

- [54] **MECHANISM AND METHOD FOR PROVIDING INTRA-CELL THERMAL RESISTANCE IN HONEYCOMB PANEL CORES**
- [75] Inventor: **Ronald J. Scanlon**, Imperial Beach, Calif.
- [73] Assignee: **Rohr Corporation**, San Diego, Calif.
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Related U.S. Application Data

- [63] Continuation of Ser. No. 43,023, June 3, 1970, abandoned.
- [52] U.S. Cl. **52/615, 52/407, 52/404**
- [51] Int. Cl. **E04c 2/36**
- [58] Field of Search **52/618, 615, 406, 407**

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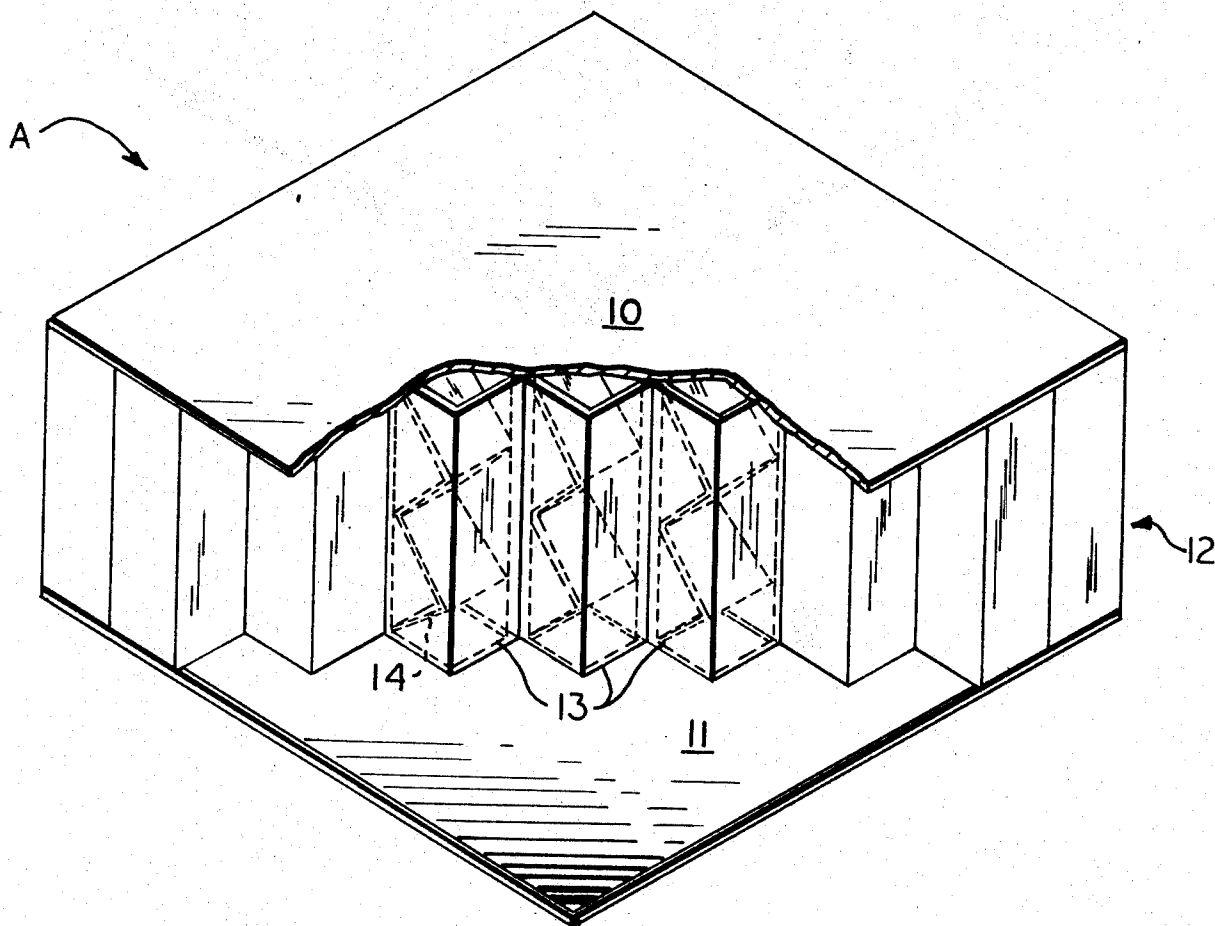
Primary Examiner—John E. Murtagh

