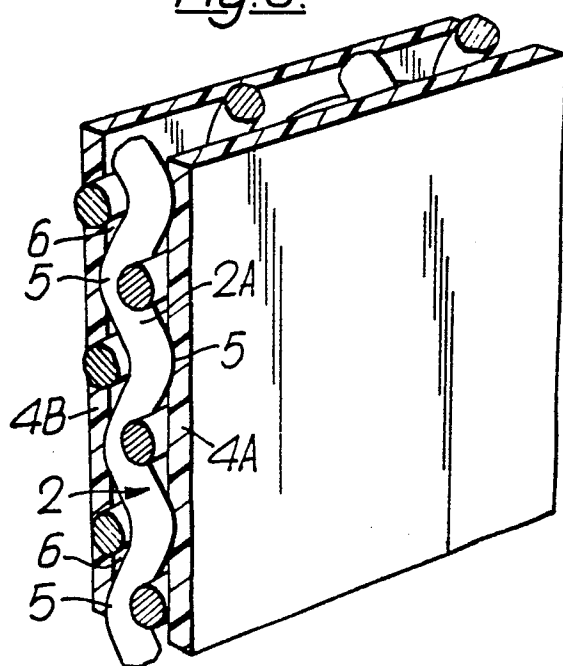


Fig.4.

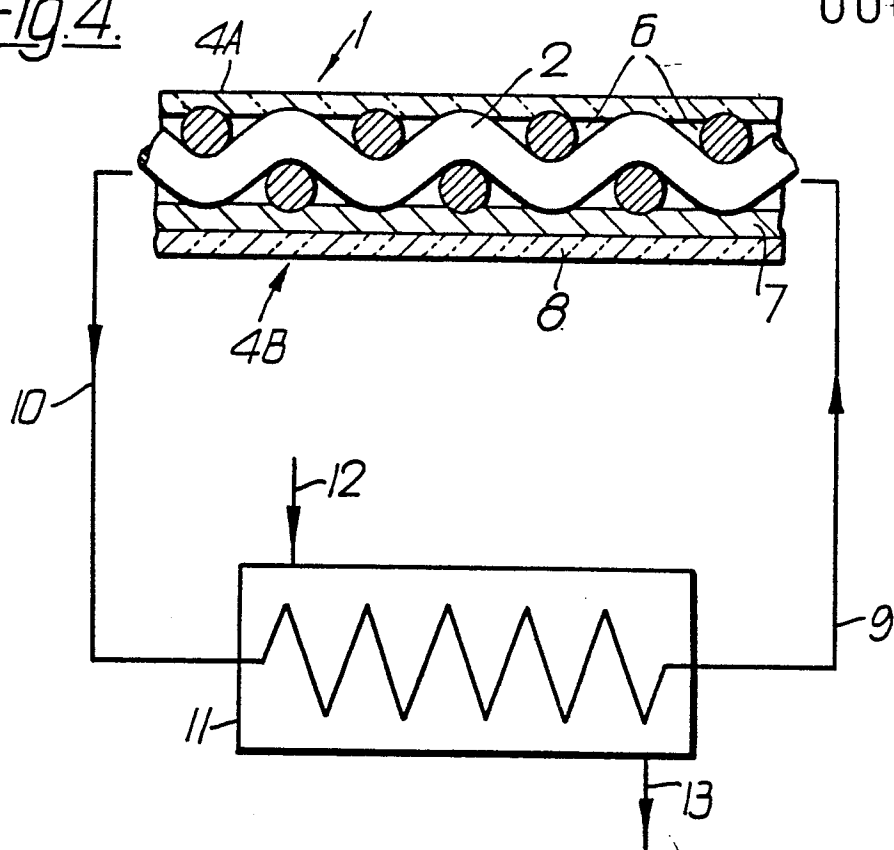


Fig.5.

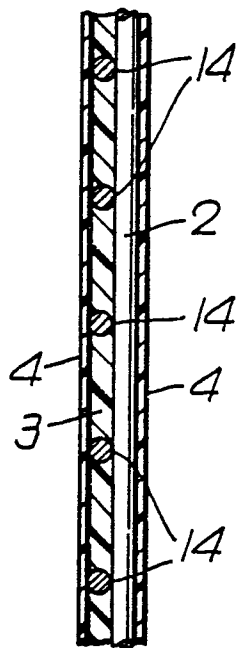
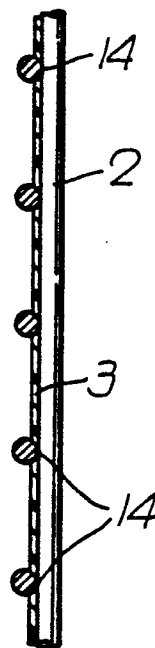


Fig.6.





European Patent
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EUROPEAN SEARCH REPORT

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Application number
EP 78 30 0274

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ²)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	<u>US - A - 3 825 063 (COWANS)</u> * Columns 3-6; figures 1-4,6,9,10,11 *	1-4, 11,12	F 28 F 21/00 F 24 J 3/02
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	<u>GB - A - 1 302 516 (UKAEA)</u> * Pages 2,3; figures 1-3 *	1	
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	<u>GB - A - 656 811 (BATA)</u> * Pages 1,2; figures 1,2 *	8	TECHNICAL FIELDS SEARCHED (Int.Cl. ²)
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	<u>US - A - 3 236 294 (THOMASON)</u> * Column 2, lines 35-72; figure 6 *	12	F 28 F C 02 B F 24 J

			CATEGORY OF CITED DOCUMENTS
			X: 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
			&: member of the same patent family, corresponding document
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	16-11-1978	SMETS	