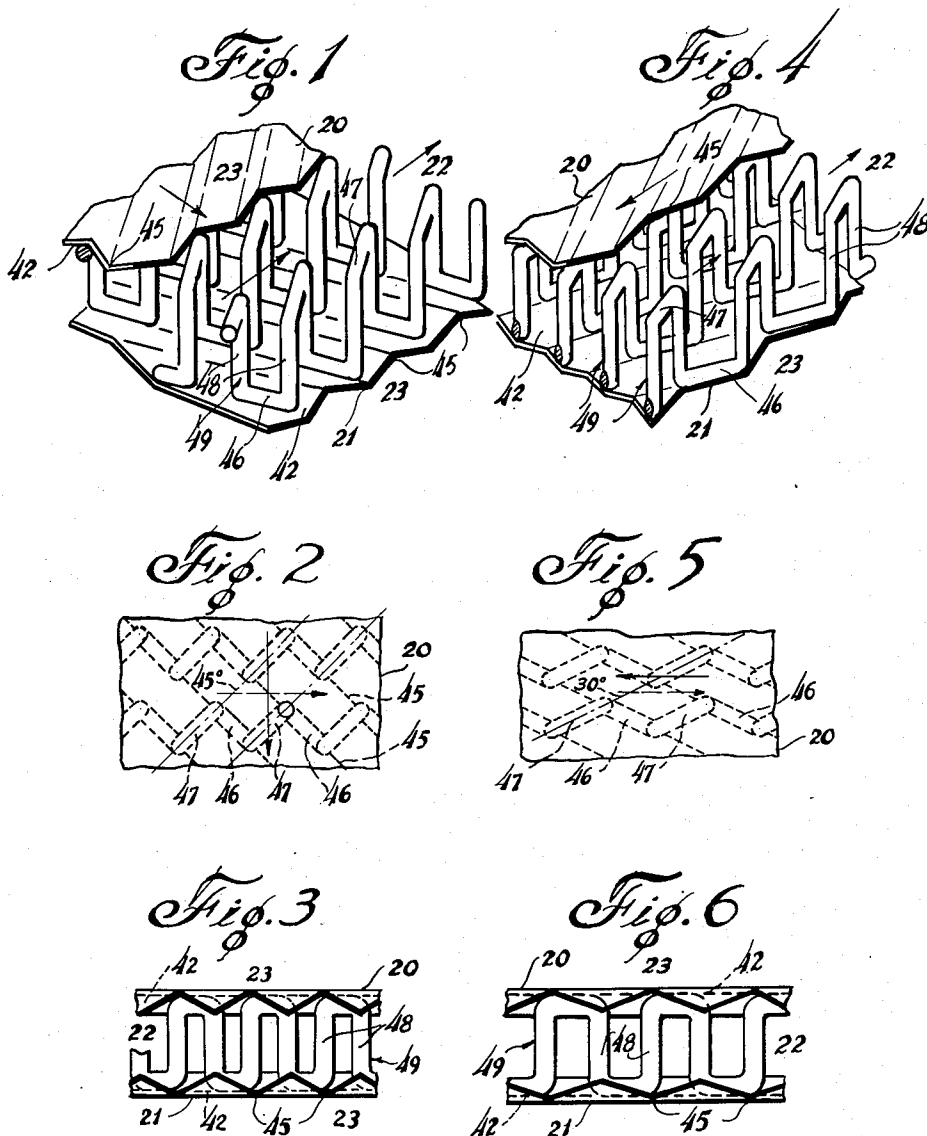


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SINUOUS WIRE ELEMENT AS EXTENDED SURFACE
ON UNDULATED HEAT EXCHANGER PLATE WALL
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SINUOUS WIRE ELEMENT AS EXTENDED
SURFACE ON UNDULATED HEAT EX-
CHANGER PLATE WALLSven Holm and Arthur Jensen, Wellsville, N. Y.,
assignors to The Air Preheater Corporation,
New York, N. Y.Original application June 3, 1947, Serial No.
752,008, now Patent No. 2,595,457, dated May
6, 1952. Divided and this application October
23, 1951, Serial No. 252,602

3 Claims. (Cl. 257--256)

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This invention relates particularly to improve-
ments in extended surface for heat exchange ap-
paratus in the form of pin-like fins projecting
from plate surfaces into the path of the heating
gases and constituted by parts of specially formed
wire elements attached to the plates.

