June 30, 1942. A. H. BOILEAU 2,288,067

ICE CREAM FREEZER

Original Filed Jan. 26, 1939 2 Sheets-Sheet 1

Fig. 1.

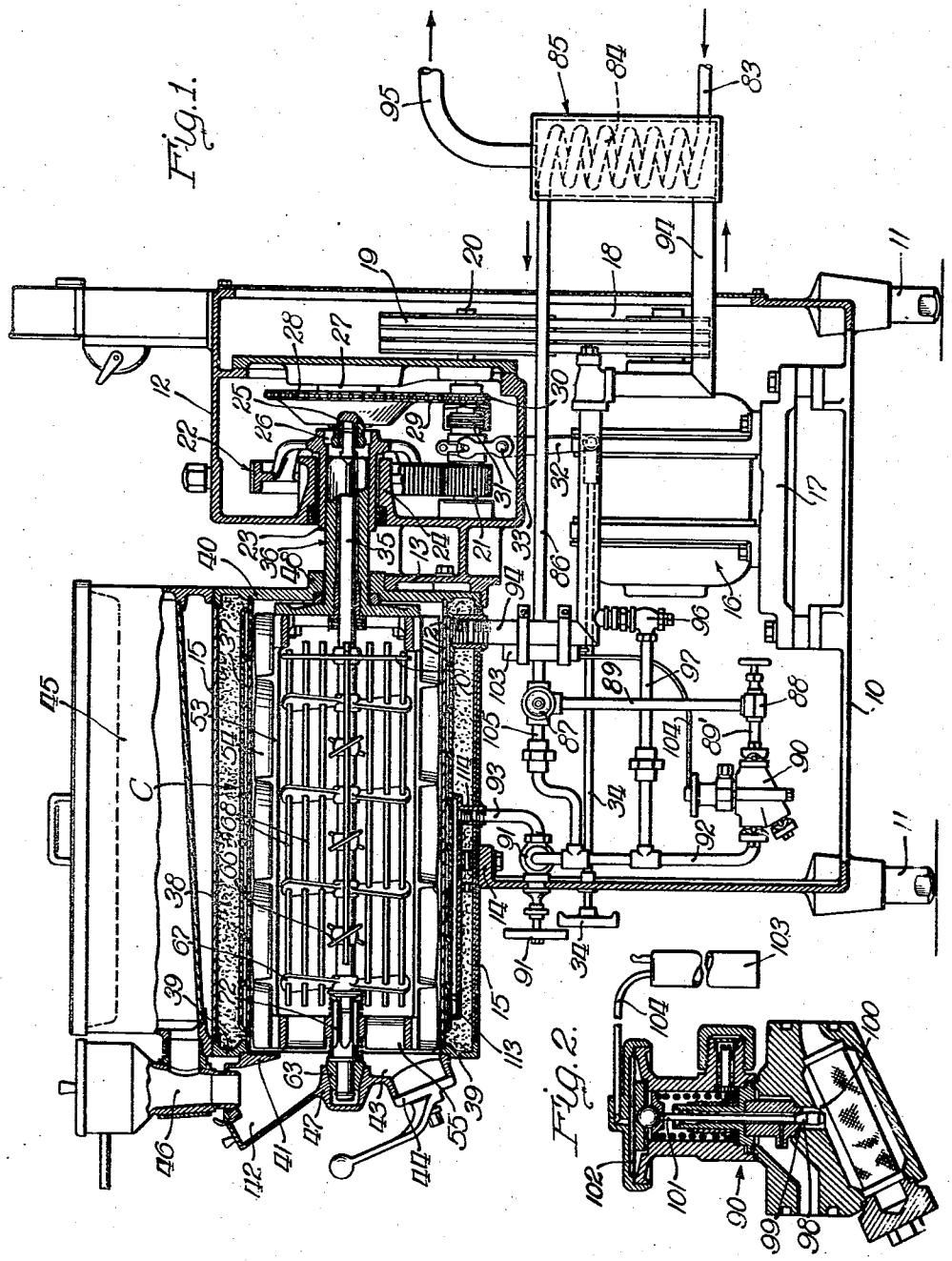


Fig. 2.

