

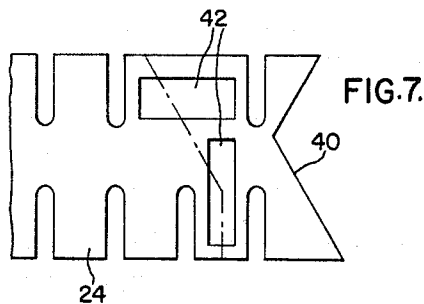
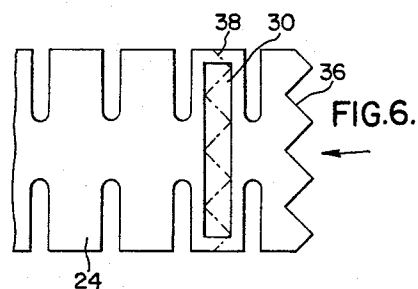
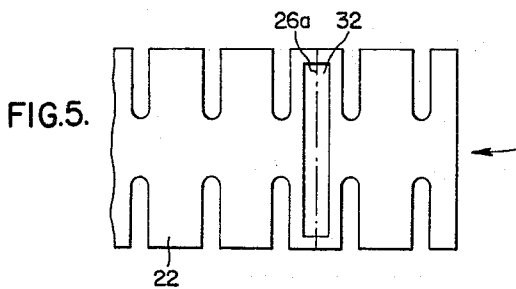
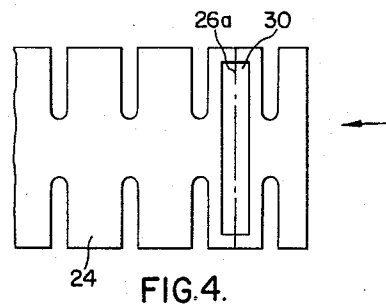
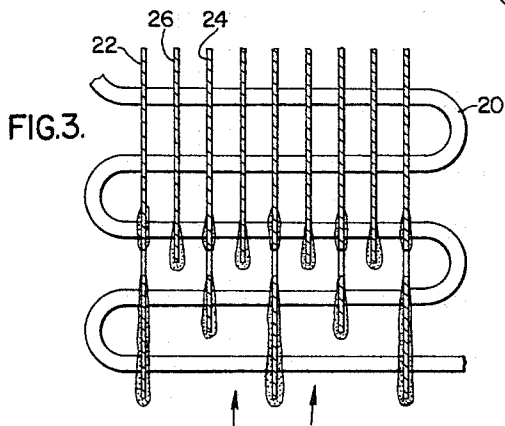
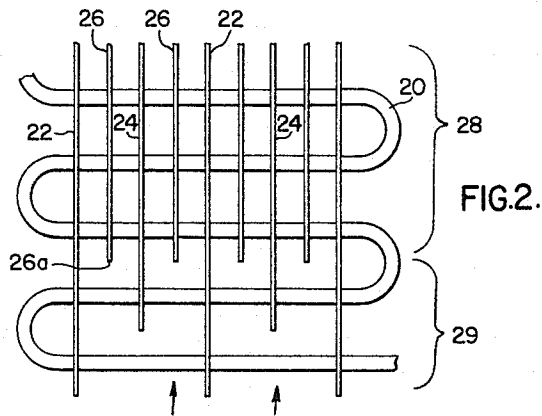
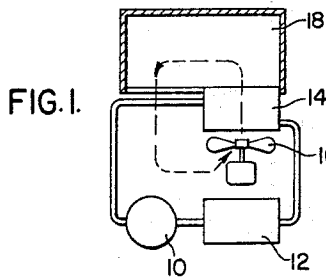
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A. J. PFEIFFER ETAL

3,267,692

STAGGERED FINNED EVAPORATOR STRUCTURE

Filed May 28, 1965



INVENTORS
Aelred J. Pfeiffer
& Philip F. Harbour
BY *Edward C. Gray*
ATTORNEY

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3,267,692

STAGGERED FINNED EVAPORATOR STRUCTURE

Aelred J. Pfeiffer and Philip F. Harbour, both of Columbus, Ohio, assignors to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania
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This invention relates to a refrigeration system of the character in which air is chilled to a below-freezing temperature.

The general problem with which this invention is concerned is encountered, for example, in the so-called frostless food freezers in which air at a below-freezing temperature is circulated through the frozen food compartment. Such freezers substantially avoid the build-up of frost upon the food packages by removing most of the moisture from the air in the form of frost on an evaporator operating at a temperature substantially below freezing. The frost on the evaporator must be periodically removed by defrosting the evaporator to reduce the resistance to air flow presented by the frost build-up, and to restore the initial heat transfer characteristics of the evaporator. By and large however, lengthening of the time between defrosting cycles is desirable since reduction in frequency of defrosting in turn promotes overall uniformity of temperature in the freezer compartment, and reduces the fluctuations in load against which the refrigeration system works.

