

Clarke, Modet & C^o
COLOMBIA

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISION DE NUEVAS CREACIONES
E. S. D.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 04-109305-00006-0000

Fecha: 2008-05-13 15:40:39 Dep. 2020 NUECREACIONES
Tra. 2 PATENTES Eve: 1 REGDEPOSITO
Act. 444 RESPUESTAREQUE Folios: 12

Re: Expediente No. 04-109.305
Solicitud de patente a nombre de **BRAZEWAY, INC.**

Yo, DILIA MARIA RODRIGUEZ D'ALEMAN identificada como aparece al pie de mi firma, domiciliada en la carrera 11 A No. 86-53, piso 6, obrando como apoderada de la sociedad **BRAZEWAY, INC.** domiciliada en Michigan, Estados Unidos de América, solicitante de la patente de la referencia, en respuesta al oficio No. 2211 notificado por fijación en lista el 14 de febrero de 2008, relacionado con el concepto técnico de fondo No. 242, me permito manifestar:

1. Con fundamento en la facultad que confiere el artículo 34 de la Decisión 486 al solicitante para modificar la solicitud de patente en cualquier momento del trámite, presento junto con este memorial nuevo capítulo reivindicatorio en el cual se realizan las modificaciones más abajo enunciadas.
 - 1.1 Se incorporaron números de referencia a todas las reivindicaciones de acuerdo con los componentes del dispositivo que aparece a lo largo de las figuras 1 a 9, de modo que se proporciona claridad a la solicitud.
 - 1.2 Se eliminó la característica de la reivindicación 1 donde se mencionada que la aleta universal es "para uso en una aleta".
 - 1.3 Se modificó el objeto reclamado en la nueva reivindicación 10 a un "intercambiador de calor", de modo que esta reivindicación ahora depende de aquellas que la preceden.
 - 1.4 Se modificó el método de la reivindicación 19, de modo que se menciona el paso de separar la aleta que se describió previamente en las reivindicaciones 1 a 9.

En cuanto a estas modificaciones me permito decir que las mismas no amplían de ninguna manera la materia objeto de la presente solicitud y se realizaron con el ánimo de superar las objeciones de claridad planteadas por el examinador en su concepto técnico.

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Para este efecto, me permito acompañar el recibo de pago con el cual queda cubierta la tasa correspondiente a la modificación de una solicitud de patente en cuanto a su capítulo reivindicatorio.

2. Claridad de la solicitud

Respecto a este punto me permito decir que mediante las modificaciones realizadas en el capítulo reivindicatorio queda subsanada la totalidad de las objeciones planteadas por el examinador en su concepto técnico.

Ahora bien, es deseo del manifestante aclarar que de acuerdo con las modificaciones mencionadas anteriormente, se redujo el número de reivindicaciones independientes, obteniendo únicamente una reivindicación independiente (1) donde se reclama una aleta universal, y a partir de ésta se obtiene el intercambiador de calor de la nueva reivindicación 10 y el método de la reivindicación 19.

Adicionalmente, con respecto al método de la reivindicación 19, éste se encuentra caracterizado por un conjunto de pasos o etapas las cuales son "(a) separar al menos una aleta (28)" y "(b) posicionar dicha aleta (28)" y lo que se desea obtener por medio de este método es una aleta que se encuentra en un intercambiador de calor, que es el producto, por lo tanto no se está haciendo alusión únicamente a las características físicas de dicho intercambiador, tal y como lo establece el examinador en su concepto técnico, sino que por el contrario se está describiendo el método para obtener el intercambiador utilizando la aleta descrita en las nuevas reivindicaciones 1 a 9.

3. Nivel Inventivo

El examinador establece en su concepto técnico que las reivindicaciones 1 a 30 de la presente solicitud carecen de altura inventiva a la luz del documento GB 2014483 (D1). En este sentido, es deseo del solicitante argumentar la presente invención presenta un número de ventajas sobre el arte previo dentro de las cuales se encuentra el tener secciones de tubo completas y aberturas inclinadas.

En este sentido, el documento D1 divulga tubos que no son completos y que únicamente tienen un borde redondeado por porción de tubo, lo que hace que el extremo de cada porción de tubo deba estar unido con un conector. Esta característica se puede ver claramente en las figuras 2 y 3, donde se ve que los extremos 34 y 36 son redondeados, lo que significa que hay una continuidad en la sección de tubo, mientras que el otro extremo (A-F) es recto, lo que quiere decir

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que la sección termina allí y se tienen diferentes secciones de tubo. Así, cada una de estas uniones se considera en el medio de la fabricación de intercambiadores de calor como una desventaja del dispositivo, ya que representa una posible trayectoria de fuga.

En contraste, las secciones de tubo completas divulgadas a lo largo de la presente solicitud no tienen uniones que puedan ser consideradas como una fuga, y por lo tanto las probabilidades de tener filtraciones o grietas disminuyen significativamente, lo que al final se ve representado en un producto de una calidad mucho mayor con transferencia de calor más eficiente. Esta sección de tubo (30) es mostrada de forma clara en la figura 2 de la presente solicitud, donde se puede ver que no hay uniones como las mostradas en la invención del documento D1.

Adicionalmente, la unión de cada extremo de tubo que se describe en el documento D1, representa un aumento en los costos, ya que además hay que incluir la fabricación de un doblez o un conector, y es necesario también tener un material de llenado de la unión que puede ser soldadura y un procedimiento para crear dichas uniones.

Además, se dirige la atención del examinador al hecho que las aberturas inclinadas de la presente invención permiten que más tubos sean incluidos en un tamaño determinado de un intercambiador de calor. Adicionalmente, las aberturas inclinadas crean un patrón de tubo que es más conductivo a la hora de mezclar el aire, lo que incrementa la transferencia de calor.

En resumen, me permito decir que gracias a las modificaciones expuestas en el punto 1 de este memorial y los argumentos anteriormente mencionados, la presente solicitud cumple cabalmente con los requisitos de claridad y nivel inventivo respecto al dispositivo y método expuestos en el capítulo reivindicatorio. Por lo tanto, solicito comedidamente a ese despacho se sirva reconocer estos requisitos y conceder el privilegio de patente de invención a la solicitud en estudio.

Señor Superintendente,


DILIA MARIA RODRIGUEZ D'ALEMAN
CC. 41.654.882
TP 20824 CSJ



163/163

FORMULARIO ÚNICO DE CORRECCIONES Y MODIFICACIONES

SOLICITUD DE:

1

☐ Corrección de error material

☒ Modificación a una solicitud.

2
SOLICITANTE
(71)

Nombre: BRAZEWAY, INC.
Dirección: 2711 East Maumee Street Adrian,
Michigan 49221 Estados Unidos de América
Nacionalidad o domicilio: Adrian, Michigan,
Estados Unidos
Lugar de Constitución: Michigan, Estados Unidos

Teléfono:

Fax:

E-mail

IDENTIFICACIÓN

C.C.

☒

NIT

☐

C.E.

☐

Otro

☐

Cual

Número

3
**REPRESENTANTE
O APODERADO**
(74)

Nombre: DILIA MARÍA RODRÍGUEZ
D'ALEMAN
Dirección: Carrera 11 No. 86-53, piso 6
Teléfono: 6 181088 Fax: 6350824
E-mail: clarkemodet@clarkemodet.com.co

IDENTIFICACIÓN

C.C.

☒

NIT

☐

C.E.

☐

Otro

☐

Cual

Número 41.654.882

TP 20824 CSJ

4 Número del expediente: 04-109.305

5 Descripción de la corrección o modificación solicitada: Que se anote: Se presenta nuevo capítulo reivindicatorio.

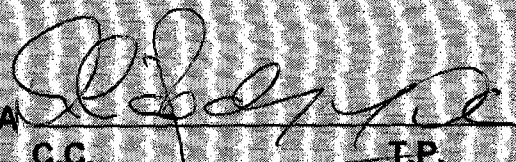
Comprobante de pago No. 08-35,530 de 6 de mayo de 2008

7 Anexos:

- ☒ Comprobante de pago de la tasa
- ☐ Poderes si fuese el caso
- ☐ Documento que acredita la existencia y representación legal de las partes, cuando sean personas jurídicas.

8

NOBRE DILIA RODRIGUEZ D'ALEMAN

FIRMA 
C.C. T.P.

164 164

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 08 - 35,530
FECHA : MAYO 6 DE 2008

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 04-109305- -00006-0000

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***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
CLARKE MODET Y CO. COLOMB	CONSIGNACION	BANCO DE BOGOTA	062754387	693055	06/05/2008	14,897,000.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-03	CAMBIO DE MODALIDAD Y MODIFICA	12 MARCAS Y LENAS COMERCIALES
		TOTAL :	\$ 103,000.00

SON: CIENTO TRES MIL PESOS

RESPONSABLE :

P. 592

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

REIVINDICACIONES

1. Una aleta universal (20) para un intercambiador de calor de tubo, la aleta universal caracterizada porque comprende:

una lámina (52) de material conductor de calor configurada para ser separada para formar una o más aletas (28) para uso en la aleta (28) sobre el intercambiador de calor de tubo (32) con respecto a un número de pares verticales y horizontales de segmentos de tubo en dicho intercambiador de calor (32), dicha lámina tiene un ancho (W) y un largo (H); y

una pluralidad de aberturas (22) en dicha lámina (52), cada una de dichas aberturas (22) configurada para permitir un par de segmentos de tubo (34) paralelos del intercambiador de calor (32) para pasar a través de estos, dichas aberturas (22) son relativamente inclinadas a dicho ancho (W) y largo (H) de dicha lámina (52), dichas aberturas (22) están dispuestas sobre dicha lámina (52) en una pluralidad de filas (26) y una pluralidad de columnas (24) con filas adyacentes (26) que están espaciadas generalmente iguales aparte y columnas adyacentes (24) que están generalmente espaciadas iguales aparte, y dicho espacio entre las filas adyacentes (26) y las columnas adyacentes (24) está dimensionado para permitir que dicha lámina (52) sea separada entre al menos una de dichas filas adyacentes (26) y dichas columnas adyacentes (24) para formar una o más aletas (28) cada una de las cuales contiene una pluralidad de aberturas (22) al menos igual a un número total de pares de segmentos de tubo en el intercambiador de calor (32).