Assistant Examiner—H. E. Raduazo

[57] **ABSTRACT**

The individual cells of the core of a honeycomb panel have inserted therein spaced, transversely extending layers of foil which act as barriers to the transfer of radiant heat through the cells. In a preferred form of the invention these transverse layers are all portions of a single zig-zag or reversely bent strip.

2 Claims, 5 Drawing Figures



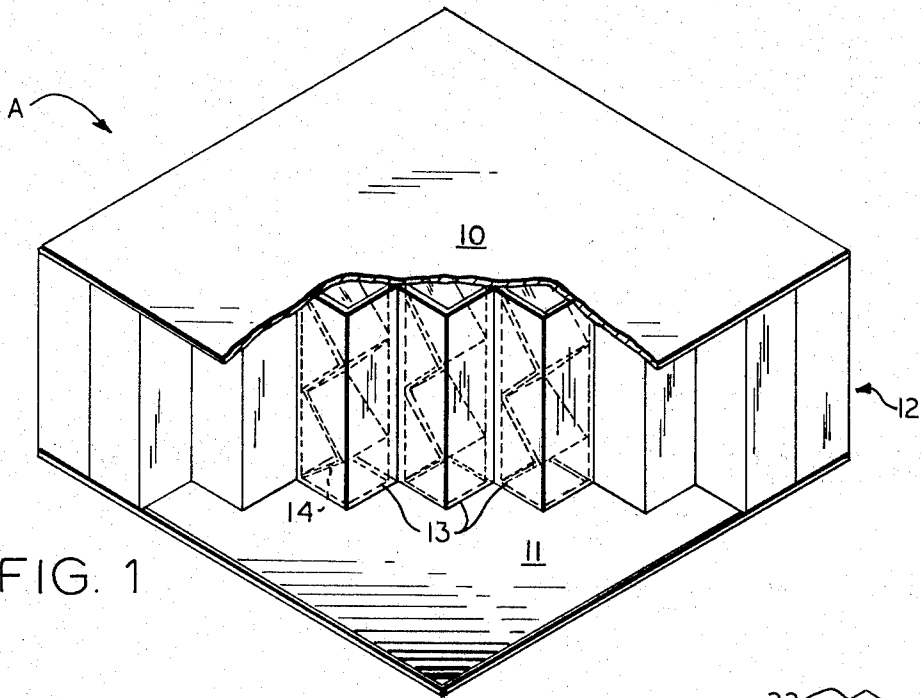


FIG. 1

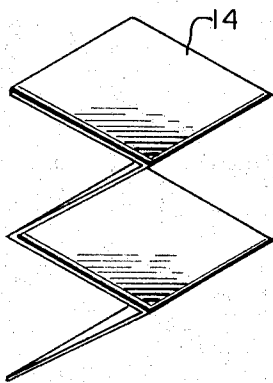


FIG. 2

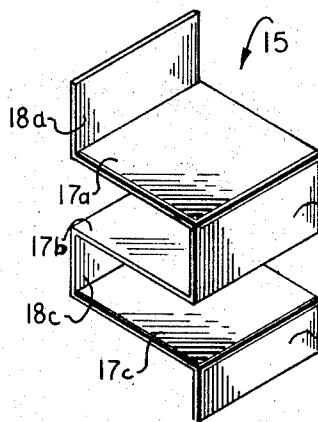


FIG. 3

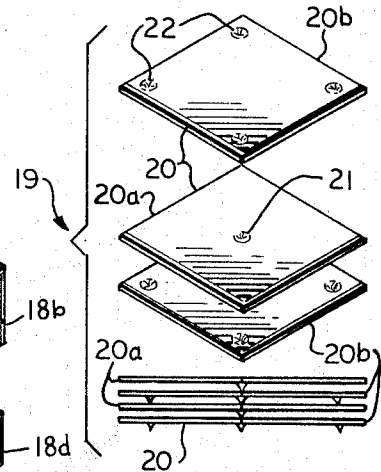


FIG. 4

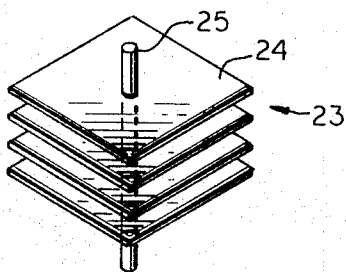


FIG. 5

INVENTOR
RONALD J. SCANLON

BY

George E. Pearson
ATTORNEY

MECHANISM AND METHOD FOR PROVIDING INTRA-CELL THERMAL RESISTANCE IN HONEYCOMB PANEL CORES

This is a continuation, of application Ser. No. 43,023, filed 6/3/70, and now abandoned.

BACKGROUND OF THE INVENTION

In comparatively recent years the use of honeycomb panels has increased greatly. These panels have tremendous strength and stiffness for their weight, as well as other desirable characteristics, and have had wide application where a low weight-to-strength ratio is required, particularly in the aircraft and aerospace industries.

Since the core of a honeycomb panel is ordinarily of extremely thin sheet material, the cell walls provide very low heat conductance from one facing sheet of the panel to the other. Also, convection flow within the core cells is not an important source of such heat transfer, even when final assembly of the parts is not performed under vacuum. While there is little radiation through the core cells from one facing sheet to the other at low temperatures, when the temperature of the hotter side of the panel is of the order of 1,000°F. or more, such radiation becomes the principal source of such heat transfer.

The principle of radiation heat shielding between two parallel, spaced, surfaces of different temperatures by the interposition of a spaced shielding sheet therebetween is well known. Without entering into the technical details of the matter, a single sheet so interposed cuts the radiant heat transfer substantially in half, while each additional sheet so interposed still further reduces radiant heat transfer between such surfaces. An additional factor of the foregoing general principle is that the lower the heat emissivity of such interposed sheet or sheets, the more effective is its bar to radiant heat transfer.

