Sept. 26, 1967 R. W. KRITZER 3,343,596

HEAT EXCHANGER AND DEFROSTER THEREFOR

Filed June 30, 1965

Fig. 1

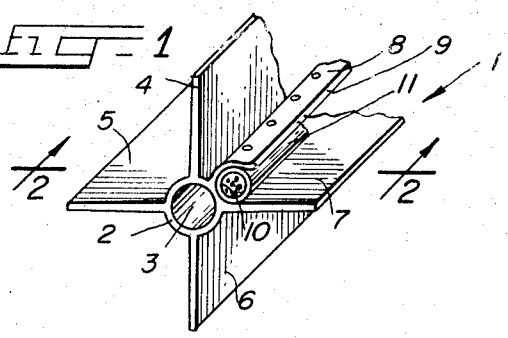


Fig. 2

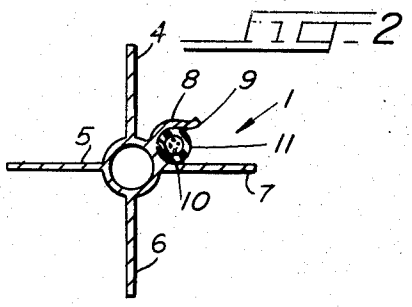


Fig. 3

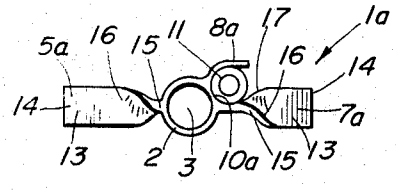


Fig. 4

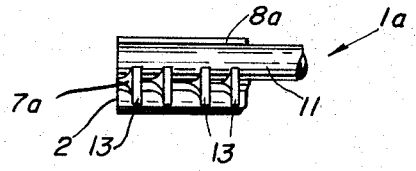


Fig. 5

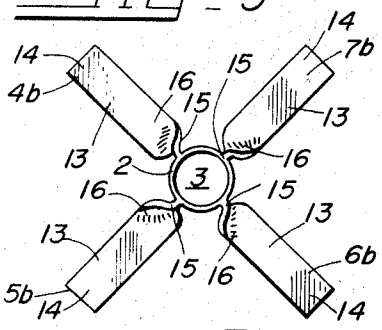


Fig. 6

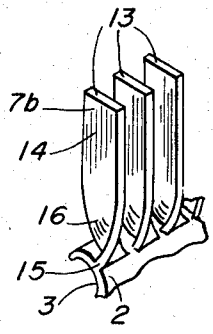


Fig. 7

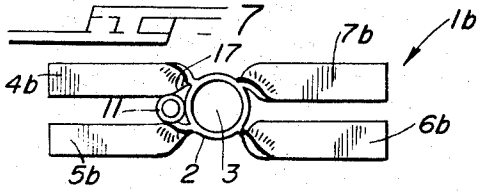
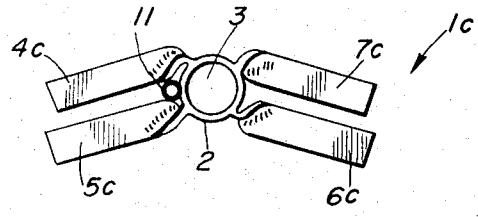


Fig. 8



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HEAT EXCHANGER AND DEFROSTER THEREFOR

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Filed June 30, 1965, Ser. No. 468,344
10 Claims. (Cl. 165—67)

This invention relates to heat exchangers, and, more particularly, to heat exchangers which are particularly well-adapted for use in refrigerator units, and the like.

It is a primary object of the present invention to afford a novel heat exchanger.

In refrigerator units, and the like, it is often desirable to mount elongated members, such as heating cables, and the like, on heat exchanger units embodied therein, such as, for example, the evaporator units thereof. It is an important object of the present invention to enable such mounting of elongated members on heat exchangers to be accomplished in a novel and expeditious manner.

The mounting of elongated members, such as heating cables, on heat exchangers is particularly important in automatically defrosting refrigerators, and the like, wherein it is desirable to mount a heating cable on the evaporator thereof for affording the heat necessary to perform the defrosting operations. It is another object of the present invention to enable such heating cables to be mounted on the evaporators of refrigerators, and the like, in a novel and expeditious manner effective to afford novel, practical and efficient mounting of such a cable.

Another object of the present invention is to enable a novel, automatically defrosting evaporator to be afforded.