2. La aleta universal (20) de la reivindicación 1, caracterizada porque dichas aberturas (22) son aberturas alargadas con cada abertura opuesta que tiene porciones de extremo (46) interconectadas por una porción central (48).

3. La aleta universal (20) de la reivindicación 2, caracterizada porque dichas aberturas (22) tienen forma de hueso de perro.

4. La aleta universal (20) de la reivindicación 1, caracterizada porque comprende además signos (51) en dicha lámina que indican ubicaciones en donde dicha lámina (52) puede ser separada para formar dichas aletas (28), dicho signo (51) se extiende a lo largo de dicha lámina (52) entre al menos una de dichas columnas (24) y dichas filas (26).

5. La aleta universal (20) de la reivindicación 4, caracterizada porque dicho signo (51) son perforaciones en dicha lámina.

6. La aleta universal (20) de la reivindicación 1, caracterizada porque dichas columnas (24) están espaciadas aparte de tal forma que una porción de dichas aberturas (22) en una de dichas columnas (24) traslapa una porción de dichas aberturas en una columna adyacente (24').

7. La aleta universal (20) de la reivindicación 6, caracterizada porque dichas columnas adyacentes (24') cuando son separadas tienen un borde ondulado.

8. La aleta universal (20) de la reivindicación 1, caracterizada porque dicho espacio entre las filas adyacentes (26) es generalmente igual a dicho espacio entre las columnas adyacentes (24).

9. La aleta universal (20) de la reivindicación 1, caracterizada porque cada una de dichas aberturas (22) es generalmente idéntica.

10. Un intercambiador de calor (32), caracterizado porque comprende:

una porción de tubo (30) que tiene una pluralidad de segmentos rectos (34) de tubos interconectados por una pluralidad de segmentos de conexión (36) de tubo con cada segmento de conexión (36) que interconecta dos segmentos rectos (34), dichos segmentos rectos (34) y de conexión (36) están dispuestos en una configuración sinuosa, dicha porción de tubo (30) tiene una cantidad conocida de pares verticales y horizontales de pasajes de tubo (38); y

al menos una aleta sobre dicha porción de tubo, de acuerdo con cualquiera de las reivindicaciones precedentes,

en donde dicha aleta (28) tiene una cantidad de dichas aberturas (22) al menos igual a dicho número de pares de pasajes de tubo (38) en dicha porción de tubo (30) y dicha aleta (28) está dispuesta en dicha porción de tubo (30) con cada par de pasajes de tubo (38) de dicha porción de tubo (30) que pasa a través de una de dichas aberturas (22) en dicha aleta (28).

11. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dicha porción de tubo (30) es un tubo continuo sencillo (42).

12. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dicha al menos una aleta (28) es una de una pluralidad de aletas (28) y dicha pluralidad de aletas (28) está alineada en una configuración paralela con dichas aberturas (22) en dichas aletas (28) que están alineadas para formar un banco de aletas (50) que está dispuesto sobre dicha porción de tubo (30).

13. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dicha porción de tubo (30) tiene más pasajes de tubo (38) verticales que pasajes

de tubo (38) horizontales.

14. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dicha porción de tubo (30) tiene más pasajes de tubo (38) horizontal que pasajes de tubo (38) vertical.

15. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dichas aberturas (22) en dicha lámina de aleta universal (20) está relativamente inclinada a dicho ancho (W) y dicho alto (H) de dicha lámina de aleta universal.

16. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dicho espacio entre las filas adyacentes (26) es generalmente igual a dicho espacio entre las columnas adyacentes (24).

17. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dichas aberturas (22) en dicha lámina de aleta universal (20) son aberturas alargadas con cada abertura que tiene porciones de extremo (46) opuestas interconectadas por una porción central (48).

18. El intercambiador de calor (32) de la reivindicación 10, caracterizado porque dichas columnas (24) de dicha lámina de aleta universal (20) están espaciadas aparte de tal forma que una porción de dichas aberturas (22) en una de dichas columnas (24) traslapa una porción de dichas aberturas (22) en una columna adyacente (24') y dicha aleta (28') tiene un borde ondulado.

19. Un método para hacer una aleta (28) en un intercambiador de calor (32) de tubo, el método caracterizado porque comprende las etapas de:

(a) separar al menos una aleta (28), de acuerdo con cualquiera de las reivindicaciones 1 a 9; y

(b) posicionar dicha aleta (28) sobre dicha porción de tubo (30) de dicho intercambiador de calor (32) con pares de pasajes de tubo (38) que pasan a través de dichas aberturas (22).

20. El método de la reivindicación 19, caracterizado porque el paso (a) incluye preformar dicha lámina de aleta universal (20) de tal forma que dicha lámina de aleta universal (20) tiene un ancho, un largo y una pluralidad de aberturas (22) con cada abertura (22) configurada para permitir un par de pasajes de tubo (38) del intercambiador de calor (32) para pasar a través de estos, dichas aberturas (22) están dispuestas sobre dicha lámina de aleta universal (20) en una pluralidad de filas (26) y una pluralidad de columnas (24) con filas adyacentes que están espaciadas en forma igual aparte y columnas adyacentes que están espaciadas en forma igual, y dicho espacio entre las filas adyacentes y las columnas adyacentes está dimensionado de tal forma que dichas aletas universales (20) pueden estar separadas entre al menos una de dichas filas adyacentes y columnas adyacentes para formar dicho al menos una aleta con respecto al número de pares horizontales y verticales de pasajes de tubo (38).

21. El método de la reivindicación 20, caracterizado porque preformar dicha lámina de aleta universal (20) incluye colocar señales (51) en dicha lámina de aleta universal (20) entre al menos una de dichas columnas (24) y dichas filas (26), dicha señal (51) indica la ubicación en donde dicha lámina de aleta universal (20) puede ser separada para formar dicha al menos una aleta (28).

22. El método de la reivindicación 21, en donde dicha señal (51) son

perforaciones en dicha aleta universal.

23. El método de la reivindicación 20, en donde (a) incluye estampar por troquelado dicha lámina de aleta universal (20) de una lámina (52) de material conductor de calor.

24. El método de la reivindicación 20, en donde preformar dicha lámina de aleta universal (20) incluye preformar dicha lámina de aleta universal (20) con dicha pluralidad de aberturas (22) relativamente inclinadas a dicho ancho y largo de dicha lámina de aleta universal (20).

25. El método de la reivindicación 19, que comprende además formar una porción de tubo (30) que tiene un número predeterminado de pares verticales y horizontales de pasajes de tubo (38).

26. El método de la reivindicación 25, en donde formar dicha porción de tubo (30) incluye formar dicha porción de tubo con el mayor número de pares horizontales de pasajes de tubo (38) que pares verticales de pasajes de tubo (38).

27. El método de la reivindicación 25, en donde formar dicha porción de tubo (30) incluye formar dicha porción de tubo con un número mayor de pares verticales de pasajes de tubo (38) que pares horizontales de pasajes de tubo (38).

28. El método de la reivindicación 25, en donde formar dicha porción de tubo (30) incluye unir una longitud continua de tubos (42) de tal forma que dichos tubos (42) forman dicha porción de tubo (30).

172,178

United States Patent [19]
Ochiai et al.

[11] **Patent Number:** 4,898,232
[45] **Date of Patent:** Feb. 6, 1990

- [54] **HEAT EXCHANGER AND PROCESS FOR PRODUCING THE SAME**
- [75] **Inventors:** Izumi Ochiai; Masahiro Miyagi; Yoshio Nozawa, all of Tochigi; Yukio Kitayama, deceased, late of Oyama, all of Japan, by Yuko Kitayama, Midori Kitayama, Takahisha Kitayama, successors
- [73] **Assignee:** Hitachi, Ltd., Tokyo, Japan
- [21] **Appl. No.:** 178,610
- [22] **Filed:** Apr. 7, 1988
- [30] **Foreign Application Priority Data**
Apr. 8, 1987 [JP] Japan 62-84711
- [51] **Int. CL⁴** F28D 1/04
- [52] **U.S. CL** 165/151; 29/890.035
- [58] **Field of Search** 165/151, 148; 29/157.3, 29/157 A, 157.3 B

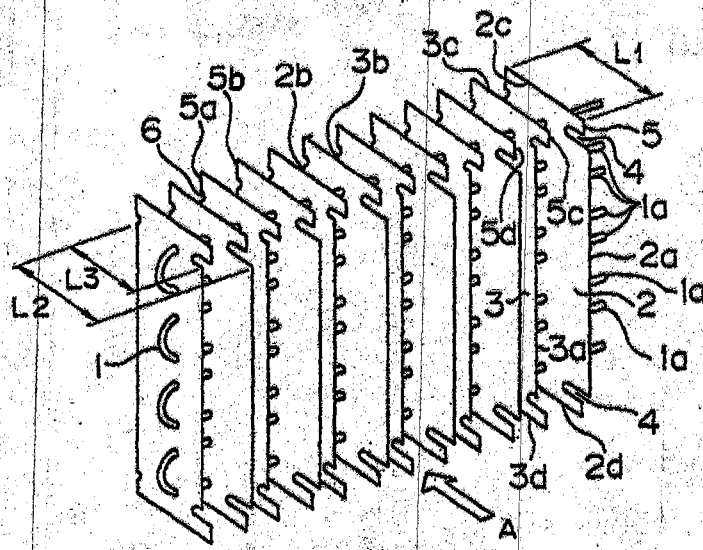
- [56] **References Cited**
U.S. PATENT DOCUMENTS
3,780,799 12/1973 Pasternak 165/151 X
3,815,672 6/1974 Bullard et al. 165/151

Primary Examiner—Larry Jones
Attorney, Agent, or Firm—Antonelli, Terry & Wands

[57] **ABSTRACT**
A heat exchanger having different types of fins of differ-

ent widths arranged such that different types of fins are arranged alternately can be efficiently produced by a process which has the steps of: forming a plurality of rows of refrigerant-tube holes in a hoop; forming lines of cutting which extend parallel to a direction of feed of the hoop at positions which are offset from the midpoint between adjacent rows of the holes, the lines of cutting having a length smaller than the longitudinal size of fins to be obtained; forming slits or elongated holes in positions of the hoop to which the ends of the lines of cutting is to be extended, the slits or elongated holes having longitudinal axes extending in the direction crossing the direction of feed of the hoop; cutting the hoop along a transverse line of cutting which extends in the direction crossing the direction of feed of the hoop past regions between adjacent slits or elongated holes which oppose to each other in the direction of feed of the hoop, thus severing a group of fins having a plurality of fins of different types connected integrally; stacking the successively severed groups of fins; inserting refrigerant tubes into the holes in the fins and expanding the tubes so as to fix the tubes to the fins in the successive groups; and cutting the stacked successive groups of fins at positions between adjacent rows of the holes and within the regions of the slits or the elongated holes.

