In general, this invention relates to a new and improved ribbed or extended surface tray for use in freeze-drying apparatus and a method of making the same. More particularly, the present invention relates to a better ribbed tray (hereinafter referred to as an extended surface tray) which can be manufactured economically and at the same time be food sanitary.

Industry is making wide use of freeze-drying techniques and vacuum-drying techniques in the preparation of many products. Freeze-drying can be utilized for the processing of extracts, citrus juices, meats, milk, blood, bones, etc., so that they may be stored indefinitely without refrigeration. Modern processing of such articles is being accomplished without impairment or loss of natural flavor, vitamin content or quality.

Extended surface trays are used as a means of accelerating the freeze drying cycle. The purpose of the extended surface is to provide a high ratio of heating surface to product mass. Heat is conducted upward from the bottom of the tray and in turn is re-radiated and conducted to the product. These trays have been extremely successful and have reduced freeze drying cycles by fifty percent or more. In addition, the uniformity and quality of the product have improved since all levels of the product are being exposed to a similar temperature condition.

It is the general object of this invention to produce an extended surface tray which is food sanitary and can be manufactured economically.

Another object is to produce a ribbed tray for drying purposes which eliminates the need for welding the ribs to the bottom of the tray.

And the further object of the invention is to produce a tray without welded corners so that there is a substantial clearance between the end of each rib and the end of the tray for simple cleaning of the tray.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentations shown.

FIGURE 1 is a perspective view of an extended surface tray manufactured in accordance with the principles of the present invention.

FIGURE 2 is a partial perspective view of an extruded member to be manufactured into the extended surface tray of FIGURE 1.

FIGURE 3 is a partial view of the extrusion of FIGURE 2 after the second step of the manufacture has been completed.

FIGURE 4 is a partial view of the extrusion of FIGURE 2 after a third step of manufacture has been completed.

FIGURE 5 is a top plan view of a tray manufactured from the extrusion of FIGURE 2.

FIGURE 6 is a cross sectional view of a tray of FIGURE 5 taken along lines 6-6.

FIGURE 7 is a cross sectional view of a tray of FIGURE 6 taken along lines 7-7.

FIGURE 8 is a partial perspective view of a second type of rib which might be utilized in the tray of the present invention.

In FIGURE 1, there is shown an extended surface tray built in accordance with the principles of the present invention.

The tray 10 includes a bottom wall 12 having holes (not shown) therethrough. The holes are useful to provide more efficient radiant heat transfer and also aid in the circulation of vapors from the specimens within the tray during the freeze drying operation. However, a solid bottom tray may be utilized if desired. The tray 10 has two longitudinally extending side walls 14 and 16 on either side thereof. The side walls 14 and 16 extend slightly less than the length of the bottom wall 12 and are perpendicular thereto. A pair of opposite end walls 18 and 20 extend from the bottom wall 12 and form slight gaps at the corner of the tray 10. These gaps provide sufficient clearance for cleaning the inside of the tray by the elimination of closed corners. Within the tray 10 are upwardly extending ribs 22 parallel to each other and having a height slightly less than the height of the side walls 14 and 16 and the end walls 18 and 20. The ribs 22 have a length slightly less than the length of the side walls 14 and 16 so as to provide substantial clearance between the ends of the ribs 22 and the end walls 18 and 20. This eliminates the need for welding the ribs to the end wall while providing an easy method of cleaning the tray 10.

The tray 10 shown in FIGURE 1 can be easily manufactured in accordance with the method shown in FIGURES 2-7. In FIGURE 2, there is shown an extruded member 24 from which will be manufactured the freeze tray 10. The member 24 is extruded from extrusion grade stock by any of the standard methods of extruding metal. The member 24 consists of a base member 26 from which extend perpendicularly side walls 28 and 30 and ribs 32. The side walls 28 and 30 are parallel to each other and to the ribs 32. The ribs 32 have a height slightly less than the height of the side walls 30. In the center of the bottom portion 26, there are drilled holes 34 between the ribs 32 for the reasons discussed with respect to FIGURE 1.

After the provision of the extruded member 24 as shown in FIGURE 2, the next step in the manufacture of the freeze drying tray 10 is the milling of the side walls 28 and 30 and the ribs 32 along a line 38. The side walls 28 and 30 and the ribs 32 are milled leaving a flap portion 36 of the bottom wall 26.

A second milling operation forms the third step in the manufacture of the freeze drying tray 10. In FIGURE 4, this second milling step includes milling the exposed ends of the ribs 32 along a line 40 slightly inwardly and parallel to the line 38. The line 40 in one actual embodiment of the present invention is one-quarter inch from the line 38.

The next step in the manufacture of the freeze drying tray 10 is the folding of flap 36 along fold line 42 spaced from the mill line 38. This can best be seen with respect to FIGURES 5 and 7.

The folding of the flap 36 along line 42 forms clearance spaces 44 and 46 between the flap 36 and the ends of side walls 28 and 30. In an actual embodiment, the clearance spaces 44 and 46 were approximately one-quarter inch wide.