Accordingly, the general object of the invention is the provision of a refrigeration arrangement in which the frequency of defrosting is reduced.

A more specific object is the provision of such an arrangement in which the evaporator is designed to accumulate a substantially greater frost build-up without unduly restricting air flow therethrough.

It is contemplated, in accordance with the invention, that a fin and tube evaporator be provided with the leading edges of adjacent fins having a staggered arrangement, and with the more forwardly projecting fins being provided with cut-out areas in their surfaces generally facing the leading edges of the adjacent recessed fins. Accordingly the frost, which tends to first accumulate on the leading edges of the fins, is permitted to build up in a transverse direction to a substantially greater degree without unduly narrowing the air flow passages between the adjacent fins at the point of frost build-up. In accordance with an additional feature of the invention, clogging of the air flow passages between fins is further reduced by effectively lengthening the leading edges of individual fins by notching or, alternatively, otherwise providing inclined contours in the leading edges.

The invention will be described in connection with the accompanying drawing in which several embodiments incorporating the invention are illustrated by way of example, and wherein:

FIGURE 1 is a schematic representation of one refrigeration arrangement incorporating the invention;

FIGURE 2 is a top view of a fin and tube type evaporator having the staggered fin array presented by the air entering face of the evaporator;

FIGURE 3 is a sectional view of the evaporator of FIGURE 1 illustrating the manner in which frost accumulates on the leading edges of the fins;

FIGURE 4 is a fragmentary side view of a medium length fin having a cut-out in its surface area generally facing the leading edge of a shorter length fin;

FIGURE 5 is a fragmentary side view similar to FIG. 4 but illustrating the arrangement of the cut-out in a long fin;

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FIGURE 6 is a fragmentary side view of a medium length fin having a leading edge shaped to effectively lengthen it in accordance with one modification of the invention; and

FIGURE 7 is a fragmentary side view of another fin having a shaped leading edge to effectively lengthen it in accordance with another modification of the invention.

The refrigeration arrangement of FIGURE 1 includes a refrigerant compressor 10 connected to supply refrigerant through condenser 12 to a fin and tube type evaporator 14 which receives refrigerant in a state sufficient to depress the temperature of the evaporator to a level well below freezing. The air to be cooled is forced through the evaporator, passing between the parallel fins, by means of a fan 16. Suitable duct-work carries the cold air to the freezer compartment 18 and back to the fan in the recirculating path generally indicated by the broken-line arrows of FIGURE 1.

The evaporator 14 (FIG. 2) is of the extended surface type comprising a serpentine tube arrangement and a plurality of spaced-apart, generally parallel fins. The fins are suitably slotted to accommodate the serpentine tubes 20 which wind back and forth transverse to the planes of the fins, and to carry the refrigerant into heat transfer relation with the evaporator fins. In some arrangements one tube circuit carries refrigerant for cooling purposes only, while a separate tube may be provided to carry a defrosting fluid (usually hot refrigerant gas) at selected times to defrost of the evaporator.

In the examples shown in FIGURES 2 and 3, the evaporator includes fins of three different lengths as measured in the direction of air flow indicated by the arrows. One set of fins 22 have their leading edges projecting farthest upstream into the air flow and are termed the long fins. Another set of fins 24 have their leading edges recessed, i.e., offset in a downstream direction from the leading edges of the long fins, and these fins are identified as medium length fins 24. The third set of fins 26 are the shortest fins in the direction of air flow and have leading edges recessed still farther in a downstream direction.

The staggered relation of the upstream leading edges of the fins creates spacing relationship between transversely facing fins which becomes successively more open toward the upstream (air entering) face of the evaporator. Thus in the main portion 28 of the evaporator there are only single width spacings between facing fins, while in the leading portion 29 double and quadruple width spacings are provided. Thus, when the frost builds up on the leading edges of the various fins in the generally air foil shapes represented in FIGURE 3, the thickest portions of the frost, as measured in a transverse direction on adjacent fins are staggered or offset from each other. This arrangement substantially reduces the obstruction to air flow which builds up in a given length of time, as compared to a fin arrangement in which the leading edges of adjacent fins are aligned in a transverse direction.