10 Claims, 7 Drawing Sheets



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FIG. 1

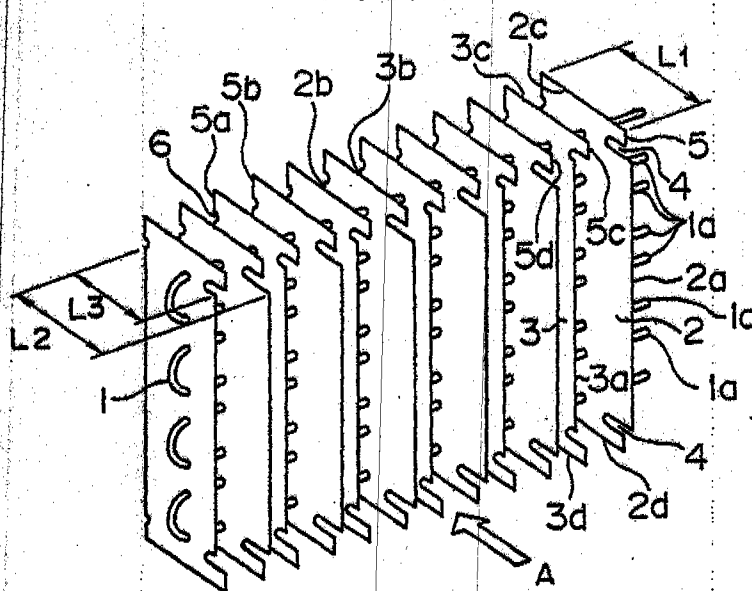
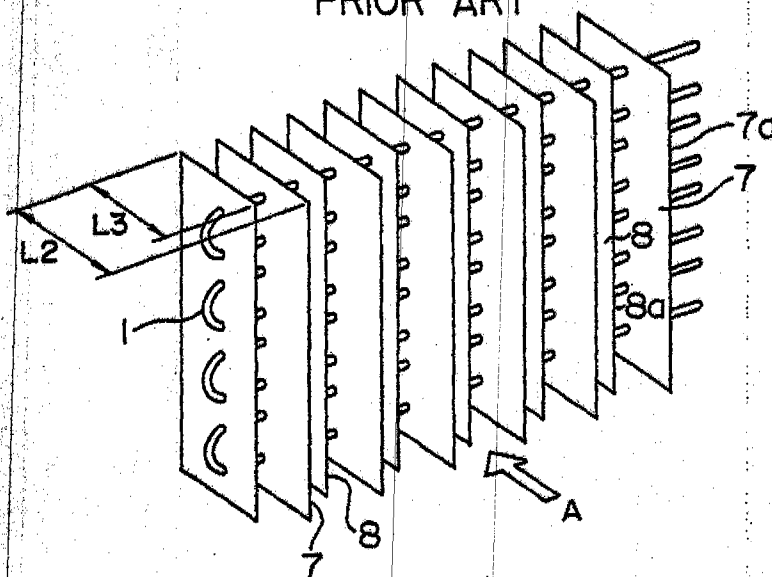
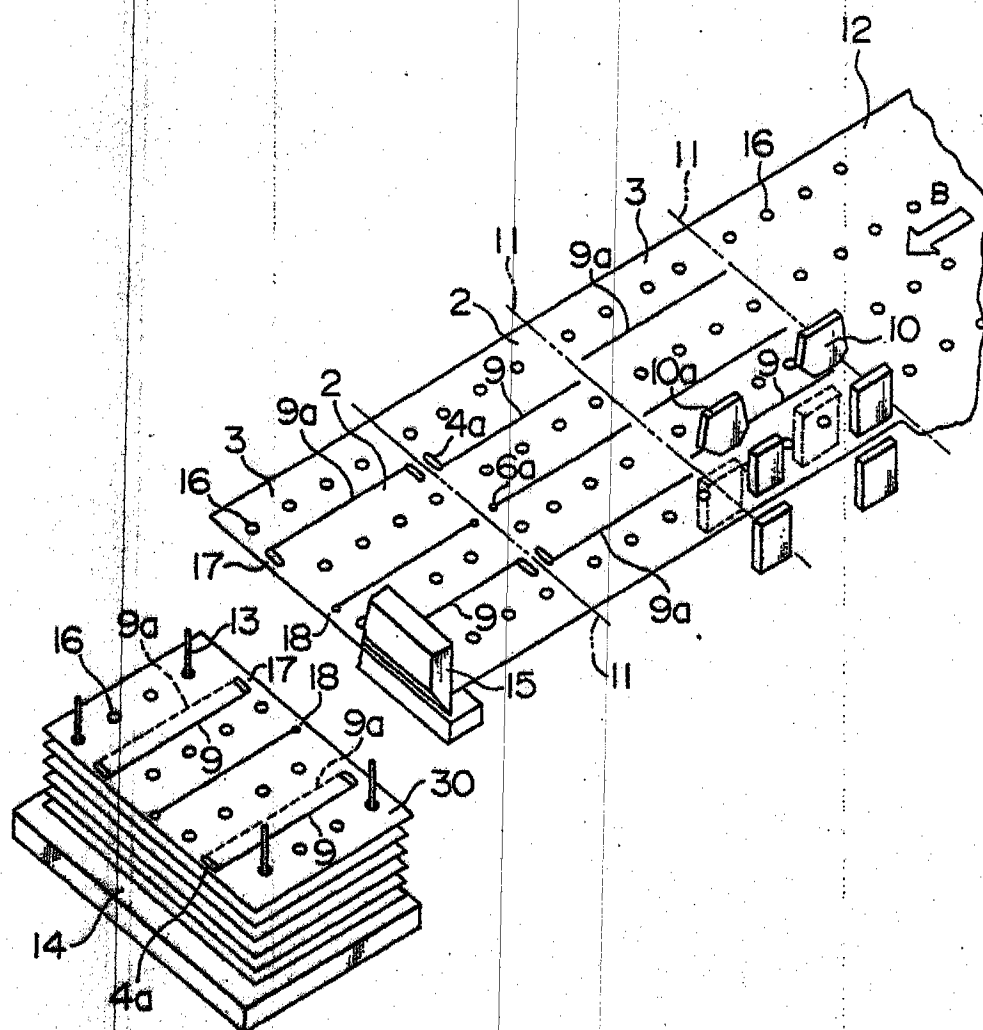


FIG. 9
PRIOR ART



17A/80

FIG. 2



HEAT EXCHANGER AND PROCESS FOR PRODUCING THE SAME

BACKGROUND OF THE INVENTION

The present invention relates to a heat exchanger and a process for producing the same. More specifically, the invention is concerned with a heat exchanger which experiences reduced deterioration in performance attributable to frosting and which can be produced with a high production efficiency.

Heat exchangers have been proposed to reduce the deterioration in performance attributable to frosting. An example of such heat exchangers is shown in Japanese Utility Model Unexamined Publication No. 50-122054. In this heat exchanger, the widths of fins are varied to be zigzag at the air inlet side of the heat exchanger so as to reduce the obstruction against the flow of air caused by frost which is formed heavily specifically at the inlet ends of the fins.

This known heat exchanger will be described hereinafter with reference to FIG. 9 which is a perspective view of the zigzag arrangement of this heat exchanger. As illustrated, the heat exchanger has a multiplicity of fins 7, 8 penetrated by heat exchanger tubes 1 which may be refrigerant tubes 1, and air flows into this heat exchanger in the direction of an arrow A. More specifically, the fins are grouped into two types: namely, fins 7 which have a greater width L2 and, hence, a greater distance between the end face 7a and the refrigerant tube 1, and fins 8 which have a smaller width L3 and, hence, a smaller distance between the end face 8a and the refrigerant tube 1. These two types of fins 7, 8 are arranged alternately and are fixed to the tubes 1.

The heat exchanger as shown in FIG. 9 can be produced by, for example, a process disclosed in Japanese Patent Unexamined Publication No. 58-110142. This process will be explained with reference to FIG. 10 which is a perspective view showing this process. A wide hoop 12 is fed in the direction of an arrow B and is cut by a press having cutting blades 10, 10a which are arranged such that pairs of wide fin 7 and narrow fin 8 are formed in a side-by-side fashion, along longitudinal lines 9, 9a of cutting. Then, the wide fin 7 and the narrow fin 8 are severed along a transverse line 11 by a cutting blade 15. A jig 14 having pins 13 receives the thus severed wide and narrow fins 7, 8 falling thereonto, with its pins 13 inserted in the refrigerant tube holes 16 formed in the respective fins, whereby the wide and narrow fins 7, 8 are stacked alternately.

In this type of heat exchanger, the deterioration of performance due to frosting is remarkably suppressed, but the efficiency of production of this type of heat exchanger is low because of the process for preparing and alternately stacking two types of fins of different widths as illustrated in FIG. 10.

The described process also suffers from a disadvantage in that, particularly when the fin of the heat exchanger is of narrow type having a single row of refrigerant tubes as shown in FIGS. 9 and 10, the refrigerant tube holes on the fins 7, 8 cannot correctly catch and receive the pins 13 on the jig 14 so as to hinder the production, with the result that the production efficiency is impaired. This is attributable to the fact that the centroid or center of mass of one of the fins 7, 8 does not coincide with the position of the hole, due to vari-

ance in the distance between the fin end and the tube (hole).

SUMMARY OF THE INVENTION

Accordingly, an object of the invention is to provide a heat exchanger having wide fins and narrow fins which are arranged alternately, and a process which makes it possible to produce such a heat exchanger at a high efficiency.