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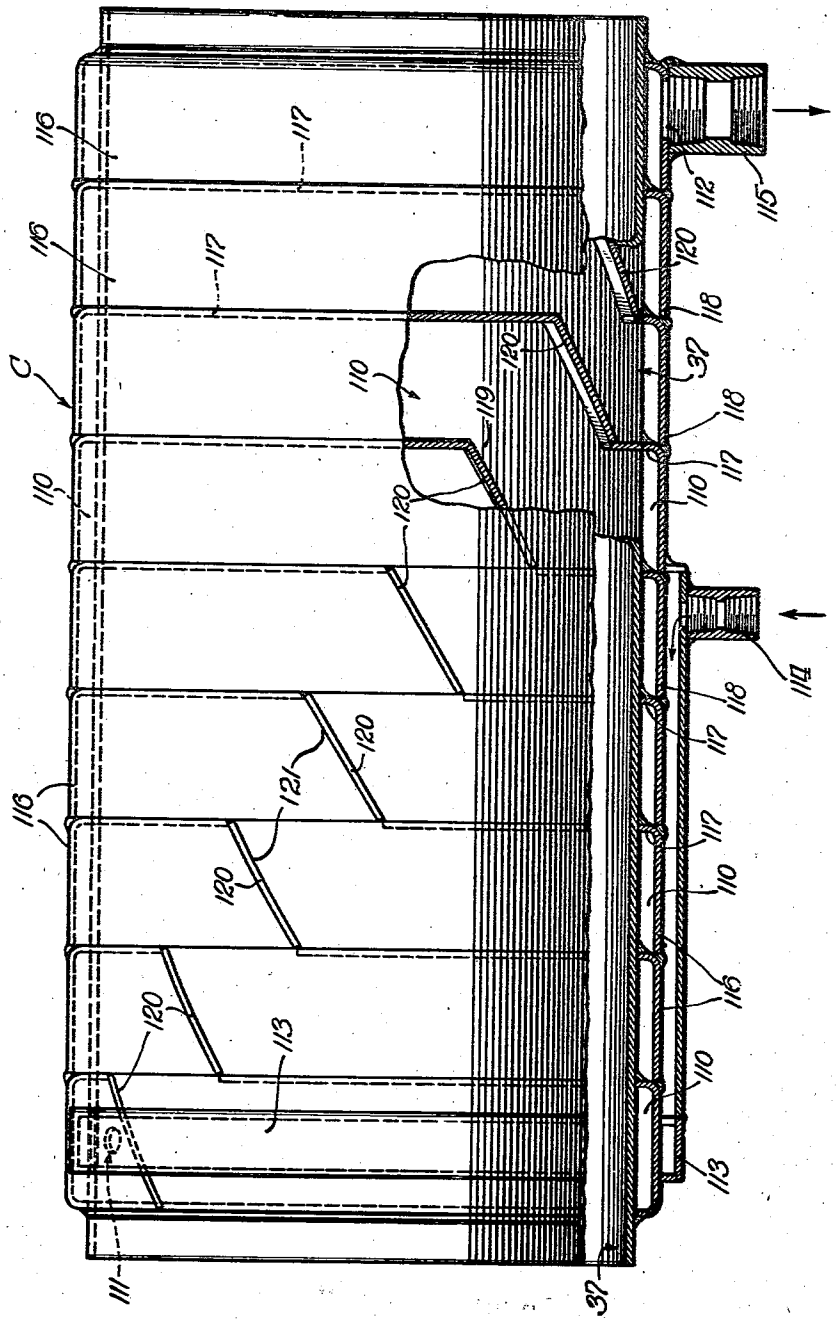


Fig. 3.

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UNITED STATES PATENT OFFICE

2,288,067

ICE CREAM FREEZER

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Original application January 26, 1939, Serial No. 252,884. Divided and this application December 26, 1939, Serial No. 310,892

8 Claims. (Cl. 62—114)

The present invention relates to an attempering apparatus, such as confection freezers, and is directed more particularly to the construction of the refrigerant evaporator or refrigerant confining passage associated with the freezing or attempering chamber and to the refrigerant flow control apparatus associated with the refrigerant evaporator for putting the evaporator quickly into and out of operation at will.

This application is a division of my co-pending application Serial No. 252,884, entitled Ice cream freezer, filed January 26, 1939, now matured into Patent No. 2,283,487, issued May 19, 1942.

