United States Patent [19]

Pasternak

[11] **3,886,639**

[45] ***June 3, 1975**

[54] **METHOD OF MAKING A FINNED HEAT EXCHANGER**

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[73] Assignee: **Peerless of America, Incorporated,** Chicago, Ill.

[*] Notice: The portion of the term of this patent subsequent to July 17, 1990, has been disclaimed.

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[21] Appl. No.: **438,682**

[52] **U.S. Cl.** ..... **29/157.3 A;** 72/325

[51] **Int. Cl.** **B21d 53/02;** B23p 15/26

[58] **Field of Search** ..... 29/157.3 A, 157.3 B; 72/325; 165/179, 181

[56] **References Cited**

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2,247,243	6/1941	Kritzer	165/177
3,202,212	8/1965	Kritzer	165/179
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3,229,722	1/1966	Kritzer	165/181 X
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3,791,003	2/1974	Pasternak	29/157.3 A
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[57] **ABSTRACT**

A heat exchanger embodying an elongated tubular member with integral fins, in the form of spines, projecting outwardly therefrom in rows, with the transversely adjacent fins in adjacent rows being disposed different distances from an end of the tubular member.

3 Claims, 5 Drawing Figures

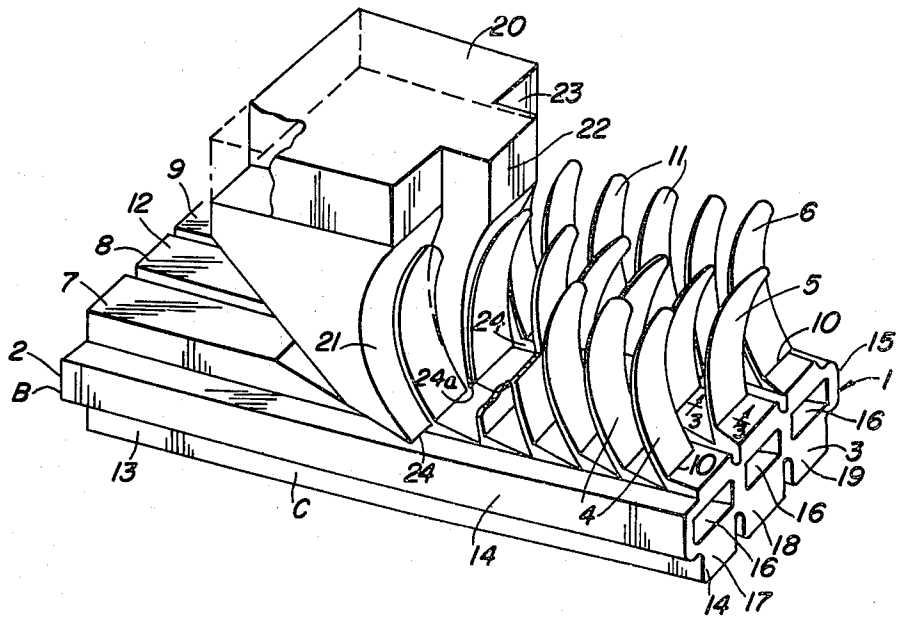


FIG - 1

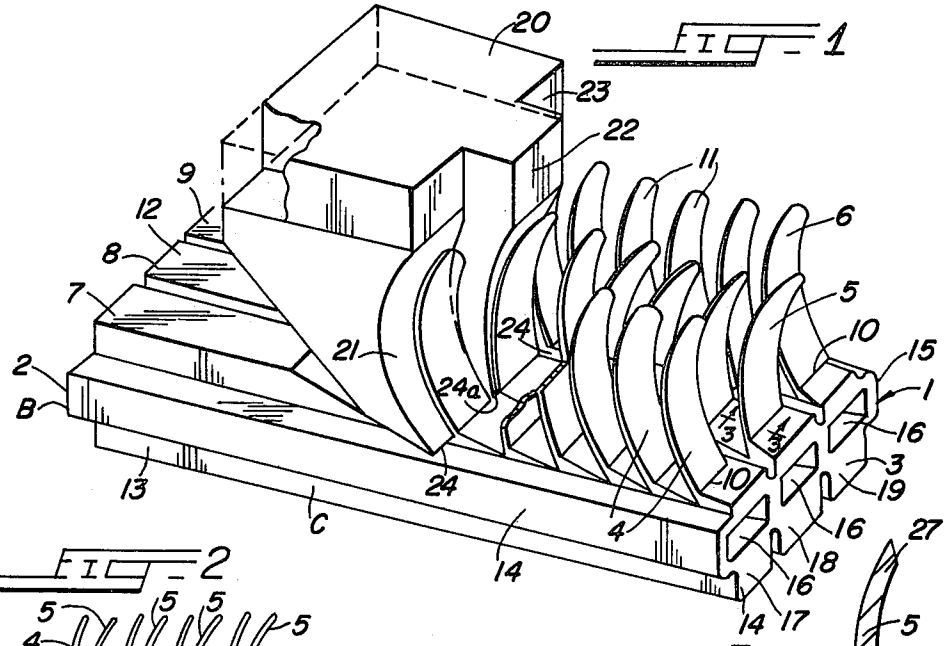


FIG - 2

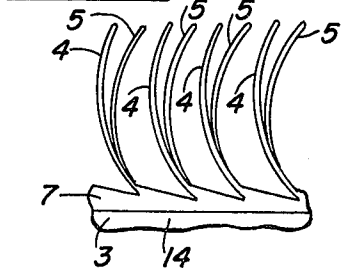


FIG - 3

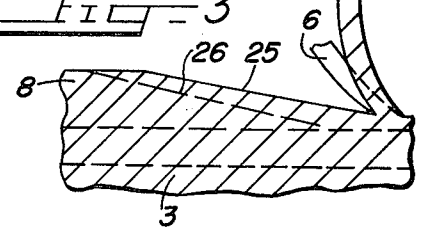


FIG - 4

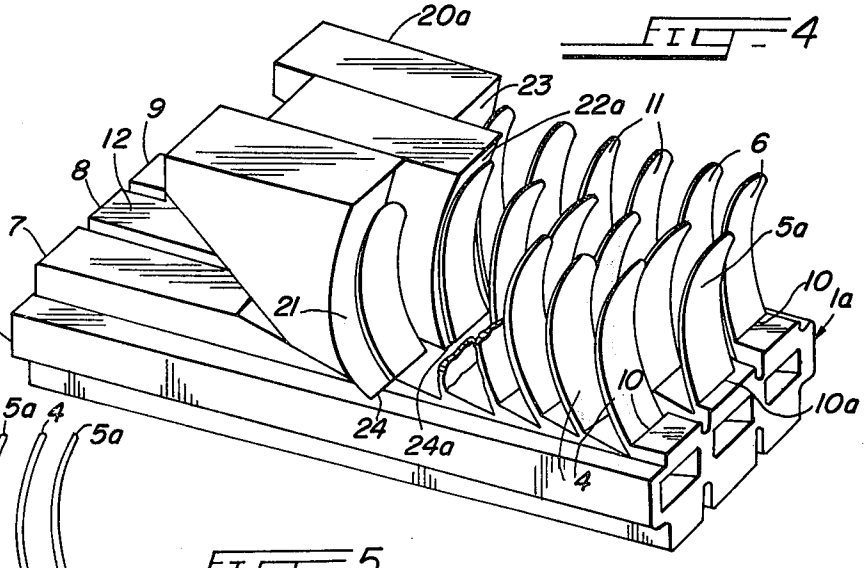
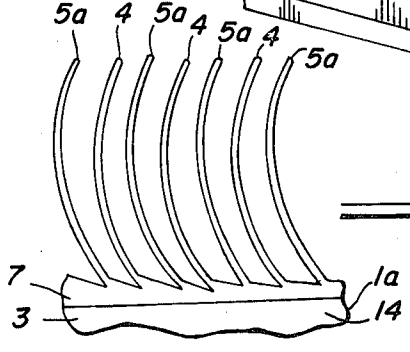


FIG - 5



METHOD OF MAKING A FINNED HEAT EXCHANGER

BACKGROUND OF THE INVENTION

This invention relates to heat exchangers and, more particularly, to heat exchangers of the type embodying outwardly projecting fins.

It is a primary object of the present invention to afford a novel heat exchanger of the finned type, and a novel method of making such a heat exchanger.