To this end, according to one aspect of the present invention, there is provided a heat exchanger having heat exchanger tube(s) and different types of fins of different widths arranged such that different types of fins are arranged alternately in the longitudinal directions of the tube(s), characterized in that each of the fins are notched in the direction perpendicular to a longitudinal direction or axis of each fin at portions near both longitudinal ends thereof, and the widths of the different types of fins are equal at both longitudinal end portions of the fins outside the notches.

According to another aspect of the present invention, there is provided a process for producing a heat exchanger comprising the steps of: forming a plurality of rows of refrigerant-tube holes in a hoop or web-like member; forming lines of cutting which extend parallel to a direction of feed of the hoop at positions which are offset from the midpoint between adjacent rows of the holes, the lines of cutting having a length smaller than the longitudinal size of fins to be obtained; forming slits or elongated holes in positions of the hoop to which the ends of the lines of cutting are to be extended, the slits or elongated holes having longitudinal axes extending in the direction crossing the direction of feed of the hoop; cutting the hoop along a transverse line of cutting which extends in the direction crossing the direction of feed of the hoop past regions between adjacent slits or elongated holes which oppose each other in the direction of feed of the hoop, thus severing a group of fins having a plurality of fins of different types connected integrally; stacking the successively severed groups of fins; inserting refrigerant tubes into the holes in the fins and expanding the tubes so as to fix the tubes to the fins in the successive groups; and cutting the stacked successive groups of fins at positions between adjacent rows of the holes and within the regions of the slits or the elongated holes.

In the production process of the invention, the hoop is cut along the lines of cutting parallel to the longitudinal axis of the hoop so as to define a plurality of fin portions of different widths in the direction of width of the hoop. These fin portions, however, are still held or connected integrally because the portions of the hoop which are outside the respective slits or elongated holes corresponding to the notches in the finished fins are not cut apart. It is therefore possible to obtain groups of fins having a plurality of fins connected in the direction of width of the hoop, so that a stack of fins can be prepared with a high efficiency. The successive groups of fins are transferred through the press and are made to fall onto the jig having pins. This eliminates the problem encountered with the known method in which independent fins are stacked, namely, the deviation of the centroids of the fins due to variation of fin widths and interference between the edges of the holes and the pins.

The integrality of the fin group is maintained at the connecting regions which are present at both longitudinal ends of the fin portions. After the assembly, the fin group is cut at these connecting regions, whereby the

assembly is separated into a plurality of heat exchangers.

In the heat exchanger thus produced, both types of fins which are adjacent to each other have the same size in the widthwise direction at both longitudinal end regions of these fins. This, however, does not cause any substantial problem because these regions are very short and disposed only at longitudinal ends of the fins.

Thus, the performance of this heat exchanger is substantially the same as that of known heat exchangers in which the ends of the fins are in a zigzag staggered pattern at the air inlet side over the entire length of the fins.

The insertion and expansion of the refrigerant tubes in the holes is preferably conducted in advance of the cutting at the positions between adjacent rows of holes, although the insertion and expansion of the tubes may be conducted after the cutting.

It is also preferred that the slits or elongated holes are formed after the formation of the associated lines of cutting parallel to the direction of feed of the hoop, though the formation of the slits or elongated holes may be executed prior to the formation of the associated lines of cutting parallel to the direction of feed of the hoop.

The positions between adjacent rows of holes to be cut at longitudinal ends of the fins are usually on longitudinal lines substantially midst between the adjacent rows, although they may be offset from the longitudinal lines midst between the rows of holes.

These and other objects, features and advantages of the present invention will become clear from the following description of the preferred embodiments when the same is made in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of the heat exchanger in accordance with the present invention;

FIG. 2 is a schematic illustration of a process for producing fins used in the heat exchanger of FIG. 1;

FIG. 3 is a perspective illustration of an intermediate step of an embodiment of a method of the invention for producing a heat exchanger;

FIG. 4 is a partial sectional view of an intermediate processing state in an embodiment of the process of the invention;

FIG. 5 is a perspective illustration of heat exchangers which have been produced by a production process of the present invention;

FIG. 6 is an illustration of another embodiment of the process of the invention showing particularly the production of fins;

FIG. 7 is an illustration of a fin production apparatus suitable for use in a fin production process in an embodiment of the process according to the present invention;

FIG. 8 is an illustration of another fin production apparatus suitable for use in a fin production process in an embodiment of the process according to the present invention;

FIG. 9 is a perspective illustration of a known heat exchanger; and

FIG. 10 is a schematic illustration of a process for producing the known heat exchanger of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a perspective view of a heat exchanger embodying the present invention. The heat exchanger has fins 2 and 3 fixed to refrigerant tubes 1. Ends 1a of the tubes 1 can be connected to form a single continuous tube. Air flows into this heat exchanger in the direction of an arrow A. The fin 2 is so constructed that its end face 2a is largely or remotely spaced from the refrigerant tube 1, while the fin 3 is so constructed that the distance between its end face 3a and the refrigerant tube 1 is comparatively small. The fins 2 and 3 are arranged alternately. During operation of the heat exchanger, frosting takes place on the air inlet ends of the fins 2 and 3. The impediment to the flow of air caused by the frosting, however, is not so serious because the end surfaces 2a and 3a are arranged in a staggered or zigzag manner.

The fin 2 is provided in the end face 2a thereof with notches 4 which are slightly spaced from both longitudinal ends 2c, 2d, such that a small severance protrusion 5 is formed on the outer side of each notch 4 as viewed in the longitudinal direction of the fin 2. Similar notches 4 are also formed in the other type of fin 3. The distance between the end face of the protrusion 5 and the refrigerant pipe 1 in the fin 2 is the same as that in the fin 3. The frosting may take place rather heavily on the ends of the protrusions 5 because these ends of the adjacent fins are disposed close to each other. This, however, does not materially affect the performance of the heat exchanger because the protrusions 5 have only a small length in the longitudinal direction of fins 2, 3 and because these protrusions 5 are disposed only in the upper and lower limited portions of the heat exchanger. Each fin is also provided with notches 6 which are formed in the other end face of thereof at positions close to the longitudinal ends 2c, 2d and 3c, 3d thereof, such that severed protrusions 5a, 5b are formed between the ends 2c(2d), 3c(3d) and the notch 6. The widths of the fins 2, 3 as measured at the ends having the protrusions 5a, 5b are the same, as represented by L_1 ($L_3 < L_1 < L_2$).

A description will be made hereinafter, with specific reference to FIGS. 2 to 5, as to a process of producing the heat exchanger shown in FIG. 1. FIG. 2 is a perspective view illustrating the production process. Four fins including two wide fins and two narrow fins arranged alternately are successively severed from a continuous hoop or metallic web-like member 12. Thus, fins are still connected at the junctures 17, 18 between the portions which will become severance protrusions 5, 5a after severance, i.e., portions outside elongated holes 4a and holes 6a. Namely, as the hoop 12 is fed in the direction of an arrow B, the hoop 12 is cut along lines 9, 9a which define the longitudinal sides 2a, 2b, 3a, 3b the fins 2, 3, such that four fins including two wide fins 2 and two narrow fins 3 are formed in a side-by-side fashion such that the wide fin 2 and the narrow fin 3 appear alternately in the breadthwise direction of the hoop, but these four fins are still unitary or integral because the lines 9, 9a of cutting do not extend beyond the elongated holes 4 which are bound to constitute the notches 4 after the severance. Thus, fin groups each having four fins are successively formed by press or punching as the hoop 12 is fed in the direction of the arrow B. The successive groups of fins after the press work are then severed by a cutting blade 15 along a line 11 which extends in the direction perpendicular to the direction B

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of feed of the hoop 12 and which passes regions between two adjacent elongated holes 4a, 4a of the successive groups. Thus, independent groups 30 of fins, each consisting of four fins 2, 3 unitarily connected in the direction of breadth of the hoop 12, fall onto a jig 14 and are automatically stacked one on the other such that the refrigerant tube holes 16 in the respective fins receive the pins 13. The stacking can be accomplished without substantial difficulty because each fin group 30 consisting of four fins before severance is wide and falls regularly or stably. Spacing between adjacent fin groups 30 is provided by cylindrical burrs rise 30a (refer to FIGS. 3 to 5, or FIG. 4 in particular) left around the holes 16.

In the press work explained above, a pair of cutting blades 10 and 10a of the press operate alternately to form the lines 9, 9a of cutting respectively in the successive groups of fins 30. Thus, in the stack of the fin groups 30 on the jig 14, the positions of lines 9, 9a of cutting are staggered. For instance, the line 9 of cutting formed by the cutting blade 10 in the uppermost fin group 30 is positioned adjacent to the line 9a (shown by broken line) formed by the cutting blade 10a in the underlying fin group 30. Thus, the distance between the refrigerant tube holes 16 and the longitudinal side face of the fin between both elongated holes 4a, 4a constituted by the lines 9, 9a of cutting, alternately varies in the stacking direction. In the illustrated embodiment, holes 4a, 6a have been formed after the formation of the lines 9, 9a of cutting. The lines 9, 9a of cutting may be formed after the formation of the holes 4a, 6a. Thus, in the process of the invention, the stack is formed by successive groups of fins 30 each including four fins which are connected at portions 17, 18, in contrast to the known process shown in FIG. 10 in which independent fins 7, 8 of two different types were successively and alternately stacked. In the known process, there is a problem that the stacking is impeded due to the fact that the fins 7, 8, 9 of different types wave in different forms. In the process of the invention, however, this problem is overcome because the successive groups 30 of fins exhibit the same tendency of waving, if any. When the heat exchanger is designed for unidirectional flow of air, the longitudinal sides of two types of fins may register at the air outlet side of the heat exchanger, i.e., the distance between the outlet side ends 2b, 3b of the fins 2, 3 and the refrigerant tubes 1 may be the same. For this reason, the positions of the junction 18 in the successive groups 30 of the fins in the stack are vertically aligned.

The elongated holes 4a and the holes 6a in the described embodiment may be substituted by slits 4b, 6b as shown in FIG. 6.

It will be understood that, in the described embodiment, the lines 9, 9a of cutting do not cross or intersect the line 11 of cutting because of the presence of the connecting portions 17, 18. When the hoop 12 as the blank material of the fins has high mechanical strength and rigidity, however, the lines of cutting 9, 9a may reach the line 11 of cutting at one of their two ends.