Heat exchangers embodying elongated members, such as, for example, heat cables, mounted thereon have been heretofore known in the art. However, such heat exchangers heretofore known have commonly had several inherent disadvantages, such as, for example, being difficult to manufacture; being inefficient in operation; requiring excessive amounts of material in the manufacture thereof; requiring special mounting members for the cables, and the like, and which members serve no useful purpose other than the cable-mounting functions thereof; or not affording efficient heat transfer between the heating cable and the portions of the heat exchangers to be defrosted, and the like. It is an important object of the present invention to overcome such disadvantages.

Another object of the present invention is to afford a novel heat exchanger embodying a heating cable removably mounted thereon in a novel and expeditious manner.

Yet another object is to enable a novel heat exchanger of the aforementioned type to be formed as an extrusion.

A further object is to afford a novel heat exchanger embodying fins constituted and arranged in a novel and expeditious manner.

An object ancillary to the foregoing is to afford a novel heat exchanger of the aforementioned type wherein at least one of such fins is disposed in supporting relation to a heating cable.

Another object of the present invention is to enable a novel heat exchanger of the aforementioned type to be afforded wherein the parts thereof are so constituted and arranged that an elongated member, such as a heating cable, or the like, may be releasably retained between two heat transfer fins thereof in a novel and expeditious manner.

A further object is to afford a novel heat exchanger of the aforementioned type 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.

In the drawings:

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

FIG. 2 is a detail sectional view taken substantially along the line 2—2 in FIG. 1;

FIG. 3 is an end elevational view of a modified form of the heat exchanger;

FIG. 4 is a fragmentary side elevational view of the heat exchanger shown in FIG. 3;

FIG. 5 is an end elevational view of another modified form of heat exchanger, showing the heat exchanger in an early stage of the manufacture thereof;

FIG. 6 is a fragmentary perspective view of the portion of the heat exchanger in FIG. 5;

FIG. 7 is an end elevational view, similar to FIG. 5, showing the heat exchanger illustrated in FIG. 5 in a completed form of the manufacture thereof; and

FIG. 8 is an end elevational view, similar to FIG. 7 showing another modified form of the present invention.

A heat exchanger **1** embodying the principles of the present invention, is shown in FIGS. 1 and 2 of the drawings to illustrate the presently preferred embodiment of the present invention.

The heat exchanger **1** embodies an elongated tubular body portion **2** having a pasageway **3** extending axially therethrough for the passage of suitable working fluid, such as refrigerant liquid, through the body portion **2** from one end to the other. Four elongated fins **4**, **5**, **6**, and **7** extend longitudinally of the body portion **2**. In the heat exchanger **1** shown in the drawings the fins **4**–**7** project radially outwardly from the body portion **2** in equally spaced relation therearound.

The body portion **2** and the fins **4**–**7** may be made of any suitable material such as, for example, aluminum, copper, steel-alloy, and the like. Preferably, they are constructed as a single, integral unit, such as, for example, in the form of an extrusion.

The heat exchanger **1** also embodies an elongated retainer bracket or mounting bracket **8**, which extends the length of the body portion **2**, and projects laterally outwardly therefrom between the fins **4** and **7**, FIGS. 1 and 2. In the form of heat exchanger shown in FIGS. 1 and 2, the bracket **8** curves outwardly and downwardly from the body portion **2** toward the fin **7**, and terminates at its outer longitudinal edge portion in an upwardly curved lip **9**. The bracket **8** and the fin **7** are so disposed relative to each other that they define a pocket or recess **10**, which extends the length of the body portion **2**, for receiving an elongated member, such as a heating cable **11** in snug fitting engagement therein, FIGS. 1 and 2.

Preferably, the bracket **8** is of such shape that when the cable **11** is disposed in the recess **10**, the bracket **8** extends around the upper surface of the cable **11** in firmly clamped relation thereto from the body portion **2** to the inner edge **12** of the lip **9**, the inner portion **12** of the lip **9** being disposed below and forwardly of the top of the cable **11** so that the bracket **8** is effective to retain the cable **11** within the recess **10**.

In the preferred form of the heat exchanger **1**, when the cable **11** is not mounted in the recess **10**, the bracket **8** is preferably so disposed relative to the fin **7** that the distance between portion **12** of the bracket **8** and the fin **7** is somewhat less than when the cable **11** is disposed in recess **10**. With this construction, when it is desired to insert the cable **11** in assembled position in recess **10**, it may be pressed laterally against the lower surface of the lip **9** to thereby cam the bracket **8** upwardly away from the fin **7** and permit the cable **11** to be pressed into the recess **10**. As the cable **11** moves into normal operative position in the recess **10**, the bracket **8** and the fin **7** again flex toward each other, to thereby snugly clamp the cable **11** between the bracket **8** and the fin **7** with the inner edge **12** of the lip **9** in the aforementioned retaining position relative to the cable **11**, and with the fins **4–7** projecting outwardly from the body portion to a distance substantially greater than the width of said cable **11**.