Another object is to afford a novel method of making finned heat exchangers of the type disclosed in my U.S. Pat. No. 3,746,086 issued July 17, 1973.

Another object of the present invention is to afford a novel finned heat exchanger, wherein the fins are formed by cutting or gouging them from wall portions of the heat exchanger.

Another object is to afford a novel finned heat exchanger wherein the fins are formed by cutting or gouging them from the ribs of ribbed tubular stock.

Heat exchangers embodying spines formed from outwardly projecting ribs on a tubular member have been disclosed in R. W. Kritzer U.S. Pat. Nos. 3,202,212 and 3,229,722. Heat exchangers of the type disclosed in the aforementioned Kritzer patents have proven to be very effective. However, it is an object of the present invention to afford improvements over heat exchangers of the type disclosed in the aforementioned Kritzer patents.

Another object of the present invention is to afford a novel finned heat exchanger having fins in the form of outwardly projecting spines constituted and arranged in a novel and expeditious manner.

Another object of the present invention is to afford a novel finned heat exchanger which is practical and efficient in operation and which may be readily and economically produced commercially.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of a length of heat exchanger element embodying the principles of the present invention;

FIG. 2 is a fragmentary, side elevational view of a portion of the heat exchanger element shown in FIG. 1;

FIG. 3 is an enlarged, somewhat diagrammatic, fragmentary, sectional view taken substantially on the line 3—3 in FIG. 1;

FIG. 4 is a perspective view similar to FIG. 1, but showing a modified form of the present invention; and

FIG. 5 is a fragmentary, side elevational view of a portion of the heat exchanger element shown in FIG. 4.

DESCRIPTION OF THE EMBODIMENTS SHOWN HEREIN

A heat exchanger element 1 embodying the principles of the present invention, is shown in FIGS. 1–3 of the drawings as one end portion of an elongated tubular member 2, to illustrate the presently preferred embodiment of the present invention, and to illustrate the presently preferred method of making heat exchangers in accordance with the principles of the present invention.

As will be discussed in greater detail hereinafter, in the preferred practice of the present invention the heat exchanger element 1 preferably is formed from a suitable length of tubular stock, such as the tubular member 2, working from one end portion A of the tubular member 2, FIG. 1, toward the other end B thereof, and severing the heat exchanger 1 from the remainder B–C of the tubular member 2 upon completion of the forming of the desired length of heat exchanger, such as, for example, the length A–C.

The heat exchanger element 1 embodies, in general, an elongated tubular body portion 3 having elongated fins 4, 5 and 6 projecting outwardly, in rows, from elongated, outwardly projecting ribs 7, 8 and 9, respectively, which extend longitudinally of the tubular member 2 in parallel spaced relation to each other. Each of the fins 4–6 embodies an elongated base portion 10 and an outer free end portion 11. As will be discussed in greater detail presently, the fins 4–6 are formed from the tubular body member 2, and the base portions 10 thereof are integral with the adjacent, underlying portion of the tubular body portion 3 of the finished heat exchanger.

The tubular member 2 shown in the drawings is substantially rectangular in transverse cross section, embodying a top wall 12 and a bottom wall 13 disposed in substantially parallel relation to each other, and two oppositely disposed side walls 14 and 15 extending between the respective longitudinal edges of the walls 12 and 13 in substantially perpendicular relation thereto. Openings 16 extend longitudinally through the tubular member 2. As will be appreciated by those skilled in the art, the tubular member 2 is shown in FIGS. 1–3 as being rectangular in transverse cross section and as having a plurality of openings 16 extending therethrough merely by way of illustration and not by way of limitation, and tubular members having shapes other than rectangular and having a single opening extending longitudinally therethrough may be afforded without departing from the purview of the present invention.

The tubular member 2, from which the heat exchanger 1, shown in the drawings, is made, may be formed of any suitable material, such as, for example, aluminum, and, preferably, in addition to the three ribs 7–9, which project outwardly from the top wall 12, embodies three similar ribs 17, 18 and 19 on the bottom wall 13.