SUMMARY OF THE INVENTION

It is a primary objective of the present invention to increase the thermal resistance of a honeycomb panel by providing a heat barrier in the form of one or more transversely extending layers of light, thin, heat shielding material within each of the cells of the honeycomb core of a honeycomb panel. A further objective of the invention is to provide such a heat barrier by reversely bending thin strips of light sheet material and inserting one of these bent strips in fitted relation into each cell of the honeycomb core of a honeycomb panel.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objectives and advantages of the invention will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a perspective view of a fragment of square cell honey comb panel embodying the invention, portions being broken away.

FIG. 2 is an enlarged, perspective view showing a zig-zag heat shield insert of the type embodied in the panel of FIG. 1.

FIG. 3 is a similarly enlarged perspective view of a modified form of heat shield.

FIG. 4 is a similarly enlarged view in side elevation of a stacked type of heat shield for inserting in a cell of a honeycomb core, the upper three sheets being tilted and raised upwardly to show their structure.

FIG. 5 is a similarly enlarged perspective view of a further modified form of stacked heat shield insert.

DETAILED DESCRIPTION

Referring to the drawings in detail, FIG. 1 illustrates a fragment of a well known type of honeycomb panel A comprising parallel, spaced apart facing sheets 10 and 11, attached by suitable means such as brazing, welding, diffusion bonding or adhesion, to opposite ends of a square cell type honeycomb cone 12.

Fitted snugly into each cell 13 of the cone 12 is a zig-zag bent insert 14 formed by the zig-zag bending of a strip of thin, suitable sheet material, preferably metal foil, of a metal capable of withstanding without melting, substantial softening, or contamination of the panel A, the maximum temperature to which the panel is to be exposed, either during attachment of the facing sheets 10 and 11 to the core 12, or in subsequent use.