The group or array 30 of fins may be composed of any suitable even number of fins, e.g., two or 6 or more, though the fin group 30 in the described embodiment is constituted by four fins.

FIG. 7 shows an embodiment of an apparatus for carrying out the process of the present invention in which the hoop 12 is unrolled from a roll 31 and is subjected to processings performed by the cutting blades 10, 10a and 15 of the press 32, whereby suc-

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cessive fin groups 30 are obtained. These fin groups 30 are successively picked up by a vacuum unit or suction-type lifter 33 and is moved to a position where the holes 16 in the fins are aligned with the pins 13 of the jig 14 in the vertical direction. The vacuum unit then releases the fin group 30 so that the latter fall onto the jig 14 with the holes receiving the pins 13 on the jig 14.

FIG. 8 shows another embodiment of an apparatus for carrying out the process of the present invention in which the hoop 12 is unrolled from a roll 31 and is subjected to processings performed by the cutting blades 10, and 10a of the press 34, and the leading end portion of the hoop 12 of a predetermined length is held by a suction plate 35 of a vacuum unit or suction-type lifter 33 having a propeller fan 36. Then, the trailing end of the hoop portion held by the lifter 33 is cut by a cutting blade 15 which is disposed at the downstream side of a feeder 37 as viewed in the direction D of movement of the hoop 12, whereby the group 30 of fins is severed. The arrangement may be such that a pair of jigs 14 are mounted on a turn table rotatable around a shaft 38 as shown in FIG. 7, or such that the jig 14 is carried by a mobile truck 39.

FIG. 3 shows an intermediate step of the assembly process in which a plurality of fin groups 30 dismounted from the jig 14 are handled as a block and the refrigerant tubes 1 are inserted into the holes in the respective fins of the fin groups 30. The tubes are then fixed to the fins by a tube expansion technique which is known per se. During the expansion, the fin groups 30 constituting the block are held and pressed at their ends 19. The pressing of these end surfaces, however, does not cause any substantial problem such as deformation or breakage of the fins because the end surfaces 19 are vertically aligned. Thus, the insertion of the refrigerant tubes, assembly and tube expansion can be effected easily and securely.

FIG. 4 shows a step of the separation process in which the block of fin groups 30 with the refrigerant tubes 1 fixed in their holes 16 is cut by a cutting device so as to form a plurality of heat exchangers. The cutting device has a cutting blade 21 and a guide pin 20 received in and guided by the elongated holes 4a or holes 6a. The cutting blade 21 is then moved downward as indicated by an arrow C while the guide pin 20 is guided by the vertical row of elongated holes 4a so that the connecting portions 17, 18 are cut to sever the fins of each of groups 30 in the block, whereby four heat exchangers each being of the type shown in FIG. 1 are obtained, as will be seen from FIG. 5. When the elongated holes 4a are substituted by slits as shown in FIG. 6, the guide pin 20 of the cutting device may be omitted.

Thus, according to the invention, heat exchangers of the type shown in FIG. 1 can be stably and readily produced by the process explained with reference to attached drawings by virtue of the provision of notches 4 and the severance protrusion 5 of a uniform distance from the refrigerant tubes 1 in each of the successive fins.

- What is claimed is:
1. A heat exchanger comprising:
 - first and second types of fins stacked alternately with respect to each other;
 - each of first and second types of fins having notches in a direction perpendicular to a longitudinal direction of each said fin near longitudinal ends thereof; widths of said first and second types of fins being equal at both longitudinal end portions of said first



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Utter

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- (54) **PLATE-FIN AND TUBE HEAT EXCHANGER WITH A DOG-BONE AND SERPENTINE TUBE INSERTION METHOD**
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- (73) **Assignee:** Brazeway, Inc., Adrian, MI (US)
- (*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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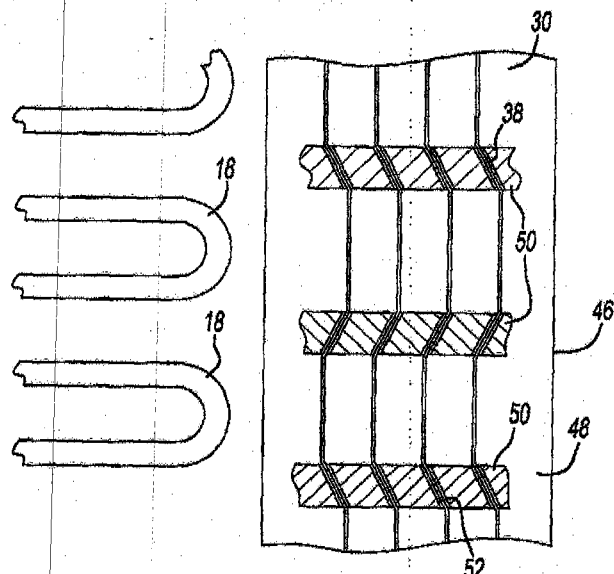
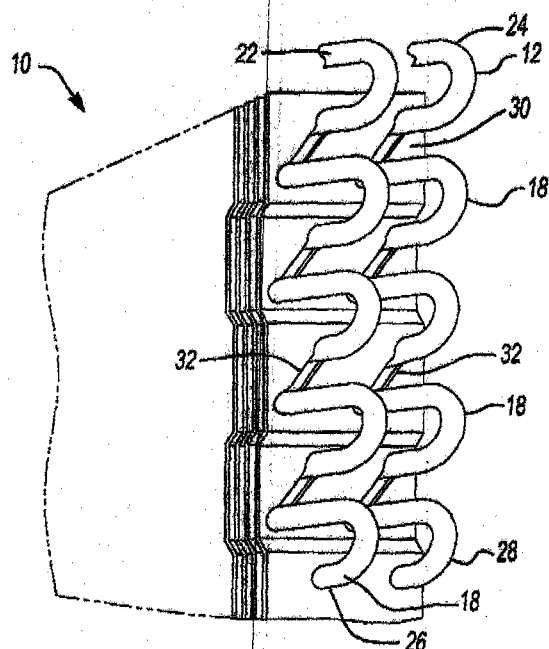
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(57) **ABSTRACT**

A dog-bone type heat exchanger having a plurality of fin members for dissipating heat. Each of the plurality of fin members includes a pair of offset surfaces interconnected by a sloped interconnecting surface. The plurality of fins members may be spaced apart at a distance that is less than, equal to, or more than the offset distance between the pair of offset surfaces on each fin member, thereby maximizing the mixing of air flow and the conductive heat transfer of the heat exchanger through an impinging effect.

3 Claims, 2 Drawing Sheets



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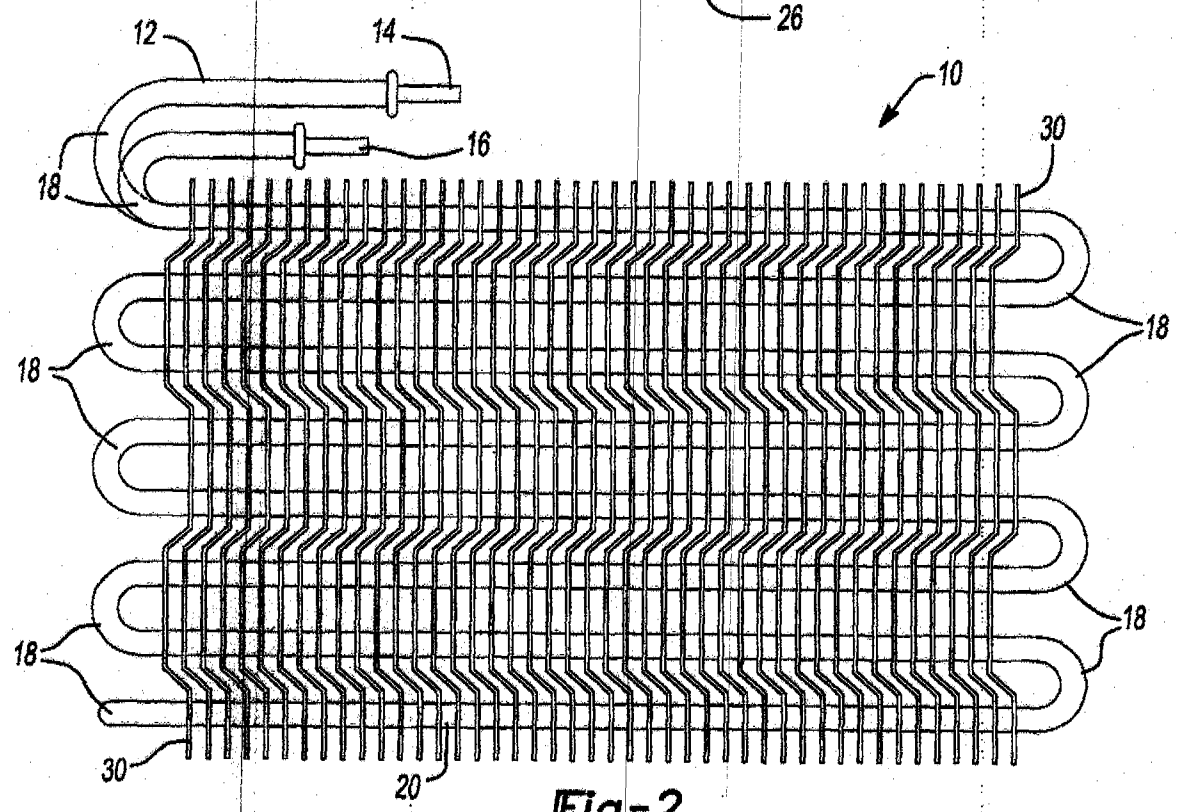
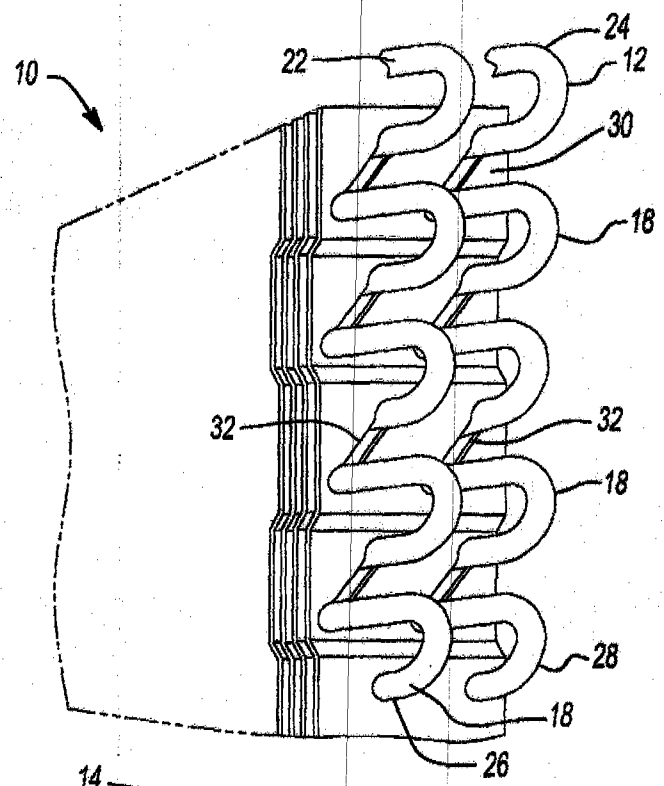


PLATE-FIN AND TUBE HEAT EXCHANGER
WITH A DOG-BONE AND SERPENTINE
TUBE INSERTION METHOD

FIELD OF THE INVENTION

The present invention generally relates to heat exchangers and, more particularly, relates to a heat exchanger having heat transfer elements with improved heat transfer characteristics.