A heat exchanger capable of transferring large
quantities of heat between a gas and air or the
like, as in a gas turbine plant, becomes a rather
bulky piece of equipment if designed as a shell
and tube type heat exchanger. A plate type
exchanger might occupy less space but even
when provided with conventional finned sur-
faces of types heretofore employed it would still
be undesirably large.

To attain a really compact heat exchanger
design it is desirable to have heat absorbing
surface in contact with each fluid of at least
100 sq. ft. per cubic foot of volume by utilizing
extended surface. The present invention con-
templated a form of extended surface wherein
the passage bounding plates are provided with
a myriad of small diameter fins in the form of
studs or pins which are part of the convolutions
of wire coils attached to the plates. To attain
the high performance required in a gas turbine
plant the diameter of the pin-fins we utilize is
in the order of .02 to .125 inch and the passage
forming plates have thicknesses of around a
quarter to one half the fin diameter.

An object of the invention is to provide an
improved form of pin-fin extended surface for
use in a heat exchanger.

Other objects and advantages of the invention
will become apparent upon consideration of the
following detailed description of illustrative em-
bodiments of the invention when read in con-
junction with the accompanying drawings in
which:

Figures 1 and 4 are fragmentary perspective
views of a small part of a plate type heat ex-
changer illustrating extended surface made up
of specially formed wire elements each attached
to the heat exchange surfaces at a multiplicity of
points and in good heat conducting relationship
therewith.

Figures 2 and 5 are partial plan views and
Figures 3 and 6 are fragmentary sectional views
corresponding to Figs. 1 and 4 respectively.

Referring now to the drawings, the heat ex-
changer consists of a series of metallic plates
20, 21, spaced to form gas and air passages 22
and 23 disposed in alternating arrangement. As
customary in plate type heat exchangers the
sides of the gas and air passages are suitably

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closed, as by providing fillers or joining the
edge portions of adjacent plates in alternation
along their side and end edges. In accordance
with the present invention, there are located in
the gas passages 22 and secured to the gas side
of the plates 20, 21, a plurality of heat exchange
elements designated as a whole by the numeral
49. Each element 49 consists of a continuous
length of sinusoidally bent wire having a plu-
rality of zig-zag bends or loops or roughly U-
shape and formed into a coil.

The fin elements to be described all consist
essentially of wires with zig-zags or bends therein
and, as illustrated in Figures 1 and 4, consist
of wires which have been formed so that the
successive loop or bend is disposed parallel with
loops contiguous thereto. The stretchers or yokes
46, 47 that connect the legs 48 at the top and
bottom of the loops are in contact with and
bonded to the plates 20, 21 respectively, that
constitute opposite walls of a gas passage.

In the construction illustrated a further in-
crease in the amount of heat exchange surface is
attained first by corrugating the wall plates 20,
21 which obviously increases their area and sec-
ondly, by fastening the wire elements 49 in the
bases of the grooves 42 of the corrugated plates
so that a closer spacing of elements may be pro-
vided. Since the form shown utilizes plates with
corrugations of the same radius as the wire which
is brazed or seam welded thereto it therefore does
not necessarily require a flattened-out portion
on the wire because a sufficient area of contact
is obtained between the surface of the wire and
the groove of like radius in the plate.