In making that heat exchanger 1, a tubular member such as the tubular member 2, and embodying the ribs 7–9 and 17–19 extending the full length thereof, may first be formed. Thereafter, the fins 4–6 may be successively formed on the ribs 7–9 from one end portion of the tubular member 2, such as the end portion A, toward the other end B thereof. The fins 4–6 may be cut or gouged from the ribs 7–9, respectively, from which

they extend, by means of a suitable cutting tool, such as the cutting tool **20** shown in FIG. **1**.

The cutting tool **20** embodies three elongated cutting surfaces **21, 22** and **23**, disposed in laterally offset relation to each other in position to be moved longitudinally of the ribs **7–9**, respectively. The two cutting surfaces **21** and **23**, which are the two outermost cutting surfaces on the cutting tool **20**, are disposed in uniplanar relation to each other. Preferably, the cutting edges **24** of the cutting surfaces **21–23**, which are disposed at the lower ends of the respective cutting surfaces **21–23**, are disposed in unilinear relation to each other.

In the cutting tool **20**, the cutting surface **22**, which is disposed between the cutting surfaces **21** and **23**, projects outwardly to the right, as viewed in FIG. **1**, from the cutting edge **24** thereof a greater distance than the cutting surfaces **21** and **23** project from their respective cutting edges **24**, to thereby dispose the main body portion of the cutting surface **22** forwardly of the cutting surfaces **21** and **23** in the direction of travel of the cutting tool **20** during a cutting operation, which is from left to right, as viewed in FIG. **1**. The cutting surfaces **21–23** are of such width, and are so disposed relative to each other, that each may be moved longitudinally along a respective one of the ribs **7–9** during a cutting operation of the tool **20**.

In the operation of the cutting tool **20**, it reciprocates through a series of spaced cutting strokes from the end A toward the end B of the tubular member **2**, with the cutting surfaces **21–23** cutting and raising fins **4–6** from the ribs **7–9**, respectively. Referring to FIG. **3**, which is a somewhat diagrammatic view through the rib **8** and one of the fins **5** thereon, the fins **4–6** are formed on each of the ribs **7–9**, respectively, by passage of the cutting surfaces **21–23**, respectively, along successive, parallel paths of travel, such as the paths of travel **25** and **26** shown on the rib **8** in FIG. **3**. As the cutting edges **24** move downwardly along the successive paths of travel, the main body portions of the cutting surfaces **21–23** turn the metal thus severed from the underlying respective one of the ribs **7–9** upwardly into outwardly projecting position. Actually, because of the spacing of the successive cut lines **25** and **26** along the outer faces of the ribs **7–9**, after the initial fins **4–6** are formed on the ribs **7–9**, sloping end portions like end portions **27** shown in FIG. **3**, are initially formed upon the outer end portions of each of the fins **4–6**. However, the cutting operation causes the fins **4–6** to compress longitudinally so that, as a practical matter, the tapers **27** substantially disappear on fins of usual thickness, to thereby afford a relatively smooth-sided appearance for the outer ends of the fins **4–6** similar to that shown in FIGS. **1** and **2**.

It will be remembered that the main body portion of the cutting surface **22** is disposed forwardly of the main body portions of the cutting surfaces **21** and **23**. Thus, in the formation of the fins **4–6**, although the bases **10** of the immediately transversely adjacent fins **4–6** in the adjacent rows thereof extending along the ribs **7–8** are disposed in unilinear relation to each other, the outer free end portions **11** of each of the fins **5** on the central rib **8** projects forwardly away from the end B of the tubular member **2** a greater distance than the fins **4** and **6** on the ribs **7** and **9**, respectively.

With this construction of the heat exchanger **1**, the free end portions **11** of the ribs **5** in alternate ones of the rows afforded along the ribs **7–8** project forwardly out of uniplanar relation to the fins **4** and **6** disposed immediately transversely adjacent thereto, to thereby afford obstructions extending transversely across the passageways between the fins **4–6** spaced longitudinally of the body member **3**. This construction is effective to increase the static drop through the heat exchanger **1**, when air flow thereacross is in a direction transverse to the length of the surface from which the ribs **4–6** project. It is also effective to increase the turbulance of the air thus flowing across the heat exchanger **1**, and to increase the heat transfer capacity of the heat exchanger **1** for the same volume of air passing across such a surface, as compared to a heat exchanger construction wherein the immediately transversely adjacent fins are all disposed in uniplanar relation to each other.