BACKGROUND OF THE INVENTION

Conventional heat exchangers of the plate fin-tube type generally include of a plurality of parallel tubes having a plurality of perpendicular fins. The plurality of perpendicular fins is thermally coupled to the plurality of parallel tubes to serve as an evaporator. Heat absorbing fluid is forced through a capillary tube into the plurality of parallel tubes at a low temperature and pressure. Subsequent evaporation of the fluid removes heat energy from the air passing adjacent the tubes of the evaporator, thus cooling the air. The fins attached to the tube increase the effective heat absorbing area over which the airflow is directed, thus increasing the cooling efficiency of the evaporator. A small motor driven fan is utilized to draw air over the heat absorbing area of the evaporator and discharge the cooled air into the interior of the refrigerator.

Several attempts have been made to increase the cooling efficiency of the evaporator by varying the arrangement of the tube pattern and fin shape. U.S. Pat. No. 4,580,623 discloses a heat exchanger having parallel rows of serpentine tube coils slanting in the same direction and using ultra thin fins having a pattern embossed thereon to induce turbulence in the airflow over the evaporator. However, the refrigeration industry is currently requiring a wider evaporator to increase the face area of the evaporator met by the airflow to reduce the effects of frost growth and thereby increase the cooling efficiency of the refrigerator system. To enhance the cooling efficiency it is possible to add additional rows of tubes or additional fins to the evaporator. However, additional fins generally cause a narrowing of the space between fins, which may limit airflow there between and increase the amount of material necessary to manufacture the evaporator, thus increasing cost. Further, additional rows of fins may also lead to excessive air-pressure drops across the fins, especially as frost accumulates on the fins and tubes.

A need to improve the cooling efficiency of the current fin design is particularly felt in the area of "dog-bone" type heat exchangers. Dog-bone type heat exchangers generally include a plurality of fins each having a series of slots formed therein. These slots are generally in the shape of a dog bone—having generally circular end portions and a slightly narrower intermediate, connecting portion. Unlike other heat exchanger types, dog-bone heat exchangers employ a single, continuous tube that is bent into a serpentine-like pattern, which traverse back and forth through the series of slots formed in the fins once assembled. This single, continuous tube eliminates the need for complicated tube assembly, such as assembly and brazing of joints. The tube is bent into its preferred shaped prior to insertion through the dog-bone slots. Due to the narrower immediate portion of the dog-bone slots, the bends along at least one side of the final tube shape are crimped to enable insertion of the tube into the fins. This tube bundle is then inserted through the dog-bone slots to form the assembly. Traditionally, it is difficult to hold the fins in proper position

during this insertion stage. Experience has shown that this difficulty is compounded if an irregularly shaped fin is used.

Dog-bone type heat exchangers are often used in refrigeration applications, such as refrigerator-freezer applications. Refrigeration applications typically use a lower airflow rate relative to commercial cooling systems. These lower airflow rates decrease the cooling capacity of the heat exchanger. Moreover, such refrigerator-freezer applications further require that frost be able to collect on the fins and tubes. Therefore, to minimize the chance of the fins being clogged with frost, the fins must be placed further apart to allow air to continue to pass through the evaporator as the frost accumulates. This increase separation of the fins limits the number of fins used and, furthermore, reduces the mixing of the airflow around the fins, thereby reducing the cooling capacity of the system. However, irregularly shaped fins are difficult to assemble with the continuous tube.

Accordingly, there exists a need in the relevant art to provide a dog-bone type heat exchanger system having evaporator fins that permit the accumulation of frost and the pass through of air, yet provides improved cooling capacity. Furthermore, there exists a need in the, relevant art to provide a dog-bone type heat exchanger having sufficiently spaced fins that provides improved mixing of the airflow around such fins to improve cooling capacity. Still further, there exists a need in the relevant art to provide a dog-bone type heat exchanger system having fins capable of improving the mixing of the airflow around such fins without adversely affecting the ease of assembly. Lastly, there exists a need in the relevant art to provide a dog-bone type heat exchanger system that overcomes the disadvantages of the prior art.

SUMMARY OF THE INVENTION

According to the principles of the present invention, a dog-bone type heat exchanger is provided having an advantageous construction and method of assembly. The dog-bone type heat exchanger includes a plurality of fin members for dissipating heat. Each of the plurality of fin members includes a pair of offset surfaces interconnected by a sloped interconnecting surface. The plurality of fins members may be spaced apart at a distance that is less than, equal to, or more than the offset distance between the pair of offset surfaces on each fin member.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. 1 is a perspective view illustrating an evaporator according to the principles of the present invention;

FIG. 2 is an elevational view illustrating the evaporator of the present invention;

FIG. 3 is a front view illustrating the dog-bone slots;

FIG. 4 is a side view illustrating the profile configuration of the fin according to the present invention; and

FIG. 5 is a plan view illustrating the insertion of the tube bundle into a plurality of fins being secured within a jig member.

DETAILED DESCRIPTION OF THE
PREFERRED EMBODIMENTS

The following description of the preferred embodiment is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

Referring to FIGS. 1-4, an evaporator system, generally indicated at 10, is illustrated for use in a refrigeration system (not shown). The refrigeration system generally includes a refrigerator having a spaced apart wall section forming a passageway. Evaporator system 10, in accordance with the present invention, is placed in the passageway and is used to cool the air drawn over evaporator system 10 and is discharged into the refrigerator by a fan. Evaporator system 10, when used in a restaurant appliance, is generally operated at a temperature such that frost tends to collect on the surfaces of the evaporator. Accordingly, evaporator system 10 must include pathways extending there through to permit the passage of air to prevent clogging of the evaporator. Should the evaporator system become clogged, the airflow over the evaporator is reduced causing an airside pressure drop and a decrease in the cooling efficiency of the device (i.e., reducing the airflow over evaporator system 10 reduces the amount of cool air discharged into the refrigerator). In an attempt to keep the refrigerator at the desired temperature level, the system works harder (i.e., the compressor runs almost continuously to provide a supply of heat absorbing fluid to evaporator system 10 in an attempt to provide additional cool air to the refrigerator).

Evaporator system 10 of the preferred embodiment comprises a continuous tube 12 having both inlet 14 and outlet 16 ends. Continuous tube 12 is formed in a serpentine configuration by a plurality of reverse bends 18 and parallel tube runs 20. As best seen in FIGS. 1 and 3, continuous tube 12 is folded into an essentially bi-planar configuration resulting in two adjacent rows of tubes 22, 24. Tube rows 22, 24 are made up of sets of two parallel tubes 26, 28 with the exit of each set connected to the entrance of the next successive set in the respective row by a respective reverse bend 18. The sets of parallel tubes in each row 22, 24 are sloped in co-planar directions relative to the longitudinal axis of tube row 22, 24.

As best seen in FIGS. 1, 3, and 4, fins 30 each include a varying profile capable of dramatically enhancing the mixing of the air flow passing through evaporator system 10 and further capable of enhancing the impinging effect of air contacting each fin 30. With particular reference to FIGS. 3 and 4, fins 30 each includes a first surface 34 and a second surface 36. According to the present embodiment, first surface 34 is a planar surface that is parallel to and offset from second planar surface 36 as indicated at A. First surface 34 and second surface 36 are interconnected via a sloping, interconnecting surface 38. Preferably, fin 30 further includes a plurality of first surfaces 34 and second surfaces 36 each interconnected in a similar manner by sloping, interconnecting surface 38. Most preferably, first surface 34 and second surface 36 alternate after each pair of slots 32, thereby providing the maximum number of alternating surfaces 34, 36, while maintaining a generally flat surface adjacent slots 32 for assembly. This will be discussed further below. It should be noted, however, that the exact dimensions and shape of fins 30 may be modified to accommodate the particular needs of the intended application. The planar shape of first surface 34 and second surface 36 is preferably oriented perpendicular to the direction of insertion of continuous tube 12.

Still referring to FIGS. 3 and 4, fins 30 are preferably made of stamp-formed aluminum having a thickness of

about 0.15 mm. More particularly, fins 30 are preferably stamp-formed in a single manufacturing step to form the outer dimensions of fin 30, slots 32, first surface(s) 34, second surface(s) 36, and interconnecting surface(s) 38. As best seen in FIG. 3, slots 32 each include a pair of generally circular portions 40 having a generally narrower intermediate portion 42 extending between the pair of generally circular portions 40. Referring now to FIG. 4, the pair of generally circular portions 40 each include an outwardly-turned collar portion 44 being stamp-formed to provide a generally non-abrasive surface for contacting continuous tube 12. Collar portion 44 further serves to provide an enlarged contact surface area to improve conductive heat transfer between continuous tube 12 and each fin 30.