If, after the cable **11** has thus been disposed in normal operative position in the recess **10**, it is desired to remove the cable **11** from the heat exchanger **1**, this may readily be accomplished by pulling outwardly on the cable **11** in a direction toward the opening defined by the fin **7** and the lip **9**. Such outward pulling on the cable **11** is effective to again cam the bracket **8** and the fin **7** away from each other to thereby permit the cable **11** to be withdrawn from the recess **10**.

With the heat exchanger **1** constructed in the aforementioned manner, the cable **11** may be releasably retained thereon in a manner effective to insure good heat exchange relation between the heat exchanger **1** and the cable **11**.

Also, with the heat exchanger **1** constructed in accordance with the principles of the present invention, the cable **11** may be readily inserted into and removed from operative, assembled position in the recess **10**.

In addition, with the heat exchanger **1** and the cable **11** disposed in assembled relation, as shown in FIGS. 1 and 2, the construction of the assembled unit is such that it may be used to afford heat exchangers, such as, for example, evaporators for refrigerator units and the like, of various shapes and forms. Thus for example, if desired, the assembled unit afforded by the heat exchanger **1** and the cable **11** may be bent into a serpentine shape, the cable **11** being so disposed with respect to the body portion **2** and the fins **4–7** that the heat exchanger **1** may be bent into substantially any serpentine shape which would be practical if the cable **11** were not present in the assembled unit. Also, if desired, the heat exchanger **1**, with the cable **11** disposed in assembled relation thereon, may be used in the form of an elongated, straight heat exchanger, or a plurality of straight sections of the heat exchanger **1** may be disposed in parallel nested relation to each other.

In FIGS. 3 and 4 of the drawings, a modified form of the present invention is shown, and parts thereof which are the same as parts shown in FIGS. 1 and 2 are indicated by the same reference numerals, and parts which are similar to, but which have been substituted for corresponding parts shown in FIGS. 1 and 2 are indicated by the same reference numerals with the suffix "*a*" added thereto.

The heat exchanger **1***a* shown in FIGS. 3 and 4 includes an elongated tubular body portion **2** having a passageway **3** extending axially therethrough for the passage of a suitable working fluid, such as, for example, the aforementioned refrigerant liquid. Two elongated fins **5***a* and **7***a* project substantially radially outwardly from diametrically opposed sides of the body portion **2**, and extend longitudinally of the body portion **2** preferably throughout the full length thereof. Each of the fins **5***a* and **7***a* comprise a plurality of spines **13**, each of which embodies a substantially flat outer end portion **14** connected to a base portion **15** by a curved intermediate portion **16**, FIG. 3. The base portions **15** of the spines **13** in each of the ribs **5***a* and **7***a* preferably are disposed in longitudinal

alignment with each other longitudinally of the body portion **2**, and the outer end portions **14** are preferably perpendicular to the base portions **15** and are disposed in parallel spaced relation to each other longitudinally of the body portion **2**. As will be appreciated by those skilled in the art, the spines **13** may be formed in any suitable manner, but, preferably, they are formed in the manner discussed in greater detail in my co-pending application for United States Letters Patent, Ser. No. 476,010, filed July 30, 1965.

The heat exchanger **1***a* includes a retainer bracket or mounting bracket **8***a*, which is the same as the mounting bracket **8** shown in FIGS. 1 and 2 except that it does not embody the outwardly curved lip **9** thereof. In the heat exchanger **1***a* shown in FIGS. 3 and 4, the curved intermediate portions **16** of the spines **13** of the fin **7***a* form concave-upwardly, arcuate portions **17** facing toward the bracket **8***a*, FIG. 3. The arcuate portions **17** extend outwardly beyond the free longitudinal edge of the bracket **8***a*, so that when it is desired to insert the cable **11** in the recesses **10***a* of the heat exchanger **1***a*, the cable **11** may first be disposed between the outer longitudinal edge of the bracket **8***a* and the outer edge portion of the arcuate portion **17** of the fin **7***a*, and, thereafter, when the cable **11** is pressed toward the recess **10***a*, the bracket **8***a* and the spines **13** of the fin **7***a* are first cammed outwardly away from each other, and then the resiliency thereof brings the bracket **8***a* and the spines **13** of the fins **7***a* back toward each other into firm clamping engagement with cable **11**. When the cable **11** is disposed in normal operative position in the recess **10***a*, the arcuate portion **17** of the fin **7***a* extends upwardly around the lower outer portion of the cable **11** in position to effectively releasably retain the cable **11** in the recess **10***a*.