Referring now to FIGURES 4 and 5, it will be seen that both the medium length fin 24, and the long fins 22 are provided with cut-out portions 30 and 32, respectively, which transversely face the leading edge 26a (indicated by the broken line of the adjacent short fin 26). The purpose of the cut-outs 30 and 32 is to provide an area where no frost build-up can occur on the medium and longer length fins. Thus, a passage for air flow remains for a considerably longer period after the frost build-up on the leading edge of the short fins extends substantially into the space between the adjacent fins.

It is also desirable, in accordance with the invention, to effectively lengthen the leading edges of the fins to spread out a given amount of moisture in the form of

frost build-up over a longer length so that the thickness of the frost build-up in a transverse direction is correspondingly lessened. FIGURES 6 and 7 illustrate forms that the leading edges of the various fins may take in effectively lengthening these leading edges. In FIGURE 6 both the medium length fin 24 and the short fin are provided with saw-toothed shaped notches 36 and 38, respectively, to effect the lengthening of the leading edges. In FIGURE 7 the medium fin 24 is provided on its leading edge with a single notch 40, and the leading edge of the short fin 26, again indicated by the broken line, simply extends at an angle for most of its length. In FIGURE 7 the cut-out portions 42 are located to face a substantial part of the length of the leading edge of the short fin and are formed as two separate cut-outs with a bridge between for purposes of rigidity of the fin.

Other details in arrangement embodying the concepts of the invention will likely suggest themselves readily to those working in the art. Thus, for example, the cut-out areas may in some instances take the form of the space left when a tab is bent out transversely. As a further example, the number of sets of fins may differ appreciably. Accordingly, it will be understood that the examples shown and described herein are only currently preferred modes of carrying out the invention and are not intended to limit the scope of the invention, as defined by the appended claims, to the specific detail illustrated.

Having described our invention we claim:

1. In a refrigeration system in which an evaporator is adapted to normally operate at below-freezing temperatures:

an evaporator having spaced-apart, generally parallel fins between which air flows to be cooled;
a refrigeration producing system connected to said evaporator to supply refrigerant thereto in a condition producing a below-freezing temperature;
means supplying a flow of air to be cooled to said evaporator;

said evaporator having at least two sets of fins alternating with each other, at least a portion of the fin leading edges of one set of fins projecting farther upstream into said air flow than the corresponding leading edge portion of the other set of fins, so that multiple spacings, in a transverse direction between facing fins, are presented by the upstream face of the evaporator as a whole;

said one set of fins including surface areas downstream from said leading edge portions provided with cut-out areas generally facing, in a transverse direction, the leading edge portions of said other set of fins having leading edge portions recessed in a downstream direction to delay clogging of said evaporator due to frost build-up on said leading edge portions of said other set of fins.

2. A system as specified in claim 1 in which:
at least a portion of the length of the leading edges of one set of fins extends at an angle with respect to

the direction of said air flow to effectively lengthen said leading edges.

3. A fin arrangement for a fin and tube type refrigerant evaporator adapted to normally operate at a below-freezing temperature, including:

a series of spaced-apart, generally parallel fins between which air to be chilled is directed, the upstream edges of adjacent fins being staggered to project upstream and to be recessed downstream with respect to each other to provide multiple spacing, as measured in a direction transverse to the direction of air flow, between facing fins in the upstream portion of said evaporator as compared to the spacing between facing fins in the main body portion of said evaporator;

said upstream projecting fins including cut-out portions in that area of their surfaces facing, in a transverse direction, the leading edges of the recessed fins to delay bridging of frost between said leading edges of said recessed fins and said fins having said facing cut-out portions.

4. A fin-type refrigerant evaporator adapted to normally operate at below-freezing temperatures to chill air passing between the fins, including:

a main portion formed of a number of spaced-apart, generally parallel fins;

an upstream portion formed by the uninterrupted forward projection of selected ones of said fins, with others of said fins having leading edges downstream, with respect to air flow, from the leading edges of said selected fins;

the surface areas of said selected fins including openings therein facing, in a transverse direction, said leading edges of said other fins to delay clogging of said evaporator due to frost build-up on said leading edges of said other fins.

5. The evaporator of claim 4 wherein:

at least a portion of the leading edges of said selected fins and said other fins are inclined with respect to the direction of said air flow to effectively lengthen said leading edges.

6. The refrigerant evaporator of claim 4 wherein:

at least a portion of the leading edges of said selected fins and said other fins include V-shaped notches therein.

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ROBERT A. O'LEARY, *Primary Examiner*.

MEYER PERLIN, *Examiner*.

W. E. WAYNER, *Assistant Examiner*.