It can easily be seen that to form the freeze drying tray 10 shown in FIGURE 1, it is only necessary to cut off the member 24 along a suitable line parallel to lines 38 and 40 and then perform the methods of manufacture discussed with respect to FIGURES 3-5.

As shown in FIGURE 6, a food specimen F can be placed between the ribs 32. It is to be understood that the holes 34 have a cross sectional area less than the cross sectional area of the specimen F to be freeze dried. The ribs 32 have a height slightly less than the height of the...
side walls 28 and 30 so as to prevent overflowing of the freeze drying tray.

Thus, by the method of manufacture shown in FIGURES 2–7, the freeze drying tray 10 shown in FIGURE 1 has been manufactured without the need for welding along any joints. Additionally, clearance has been provided between the side walls 28 and 30 and the end wall 36 so that the tray may be easily cleaned and has no corners. The ribs 32 are provided with an even greater clearance to the end wall 36 so that the entire unit may be easily cleaned and reused.

In FIGURE 8, there is shown a second type of rib 32' which might be utilized with the tray shown in FIGURES 1–7. The rib 32' is integral with the bottom wall 26' as discussed previously. However, the rib 32' has longitudinally extending grooves 48 formed along the side walls thereof. These longitudinally extending grooves 48 can easily be formed in the extruding process. These longitudinal grooves serve to form additional surface area for radiating heat. In this regard, they extend the surface area of the tray to an even greater extent than the tray shown in FIGURES 1–7.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

We claim:

1. A tray comprising a bottom wall having parallel side and end edges, side walls integral with and extending substantially perpendicular to said bottom wall side edges, said side walls having a length slightly less than the length of said side walls, parallel ribs integral with said bottom wall and spaced parallel to and between said side walls, said ribs having a length slightly less than the length of said side edges, and end walls substantially perpendicular to said bottom wall, side walls and ribs, said end walls being integral with said bottom wall end edges and spaced from the adjacent ends of the side walls.

2. The tray of claim 1 wherein said parallel ribs have a length slightly less than the length of said side walls, said parallel ribs extending from said bottom wall a height slightly less than the height said side walls extend from said bottom wall.

3. The tray of claim 2 wherein said bottom wall has holes therethrough between said ribs, said holes having a cross sectional area less than the cross sectional area of specimens to be placed in the tray for freeze drying.

4. The method of manufacturing an extended surface tray comprising the steps of extruding a metal piece to form integral perpendicular spaced parallel ribs extending the length of the bottom wall, milling the ribs from the bottom wall along opposite ends of the extruded metal member, folding the milled portions of the bottom wall on opposite ends of the extruded member along a line spaced from and parallel to the end edges of the ribs with said portions and said ribs being on the same side of the remainder of said bottom wall.

5. The method of claim 4 wherein the step of extruding includes extruding the ribs along the side edges of the bottom wall to a height greater than the ribs in the center of the bottom wall, and the step of milling the ribs off the ends of the bottom wall includes milling the bottom wall at opposite ends of the extruded member a distance slightly greater than the height of the side walls.

6. The method of claim 5 including a second step of milling the centrally located ribs on opposite ends of the extruded member after the first milling operation has been completed.

7. A tray comprising a bottom wall having parallel pairs of side and end edges, side walls integral with and extending substantially perpendicular to said bottom wall side edges, parallel ribs integral with said bottom wall and spaced parallel to and between said side walls, said ribs having a length slightly less than the length of said side edges, end walls substantially perpendicular to said bottom wall, side walls and ribs, said end walls being integral with said bottom wall end edges, the ends of said ribs being spaced from said end walls to form a pair of spaced parallel channels adjacent said end walls whereby said channels provide continuous communication between said ribs.

8. The tray of claim 7 wherein said ribs have longitudinal grooves along at least one side thereof, said longitudinal grooves being parallel to said bottom wall.

9. The method of claim 4 wherein said step of extruding includes forming longitudinal grooves on at least one side of said integral perpendicular spaced parallel ribs along the length thereof.

10. A method of manufacturing a tray comprising the steps of extruding material to form integral substantially perpendicular spaced parallel ribs extending along the length of and integral with a bottom wall, providing said extrusion in a length longer than the desired length of the tray, removing material at the ends of the ribs so that a ribless portion of the bottom wall is provided at each end thereof in a length slightly greater than the height of the ribs, and bending said ribless portions upwardly so that they are substantially perpendicular to the remainder of the bottom wall and on the same side of the remainder of the bottom wall as the ribs.

11. A method in accordance with claim 10 wherein said bending step is accomplished in a manner to provide a gap between the upwardly bent ribless portions and the juxtaposed ends of the ribs along the sides of the bottom wall.

12. A method in accordance with claim 10 wherein said step of removing material is accomplished in a manner so that the ribs along the side edges of the bottom wall are longer than the remaining ribs.

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