With the heat exchanger **1***a* constructed in the manner illustrated in FIGS. 3 and 4, the cable **11** and the bracket **8***a* are disposed in relatively closely overlying relationship to the fin **7***a*, so that individual sections of the heat exchanger **1***a* may be stacked vertically, as viewed in FIG. 3, in relatively closely disposed relation to each other.

Also, with such construction of the heat exchanger **1***a*, if desired, the heat exchanger **1***a* may be bent into other shapes, such as, for example, into a serpentine shape, the bends of which are along vertical planes, as viewed in FIG. 3, to thereby afford a compact heat exchanger.

In FIGS. 5, 6, and 7 another modified form of the present invention is shown. The heat exchanger **1***b* shown in FIGS. 5–7, is identical in construction to the heat exchanger **1***a* shown in FIGS. 3 and 4 except that it embodies four fins **4***b*, **5***b*, **6***b*, and **7***b*, rather than the two fins **5***a* and **7***a* of the heat exchanger **1***a*; and does not embody the mounting bracket **8***a*. The fins **4***b*–**7***b* are identical in construction to the fins **5***a* and **7***a*, each embodying the spines **13**.

In the manufacture of the heat exchanger **1***b*, it may first be extruded in such form that the fins **4***b*–**7***b* are each substantially flat members projecting radially outwardly from the body portion **2** in the manner of the ribs **4–7** shown in FIGS. 1 and 2. Thereafter, the spines **13** in each of the ribs **4***b*–**7***b* may be formed in the same manner as heretofore discussed with respect to the spines **13** of the ribs **5***a* and **7***a* shown in FIGS. 3 and 4. The structure resulting from such formation of the heat exchanger **1***b* is that shown in FIG. 5 wherein the ribs **4***b* and **6***b* are disposed in substantially uniplaner relation to each other, and the ribs **5***b* and **7***b* are disposed substantially perpendicular to the ribs **4***b* and **6***b* and in substantially uniplanar relation to each other.

Thereafter, in the manufacture of the heat exchanger **1***b*, the cable **11** is preferably disposed between the ribs **4***b* and **5***b*, in engagement with the outer peripheral surface of the body portion **2**, and the ribs **4***b*–**7***b* may then be bent into position wherein the ribs **4***b* and **5***b* are disposed in substantially parallel relation to each other, and ribs **6***b* and **7***b* are disposed in substantially parallel rela-

tion to each other, as shown in FIG. 7. In such position of the ribs 4*b*–7*b*, the ribs 4*b* and 5*b* are disposed in firm clamping engagement with the cable **11**, with the ribs 4*b* and 7*b* disposed in substantially uniplanar relation to each other, and the ribs 5*b* and 6*b* likewise disposed in substantially uniplanar relation to each other. Such bending of the ribs 4*b*–7*b* may be performed in any suitable manner, such as, for example in a suitable press.

Preferably, when the ribs 4*b* and 5*b* are disposed in the position shown in FIG. 7, the cable **11** is disposed within the arcuate portion **17** of the rib 4*b* in such position that it is effectively retained by the ribs 4*b* and 5*b* in firm engagement with the adjacent outer peripheral surface of the body portion **2** in good heat-transfer relation thereto.

With the heat exchanger 1*b* constructed in the aforementioned manner, a heat exchanger which is relatively narrow in a vertical direction, as viewed in FIG. 7, is afforded.

Also, it will be seen that with the heat exchanger 1*b* constructed in the manner shown in FIG. 7, if it is desired to dispose it in a serpentine shape, a relatively thin heat exchanger of such a type, having the adjacent passes of the body portion **2** thereof disposed relatively close to each other may readily the afforded by forming the bends of the serpentine configuration in a vertical plane, as viewed in FIG. 7.

In FIG. 8 another modified form of the present invention is shown. The heat exchanger 1*c* shown in FIG. 8 is identical in construction to the heat exchanger 1*b* shown in FIG. 7, except that the fins 4*c*–7*c* thereof are not disposed in horizontal planes, but are bent downwardly at an arcuate angle to the horizontal. With this construction, the upper surfaces of the fins 4*c*–7*c* slope downwardly and outwardly away from the body portion **2** to thereby afford particularly effective paths for the drainage of moisture from the heat exchanger 1*d* during a defrosting operation.