After thus forming the fins **4** along the desired length of the tubular member **2**, such as the length A–C, the tubular member **2** may be severed transversely to its length at the point C to thereby afford a finished heat exchanger element having fins **4–6** spaced along the length thereof. The heat exchanger **1** is shown in the drawings as having fins **4–6** projecting outwardly from only the top wall **12** thereof, and, if desired, it may be so formed. However, if desired, fins, similar to the fins **4–6** may be cut from other sides of the tubular member **2**, such as, for example, from the ribs **17–19** on the bottom wall **13**.

In FIGS. **4** and **5** a modified form of the present invention is shown, and parts which are the same as parts shown in FIGS. **1–3** are indicated by the same reference numerals, and parts which are similar to, but substituted for parts shown in FIGS. **1–3** are indicated by the same reference numerals with the suffix *a* added thereto.

The heat exchanger **1***a* shown in FIGS. **4** and **5** is the same in construction as the heat exchanger shown in FIG. **1**, except that the bases **10** of the fins **4** and **6** disposed on the ribs **7** and **9** are not in alignment with the bases **10***a* of any of the fins **5***a* disposed on the rib **8**.

In the cutting tool **20***a*, the entire cutting surface **22***a*, including the cutting edge **24***a* thereof is disposed forwardly of the cutting surfaces **21** and **23**. Preferably, the cutting surface **22***a* projects forwardly of the cutting surfaces **21** and **23** half the distance that the fins **4–6** are spaced longitudinally of the ribs **7–8**, so that the immediately transversely adjacent fins **4** and **6** on the ribs **7** and **9** are disposed in uniplanar relation to each other, with the adjacent fins **5***a* on the rib **8** disposed midway therebetween.

With this construction, the transverse passageways afforded between adjacent pairs of fins **4** and **6** spaced longitudinally of the ribs **7** and **9** are partially blocked by fins **5***a* disposed midway therebetween, to thereby afford a narrowed, tortuous path through the fins **4–6** transversely to the length of the heat exchanger **1***a*.

It is to be observed that although only three rows of fins are shown on the heat exchangers **1** and **1***a*, this is merely by way of illustration and not by way of limitation, and that heat exchangers embodying a greater number of finned ribs spaced transversely thereacross may be afforded and formed without departing from the purview of the present invention. Also, if desired, fins in rows other than alternate rows, such as, for example, alternate adjacent pairs of rows, and the like, may be offset from each other without departing from the purview of the present invention.

From the foregoing it will be seen that the present invention affords a novel heat exchanger of the finned type, wherein the fins are in the form of spines.

Also it will be seen that the present invention affords a novel method of forming such a heat exchanger.

In addition, it will be seen that the present invention affords a novel finned heat exchanger which is practical and efficient in operation, and which may be readily and economically produced commercially.

Thus, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. The method of making heat transfer element, comprising

a. forming an elongated tubular member having a wall portion with spaced elongated external ribs extending longitudinally of said tubular member, and

b. successively, from one end portion of said tubular member toward the other end portion thereof,

1. cutting fins from a plurality of said ribs simultaneously, and by means of a cutting tool having cutting surfaces aligned with respective ones of said ribs and having alternate ones of said cutting surfaces being offset longitudinally of said ribs from the immediately transversely adjacent cutting surfaces, and

c. to thereby

1. afford

a'. elongated base portions

1'. extending across said ribs transversely to the length thereof and

2'. directly attached to said ribs, and

b'. free end portions projecting outwardly therefrom, and

2. dispose said free end portions of said fins in position wherein said free end portions of said fins on alternate ones of said rows are disposed a different distance from one end of said tubular member than the free end portions on immediately transversely adjacent fins in the other said rows.

2. The method of making a heat transfer element as defined in claim **1,** and in which

a. the immediately transversely adjacent fins on adjacent rows are formed with longitudinally aligned base portions.

3. The method of making a heat transfer element as defined in claim **1,** and in which

a. the fins in said alternate rows are formed with said base portions thereof aligned transversely to the length of said tubular member along lines extending between said base portions of the adjacent pairs of fins in said other rows.

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