Fins 30 are secured on continuous tube 12 by inserting bends 18 of continuous tube 12 into canted slots 32 of fins 30. The overall length of slot 32 is slightly less than the overall outer dimension of the set of two tubes. Since the overall length of the slot is slightly less than the overall outer dimension of the set of two tubes, the tube sets are press fit into slots 32 to ensure metal-to-metal contact, which enhances heat conduction between the tube walls and fins 30. Fins 30 are evenly spaced on tube 12 and when used in refrigeration units are normally spaced three-to-six fins per inch of tube.

As best seen in FIG. 5, assembly of fins 30 and continuous tube 12 is facilitated with the use of a jig member 46. Jig member 46 generally includes a base portion 48 and a plurality of support rails 50. The plurality of support rails 50 being generally orthogonal to base portion 48 and include a series of complimentary angled channels 52 to engage interconnecting surface 38 of fins 30. Accordingly, bends 18 of continuous tube 12 are inserted into respective slots 32 of fins 30, channels 52 of support rails 50 cooperate to retain fins 30 in proper position and spacing. Once insertion is complete, the final evaporator system 10 may be removed from jig member 46.

The cooling efficiency of evaporator system 10 of the present invention may be further improved over conventional designs as a result of the particular offset and profile of fins 30. With reference to FIG. 4, an example of the planar-offset configuration of fins 30 is illustrated. Although it should be appreciated that fins 30 may be spaced apart any distance that is found to maximize heat exchange, in this example fin 30 and an adjacent fin 30' are offset a distance B that is at least less than or equal to the offset distance A between first surface 34 and second surface 36. Moreover, again relative to this particular example, distance B remain less than or equal to distance A despite various fin shapes. Such an arrangement leads to improved mixing of airflow C passing between fin 30 and fin 30'. In other words, such arrangement eliminates any straight through passage lines extending between adjacent fins, thereby requiring mixing of airflow and maximizing the amount of air molecules impinging upon interconnecting surfaces 38. The impinging of air molecules on interconnecting surfaces 38 improves the heat transfer between the air and continuous tube 12, thus improving the cooling efficiency of evaporator system 10. By improving the cooling efficiency, the amount of work required may be reduced and/or the spacing of fins 30 may be increased to facilitate the flow of air between adjacent fins 30 as frost accumulates on fins 30.

It has been seen that as air is drawn over evaporator system 10, the air impinges the cooling fins and further mixes, thereby increasing the cooling effect and efficiency of evaporator system 10 over prior art evaporators having flat fin designs. Accordingly, the invention results in lower

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manufacturing costs, since unnecessary fins may be removed. Furthermore, as a result of the option to use increased spacing between adjacent fins, the pressure drop is minimized, which enables the use of a smaller fan and compressor motor, thus decreasing operating costs and noise.

However, in summary, it is important to note that preferably the fins of the present invention include a plurality of offset planar surfaces. These offset planar surface preferably alternative between each pass of the tubing, thus maximizing the number of alternating surface while still maintaining the necessary perpendicular relationship with the tubing. This perpendicular relationship eases assembly in that a plurality of fins may be easily held in a jig at which time the preformed serpentine tubing is easily inserted.

The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

What is claimed is:

1. A method of assembling a dog-bone type heat exchanger, said method comprising:

providing a base member having a plurality of spaced support members coupled thereto forming support channels therebetween;

providing a pair of fin members each having a first surface and a second surface interconnected by a first sloped interconnecting surface, a plane of said first surface

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being offset from a plane of said second surface, at least said first surface having a plurality of slots formed therethrough, each of said plurality of slots having a pair of generally circular portions and an intermediate portion;

inserting each of said pair of fin members into said corresponding support channels formed in said base member and retaining each of said pair of fin members along only said interconnecting surface using only said support channel;

providing a continuous tube having a plurality of reverse bends forming a plurality of parallel tube runs; and

inserting each of said plurality of reverse bends through a corresponding one of said plurality of slots formed in said pair of fin members.

2. The method of assembling a dog-bone type heat exchanger according to claim 1 wherein said step of providing a pair of fin members includes providing said pair of fin members wherein the width of said intermediate portion is smaller than a diameter of each of said pair of generally circular portions, thereby generally defining a dog-bone shape.

3. The method of assembling a dog-bone type heat exchanger according to claim 1, further comprising:

spacing said pair of fin members a distance that is greater than or equal to a distance between said plane of said first surface and said plane of said second surface.

* * * * *

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES2020
Bogotá, D.C.,Abogado
DILIA M. RODRIGUEZ D'ALEMAN

ASUNTO

Radicación 04109305
Trámite 002
Evento 001
Actuación 430
Oficio
Folios - 19 7679

Patente de Invención ☒ Patente de Modelo de Utilidad ☐
Vía Nacional ☒
Vía PCT (fase nacional) ☐ Cap. I ☐ Cap. II ☐
No. Sol. Internacional _____
Fecha de Presentación Interna. _____

Como resultado del examen de fondo, realizado con fundamento en el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica:

1. Documentos estudiados

- 1.1. Descripción: Folios: 5 a 34
1.2. Reivindicaciones: Folios: 35 a 45
1.3. Dibujos: Folios: 47 a 57
1.4. Prioridad: Folios: 70 a 113
Octubre. 30 de 2003-ESTADOS UNIDOS 10/696913
1.5 Respuesta del solicitante Folios: 160 a 171

2. Objeto de la invención

- Título de la solicitud: "DISEÑO DE INTERCAMBIADOR DE CALOR CON DISPOSICION DE TUBO FLEXIBLE" (folio 5).
- Objeto de la invención: la presente solicitud se refiere a intercambiadores de calor y mas específicamente a aletas para dichos intercambiadores. Según el autor la invención permite la construcción de intercambiadores que se puedan configurar como evaporadores o condensadores y utilicen una aleta sin importar el número de pasajes de tubo verticales y horizontales. El problema a resolver según el autor, radica en la utilización diferente de

evaporadores o condensadores respecto del patrón del tubo y aleta que utilizan que se hace diferente de acuerdo al tipo de aplicación. Por lo tanto un fabricante de estos elementos debe mantener no solo diferentes configuraciones sino también una variedad de patrones de aleta que se puedan utilizar en diferentes situaciones. Por eso según el, el uso de un solo patrón de aleta universal o común reduciría el costo de su elaboración. Adicionalmente sería deseable si el patrón de tubo fuera tal que los pasajes de tubo estuvieran orientados en relación al flujo de aire para una transferencia de calor óptima o altamente eficiente.

- El objeto de la invención se catalogó como F28F1/00 según la Clasificación Internacional de Patentes (IPC.).

3. Determinación del Estado de la Técnica

Teniendo en cuenta que la fecha de prioridad reivindicada es el 30 de Octubre de 2003, se encontraron los siguientes documentos relevantes:

Nº	Documento	Título	Fecha de publicación*
D1	US6598295	PLATE-FIN AND TUBE HEAD EXCHANGER WITH A DOG-BONE AND SERPENTINE TUBE INSERTION	29-07-2003
D2	US4898232	HEAD EXCHANGER AND PROCESS FOR PRODUCING THE SAME	06-02-1990

4. Análisis de patentabilidad (artículo 14 D486)

4.1 Novedad (artículo 16 D486)

4.1.1 Respecto de la solicitud la reivindicación diecinueve (19) define textualmente: "Un método para hacer una aleta (28) en un intercambiador de calor (32) de tubo, el método caracterizado porque comprende las etapas de:

- Separar al menos una aleta (28), de acuerdo con cualquiera de las reivindicaciones 1 a 9; y
- Posicionar dicha aleta (28) sobre dicha porción de tubo (30) de dicho intercambiador de calor (32) con pares de pases de tubo (38) que pasan a través de dichas aberturas (32).

4.1.2 El documento **US6598295** (mencionado en adelante como documento D1) se refiere a un intercambiador del tipo "hueso de perro" que tiene una pluralidad de aletas para dispar el calor.

Figura 3 del documento D1.

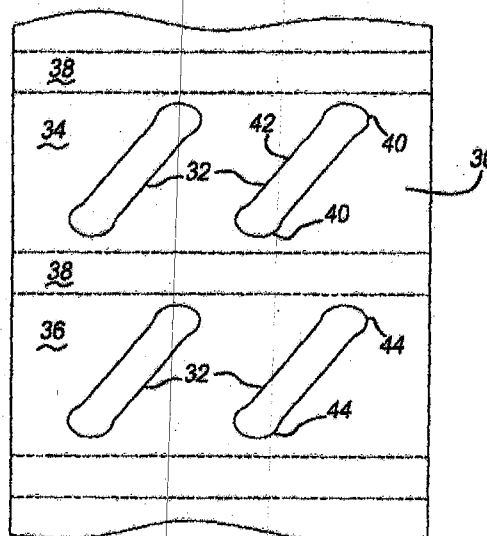


Fig-3

4.1.3 Al comparar elemento por elemento de la invención **tal como esta definido en la reivindicación diecinueve (19)**, con el documento D2, encontramos que el mencionado documento revela todos los elementos y las características de dicha reivindicación. Donde D2 contiene:

REIVINDICACION 19	D2
Un método para hacer una aleta (28) en un intercambiador de calor (32) de tubo, el método caracterizado porque comprende las etapas de: (a) Separar al menos una aleta (28), de acuerdo con cualquiera de las reivindicaciones 1 a 9; y	SI Ver: resaltes folios 181, 182, figuras 9-10; elementos 7, 8, 9, 10 y 12...
b) Posicionar dicha aleta (28) sobre dicha porción de tubo (30) de dicho intercambiador de calor (32) con pares de pases de tubo (38) que pasan a través de dichas aberturas (32).	SI Ver: resaltes folios 181, 182, figuras 9-10; elementos 7, 8, 9, 10 y 12...