From the foregoing, it will be seen that the present invention affords a novel heat exchanger wherein a heating cable or the like, may be effectively removably mounted thereon in a novel and expeditious manner.

Also, it will be seen that the present invention affords a novel heat exchanger of the aforementioned type wherein the heating cable thereof is so positioned that the heat exchanger may be bent into substantially any practical shape without interference from the cable.

In addition, it will be seen that the present invention affords a novel heat exchanger of the aforementioned type wherein the heating cable thereon is disposed in a substantially non-protruding position.

Also, it will be seen that the present invention affords a novel 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 the 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. A heat exchanger comprising
(a) an elongated tubular body portion having
  (1) a passageway extending axially therethrough
(b) elongated fins
  (1) projecting laterally from said body portion,
  (2) extending longitudinally thereof,
  (3) each comprising a plurality of elongated spines projecting longitudinally from said body portion,
(c) an elongated cable extending longitudinally of said body portion, and
(d) means for retaining said cable on said body portion
(e) said means including one of said fins supportingly engaging said cable.

2. A heat exchanger as defined in claim **1**, and in which
(a) said means includes a bracket member
  (1) projecting laterally from said body member in spaced relation to said one fin, and
  (2) supportingly engaging said cable on the side thereof remote from said one fin.

3. A heat exchanger as defined in claim **1**, and in which
(a) said means includes another of said fins supportingly engaging said cable on the side thereof remote from said one fin.

4. A heat exchanger comprising
(a) an elongated tubular body portion
(b) a plurality of elongated fins
  (1) extending along said body portion, and
  (2) projecting laterally outwardly therefrom
(c) an elongated member, and
(d) means for releasably retaining said elongated member on said body portion in substantially parallel relation thereto,
(e) said fins being of substantially greater lateral width than said elongated member,
(f) said means including one of said fins supportingly engaging said elongated member.

5. A heat exchanger as defined in claim **4**, and in which
(a) said means includes a retainer bracket arched around said elongated member on the side thereof remote from said one fin.

6. A heat exchanger as defined in claim **4**, and in which
(a) said means includes a retainer bracket engaged with said elongated member in position to clamp the latter against said one fin.

7. A heat exchanger as defined in claim **4**, and in which
(a) said means includes another of said fins disposed in such position relative to said one fin as to define a pocket within which said member is disposed
(b) said pocket extends around said member and has an opening in one side thereof through which said member may be inserted into and removed from said pocket, and
(c) said opening normally is narrower than the width of said member.

8. A heat exchanger as defined in claim **7**, and in which
(a) all of said fins comprise a plurality of elongated spines projecting outwardly from said body portion in spaced relation to each other.

9. A heat exchanger comprising
(a) an elongated tubular body portion having
  (1) a passageway extending axially therethrough
(b) elongated fins
  (1) projecting laterally from said body portion, and
  (2) extending substantially the full length thereof,
(c) an elongated cable extending longitudinally of said body portion, and
(d) means for retaining said cable on said body portion
(e) said means including
  (1) one of said fins supportingly engaging said cable, and
  (2) another of said fins suportingly engaging said cable on the side thereof remote from said one fin,
(f) said one fin and said other fin each comprising a plurality of elongated spines having longitudinal edges disposed in engagement with said cable.

10. A heat exchanger comprising
(a) an elongated tubular body portion
(b) a plurality of elongated fins
  (1) extending along said body portion, and
  (2) projecting laterally outwardly therefrom
(c) an elongated member, and

(d) means for releasably retaining said elongated member on said body portion in substantially parallel relation thereto,

(e) said means including

(1) one of said fins supportingly engaging said elongated member, and

(2) another of said fins disposed in such position relative to said one fin as to define a pocket within which said member is disposed,

(f) said pocket extending around said member and having an opening in one side thereof through which said member may be inserted into and removed from said pocket, and

(g) said opening normally being narrower than the width of said member,

(h) said one fin and said other fin each comprising a plurality of elongated spines extending from said body portion in spaced relation to each other,

(i) said spines in each of said fins having

(1) elongated bases disposed in substantially longitudinally aligned relation to each other,

(2) outer end portions disposed substantially parallel to each other, and

(3) intermediate portions curving from said bases to said outer end portions, and

(j) said intermediate portions on said one fin and on said other fin being clampingly engaged with said elongated member.

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