In Figures 1 to 3 the plates 20, 21 are undulated
as mentioned and opposite walls of the passages
have the axes of their undulations 45 disposed
oppositely or crossing to increase the turbulence
along their surfaces so as to break up the bound-
ary layer or film. The successive yokes 46, 47
of each wire element 49 are located at approxi-
mately 90° with respect to each other so that
they may be brazed or welded in the valleys of
the undulations in the plates forming opposite
walls of the passage in which they are located.

In Figures 4 to 6 the angles between the yokes
are greater so that for counterflow of the two
fluids the angles (about 30°) of the yokes with
respect to the direction of flow is lessened so as
to obtain maximum heat transfer and maintain
a low pressure drop.

The constructions described are of particular
utility in gas turbine cycles wherein heat is to
be abstracted from the gases at low pressure and

having a low density and low mass velocity. Because of such conditions it is important that the flow be well broken up on the gas side and the pin-like fins formed by the wire strips constitute a most efficient heating surface because the gas film is constantly broken up by them.

Heat exchangers embodying pin-fin extended surface in accordance with the invention may readily be adapted for transferring heat between various fluids because the ratio of the heat transfer surface contacted by a fluid flowing on one side of an intervening passage wall to the amount of surface on the other side of the wall and in contact with the other fluid may readily vary to suit conditions imposed by the particular fluids.

Although specific embodiments of the invention have been described in detail herein many changes and variations may be made without departing from the essentials of the invention and, therefore, it is desired and intended that all such changes and variations be included within the scope of the following claims.

This is a division of the application filed in our name under Serial No. 752,008, on June 3, 1947; now Patent No. 2,595,457, granted May 6, 1952.

What is claimed is:

1. In a heat exchanger having a metallic plate constituting a fluid passage wall through which heat is conducted and formed with parallel undulations extending at an angle to the direction of fluid flow along said wall; heat exchange fins projecting from said wall each consisting of an individual metallic wire of uniform cross-section bent in sinusoidal form to provide a plurality of alternately upright and inverted substantially U-shaped loops therein with leg portions extending in upright relation from said wall and with intervening stretcher or yoke portions of alternate loops bent to extend parallel to each other so that the yoke portions of said alternate U-loops fit into the dwells of the undulations in the wall of said passage; and good heat transfer bonds between said stretcher portions of said loops and said wall plate.

2. In a heat exchanger having a pair of parallelly undulated metallic plates spaced apart as walls of a fluid passage through which heat is conducted and disposed so that the undulations on plates constituting opposite walls of the passage extend at an angle to each other and to the

direction of fluid flow through said passage; and heat exchange fins bonded to said walls each consisting of an individual metallic wire of uniform cross-section bent in sinusoidal form to provide a plurality of alternately upright and inverted substantially U-shaped loops therein with leg portions extending as fins from said walls with intervening stretcher or yoke portions that connect leg portions of said U-loops that are contiguous along the axis of each wire contacting said plates over their length and being bent to extend at angles with respect to stretcher portions contiguous thereto along said wire that correspond to the relative angularity of the undulations in said plates so that the yoke portions of the contiguous U-loops fit into the dwells of the undulations in the opposite plate-walls that bound said passage.

3. In a heat exchanger having a metallic plate constituting a fluid passage wall through which heat is conducted and formed with parallel undulations extending at an angle to the direction of fluid flow along said wall; heat exchange fins bonded to said walls each consisting of an individual metallic wire of uniform cross-section bent in substantially sinusoidal form to provide a plurality of alternately upright and inverted substantially U-shaped loops therein with leg portions extending in upright relation from said wall as fins with intervening stretcher portions that connect leg portions of said U-loops that are contiguous along the axis of each wire being bent in the alternate loops to extend parallel with each other and at angles with respect to the direction of fluid flow in said passage that correspond to the angularity of the undulations in said plates with respect to the direction of fluid flow so that the stretcher portions of said alternate U-loops fit into the dwells of the undulations in said plate-wall that bounds said passage.

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