4.1.4 De acuerdo con lo anterior, todos los elementos caracterizados y que forman parte de la solicitud "Un método para hacer una aleta (28) en un intercambiador de calor (32) de tubo," mostrados en las reivindicaciones 19-30 (folios 168-171), ya fueron divulgados en D2, por lo cual se podría considerar que **carecen de novedad.**

4.1.5 Respecto de la solicitud la reivindicación uno (1, folio 165) hace referencia a una aleta de uso universal para intercambiador de calor, esta reivindicación dice textualmente:

"Una aleta universal (20) para un intercambiador de calor de tubo, la aleta universal caracterizada porque comprende:

Una lámina (52) de material conductor de calor configurada para ser separada para formar una o más aletas (28) para uso en una aleta (28) sobre el intercambiador de calor de tubo (32) con respecto a un número de pares verticales y horizontales de segmentos de tubo en dicho intercambiador de calor (32), dicha lámina tiene un ancho (W) y un largo (H) ; y una pluralidad de aberturas (22) en dicha lámina (52), cada una de dichas aberturas (22) configurada para permitir un par de segmentos de tubo (34) paralelos del intercambiador de calor (32) para pasar a través de estos, dichas aberturas (22) son relativamente inclinadas a dicho ancho (W) y largo (H) de dicha lámina (52), dichas aberturas (22) están dispuestas sobre dicha lámina (52) en una pluralidad de filas (26) y una pluralidad de columnas (24) con filas adyacentes (26) que están espaciadas generalmente iguales aparte y columnas adyacentes (24) que están generalmente espaciadas iguales aparte, y dicho espacio entre las filas adyacentes (26) y las columnas adyacentes (24) está dimensionado para permitir que dicha lámina (52) sea separada entre al menos una de dichas filas adyacentes (26) y dichas columnas adyacentes (24) para formar una o más aletas (28) cada una de las cuales contiene una pluralidad de aberturas (22) al menos igual a un número total de pares de segmentos de tubo en el intercambiador de calor (32)."

4.1.6 Respecto de la solicitud la reivindicación uno (1, folio 165) hace referencia a una aleta de uso universal para intercambiador de calor, esta reivindicación dice textualmente:

"Una aleta universal (20) para un intercambiador de calor de tubo, la aleta universal caracterizada porque comprende:

Una lámina (52) de material conductor de calor configurada para ser separada para formar una o más aletas (28) para uso en una aleta (28) sobre el intercambiador de calor de tubo (32) con respecto a un número de pares verticales y horizontales de segmentos de tubo en dicho intercambiador de calor (32), dicha lámina tiene un ancho (W) y un largo (H) ; y una pluralidad de aberturas (22) en dicha lámina (52), cada una de dichas aberturas (22) configurada para permitir un par de segmentos de tubo (34) paralelos del intercambiador de calor (32) para pasar a través de estos, dichas aberturas (22) son relativamente inclinadas a dicho ancho (W) y largo (H) de dicha lámina (52), dichas aberturas (22) están dispuestas sobre dicha lámina (52) en una pluralidad de filas (26) y una pluralidad de columnas (24) con filas adyacentes (26) que están espaciadas generalmente iguales aparte y columnas adyacentes (24) que están generalmente espaciadas iguales aparte, y dicho espacio entre las filas adyacentes (26) y las columnas adyacentes (24) está dimensionado para permitir que dicha lámina (52) sea separada entre al menos una de dichas filas adyacentes (26) y dichas columnas adyacentes (24) para formar una o más aletas (28) cada una de las cuales contiene una pluralidad de aberturas (22) al menos igual a un número total de pares de segmentos de tubo en el intercambiador de calor (32)."

4.1.7 Al comparar elemento por elemento de la invención **tal como esta definido en la reivindicación uno (1)**, con el documento D1, encontramos que el mencionado documento revela todos los elementos y las características de dicha reivindicación. Donde D1 contiene:

REIVINDICACION 1	D1
Una lámina (52) de material conductor de calor configurada para ser separada para formar una o más aletas (28) para uso en una aleta (28) sobre el intercambiador de calor de tubo (32) con respecto a un número de pares verticales y horizontales de segmentos de tubo en dicho intercambiador de calor (32),	SI Ver: resaltes folios 176, figuras 1, 3; elementos 10, 12 y 30.
dicha lámina tiene un ancho (W) y un largo (H) ; y una pluralidad de aberturas (22) en dicha lámina (52), cada una de dichas aberturas (22) configurada para permitir un par de segmentos de tubo (34) paralelos del intercambiador de calor (32) para pasar a través de estos	SI Ver: resaltes folios 176, figura, 3; elementos 30,32, 40 y 42.
dichas aberturas (22) son relativamente inclinadas a dicho ancho (W) y largo (H) de dicha lámina (52), dichas aberturas (22) están dispuestas sobre dicha lámina (52) en una pluralidad de filas (26) y una pluralidad de columnas (24) con filas adyacentes (26) que están espaciadas generalmente iguales aparte y columnas adyacentes (24) que están generalmente espaciadas iguales aparte,	SI Ver: resaltes folios 176, figura, 3; elementos 30,32, 40 y 42.
y dicho espacio entre las filas adyacentes (26) y las columnas adyacentes (24) está dimensionado para permitir que dicha lámina (52) sea separada entre al menos una de dichas filas adyacentes (26) y dichas columnas adyacentes (24) para formar una o más aletas (28)	SI Ver: resaltes folios 176, figura, 3; elementos 30,32, 40 y 42.
cada una de las cuales contiene una pluralidad de aberturas (22) al menos igual a un número total de pares de segmentos de tubo en el intercambiador de calor (32)."	SI Ver: resaltes folios 176, figuras 1, 3; elementos 10, 12. 30,32, 40 y 42.

De acuerdo con lo anterior, todos los elementos caracterizados y que forman parte de la solicitud "una aleta de uso universal para intercambiador de calor" mostrados en la reivindicaciones 1-9 (folios 165-166), ya fueron divulgados en D1 por lo cual se podría considerar que carecen de novedad.

4.1.8 El grupo de reivindicaciones (19-30, 1-9) no muestran en forma concisa lo nuevo que se pretende aportar a la técnica ni aporta diferencias a lo ya existente. El análisis anterior permitiría afirmar que no cumpliría con lo estipulado en el artículo 16 de la Decisión 486 de la Comisión de la Comunidad Andina de Naciones.

5.2 Nivel inventivo (artículo 18 D486)

5.2.1 Respecto de la solicitud la reivindicación diez (10) define el intercambiador de calor así:

"Un intercambiador de calor (32), caracterizado porque comprende:

Una porción de tubo (30) que tiene una pluralidad de segmentos rectos (34) de tubos interconectados por una pluralidad de segmentos de conexión (36) de tubo con cada segmento de conexión (36) que interconecta dos segmentos rectos (34) y de conexión (36) están dispuestos en una configuración sinuosa, dicha porción de tubo (30) tiene una cantidad conocida de pares verticales y horizontales de pasajes de tubo (38); y al menos una aleta sobre dicha porción de tubo, de acuerdo con cualquiera de las reivindicaciones precedentes, en donde dicha aleta (28) tiene una cantidad de dichas aberturas (22) al menos igual a dicho numero de pares de pasajes de tubo (30) con cada par de pasajes de tubo (38) de dicha porción de tubo (30) que pasa a través de una de dichas aberturas (22) en dicha aleta (28).

5.2.2 Respecto al estado de la técnica el documento D1 contiene:

"Un intercambiador de calor (32), caracterizado porque comprende:

Una porción de tubo (30) que tiene una pluralidad de segmentos rectos (34) de tubos interconectados por una pluralidad de segmentos de conexión (36) de tubo con cada segmento de conexión (36) que interconecta dos segmentos rectos (34) y de conexión (36) están dispuestos en una configuración sinuosa

Ver: resaltes folios 176, figuras 1, 2; elementos 22, 26 y 28.

Dicha porción de tubo (30) tiene una cantidad conocida de pares verticales y horizontales de pasajes de tubo (38); y al menos una aleta sobre dicha porción de tubo, de acuerdo con cualquiera de las reivindicaciones precedentes,

Ver: resaltes folios 176, figuras 1-3; elementos 12, 30, 22, 24, 26 y 28.

en donde dicha aleta (28) tiene una cantidad de dichas aberturas (22) al menos igual a dicho numero de pares de pasajes de tubo (30) con cada par de pasajes de tubo (38) de dicha porción de tubo (30) que pasa a través de una de dichas aberturas (22) en dicha aleta (28).

Ver: resaltes folios 176, figuras 1-3; elementos 12, 30, 22, 24, 26 y 28

La diferencia entre D1 y la solicitud es la disposición de los tubos sobre la aleta, mientras en el intercambiador de la solicitud los tubos están ubicados en pares de una misma sección de tubo, en el documento D1 los pares de tubo se forman con secciones de diferentes de tubo. Estas secciones de tubo están definidas por las aberturas inclinadas que permiten mayor conductividad en el momento de la mezcla de aire hecho que incrementa la transferencia de calor. Por lo anterior se puede afirmar que no se están aportando elementos nuevos, simplemente se esta variando

la configuración del intercambiador, es decir se varia la entrada o paso del tubo sobre las aletas del intercambiador.

5.2.3 En consecuencia se puede afirmar que con los conocimientos de la persona del oficio normalmente conocedora en el campo y los elementos que revela D1 se podría lograr el resultado obtenido. El estudio anterior permitiría afirmar que las reivindicaciones 10-18 (folios 167-168) no cumplirían con lo estipulado en el artículo 18 de la Decisión 486 de la Comunidad Andina de Naciones.

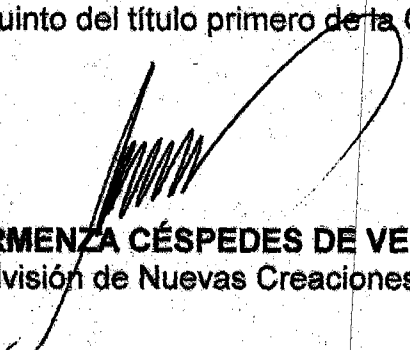
6. Conclusión:

Los requisitos de patentabilidad de la presente solicitud se encuentran afectados así:

N°	Documento N°	Reivindicaciones afectadas	Requisito que afecta
D1	US6598295	1-9	NOVEDAD
D1	US6598295	10-18	NIVEL INVENTIVO
D2	US4898232	19-30	NOVEDAD

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de 60 días contados a partir de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.


ALIX CARMENZA CÉSPEDES DE VERGEL
 Jefe de División de Nuevas Creaciones

El anterior requerimiento fue notificado por fijación en lista, de fecha
12 JUN. 2008

CONCEPTO TÉCNICO No.1585	EXAMINADOR TÉCNICO Código No.202086
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AKL