Honeycomb cones vary widely in the cross sectional configuration of their cells, for example, square, triangular, hexagonal, etc. Obviously therefore each cell insert will be so shaped that the transversely extending portions thereof fit as snugly as practicable within its respective cell so as to intercept a maximum amount of radiant heat rays emanating from the hotter of the facing sheets 10 and 11 toward the other. Since such shaping of the inserts is well within the capabilities of any routine worker familiar with honeycomb panel manufacture, such alternate shapes for different types of core cells are omitted.

In the modified form of the invention shown in FIG. 3, an insert 15 is formed by bending a strip of suitable material in square, zig-zag manner so that portion 17a, 17b and 17c thereof extend transversely across a cell of a honeycomb core, such as the cell 13 of FIG. 1, into which the insert 15 is fitted, while the other positions 18b, 18c and 18d of the insert 15 extend along the walls of such cell to position and support the insert 15 therein.

In FIG. 4 a cell insert 19 comprises a plurality of individual sheets 20 of suitable material, such as foil, each sheet being of a size and shape to fit into the cells of a honeycomb core, such as the core 12 of FIG. 1. Alternate ones 20a of these sheets have spacing elements in the form of center dimples 21 formed thereon, while the intermediate sheets 20b have corner dimples 22 formed thereon. These sheets 20a and 20b are stacked in alternate order as shown in the lower portion of FIG. 4, and a stack of the spaced sheets which comprise an insert 19 is fitted within each cell of a honeycomb core in which the invention is to be embodied in the same general manner as described previously herein for the forms of the invention shown in FIGS. 1 - 3.

In FIG. 5, an insert 23 comprises one or more sheets 24 of selected sheet material strung in selected, spaced relation, on a central support wire 25 for similar fitted insertion into each cell of a honeycomb core such as that shown in FIG. 1.

OPERATION

Honeycomb panels embodying the invention may be used in numerous applications, particularly in the fields of aviation and aerospace. For example, in a jet engine tailpipe the use of honeycomb panels embodying the invention will reduce external temperature of the tailpipe and thereby reduce radiation to external heat sensitive structures or components. Also, in supersonic air-

craft, space shuttles, space modules and re-entry capsules the material can be used to reduce heat transfer-
ence between the outer and inner skins of the vehicle.
Also, extremely light, non-structural honeycomb panel
embodying the invention can be used to shield person-
nel, structures, or components from a radiant heat
source, for example, to shield a person's body, heat
sensitive instruments, etc., from a source of radiant
heat such as a blast furnace.

The invention provides light weight insulation which
is integral with the honeycomb panel structure in which
it is embodied, its presence does not reduce the struc-
tural strength of the panel in which it is embodied, and
it lends itself to manufacture by automatic machinery.

Having thus described my invention, what I claim as
new and useful and desire to protect by U. S. Letters
Patent is:

1. An insulative honeycomb panel comprising
a honeycomb core having a multiplicity of individual
cells,
a heat insulative insert comprising a plurality of lay-
ers of thin sheet material fitted into, and extending
transversely across the interior of each of a se-

lected plurality of the cone cells intermediately of
the ends of the core,

positioning means including spacing means disposed
between adjacent ones of said layers and maintain-
ing the layers of each insert in complete spaced re-
lation with each other,

a facing sheet applied to each end of the core and se-
cured thereto, and

said positioning means being in supporting relation
with at least one transverse layer of said plurality of
layers of thin sheet material and extending there-
from into supported relation with the facing sheet
on each end of a core cell into which such insert is
inserted.

2. An insulative honeycomb panel as claimed in
claim 1 wherein the positioning means comprises a wire
extending through aligned holes provided one in each
of the layers of thin sheet material inserted in each core
cell, said wire being secured in positioning relation to
each of said layers and extending endwise of the cell
into supported engagement with both facing sheets to
prevent endwise displacement of said layers of thin,
sheet material.

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