In processing machines, such as ice cream freezers, it is desirable to use an evaporator which enables the immediate starting and stopping of the refrigeration action at substantially the full effectiveness of such refrigeration action. It is also desirable to be able to accurately control such refrigeration action in a minimum amount of time and with a minimum number of operations. Evaporators adapted or capable of such use are particularly desirable in the manufacturing of ice cream by the batch process. Such particular desirability is brought about by the normally quick, repeated operations incidental to the emptying of one batch and the re-loading and freezing of the next batch. Such construction and the performance of such evaporators enables the almost instantaneous attainment of maximum efficiency of the refrigeration in the freezing operation.

The accompanying drawings illustrate the invention in an ice cream freezer of the batch type. However, the invention is not to be limited to the specific embodiment described. The portion of the invention pertaining to the agitator element, as shown in Figure 1, is more particularly referred to, as well as claimed, in my co-pending application referred to above.

The principal object of the present invention is to provide an ice cream freezer evaporator of simple, efficient and inexpensive design wherein the operator has accurate and immediate control of the freezing process within the freezing chamber, which control is maintainable by a minimum of operations.

A further object of the invention resides in the method of making the evaporator associated with the processing chamber in which the outer evaporator shell is affixed to the outer wall of the processing chamber in a manner utilizing the affixing elements as guide means for the refrigerant being circulated through the evaporator, and also utilizing the affixing means as fins on the outer surface of the processing chamber to facilitate the more efficient heat transfer to the refrigerant medium.

An additional object is to provide an evaporator for a processing chamber in which the evaporator is so constructed and arranged as to directly apply the volatile refrigerant to the surface of the processing chamber in intimate contact therewith and guide the refrigerant in a circuitous path thereabout, whereby, due to the pressure caused by the gas of evaporation, high speed is attained in the motion of the refrigerant, which high speed of the refrigerant causes it to pass in intimate scouring contact over the outer surface of the processing chamber and the adjoining surfaces of the evaporator shell and fins formed thereon to effect thereby a separation of the liquid from the gaseous refrigerant and the removal of gas bubbles from the surface of the heat transfer elements. Such construction effects an improvement in the rate of heat transfer from the materials being treated in the processing chamber to the refrigerant medium circulated thereabout.

A still further object of this invention is to provide means to deliver volatile refrigerant to the evaporator casing about the processing chamber and to receive it therefrom whereby intermittent, prompt operation of the refrigeration system at maximum capacity without discharging unused refrigerant to the compression may be secured, as well as to pre-cool the liquid refrigerant before it enters the evaporator by the use of unevaporated refrigerant discharged from the processing chamber evaporator.

Other objects and purposes and other important features of the invention will be apparent from the following description when read in connection with the accompanying drawings in which:

Figure 1 is a longitudinal sectional view taken vertically through the freezer.

Figure 2 is a sectional view taken vertically through the automatic thermal refrigerant valve for the freezer.

Figure 3 is an elevational view in partially broken away section, showing the evaporator embracing the processing cylinder of the ice cream freezer.

Referring to the illustrations showing the preferred embodiment of the invention, in which illustrations like numerals are associated with like elements, the invention, which particularly pertains to an ice cream freezer evaporator and the

method of constructing the same, is illustrated in connection with an ice cream freezer. The ice cream freezer is supported on a hollow base 10 resting on adjustable feet 11. A gear housing 12 is provided at the upper rear portion of the base and a cylinder supporting bracket 13 is provided immediately ahead of the gear housing 12, together with a cylinder supporting shelf portion 14 immediately ahead of the bracket 13, above which shelf is mounted the cylinder structure generally indicated by the numeral 15 applied to its envelope. The freezer is driven by motor 16 housed in the hollow base 10 and mounted on any suitable bracket 17. The motor 16 through a series of belts 18 drives the pulley 19 which is keyed to drive shaft 20 journaled in suitable bearings in the gear housing 12. Pinion 21 is carried by and keyed to the drive shaft 20 and drives the spur gear 22 carried by a quill shaft 23 journaled in any suitable sleeve bearing 24 mounted directly above drive shaft 20 with the quill shaft 23 opening outwardly through the front wall of the gear housing 12. Quill shaft 23 is joined at its inner end to the adjoining free inner end of a second axially aligned shaft 25, which is partially telescoped into quill shaft 23 and there supported in alignment by a suitable rotary thrust bearing 26. The outer end of the shaft 25 is journaled in any suitable bearing generally indicated by the numeral 27. Sprocket wheel 28 fixed to and carried by shaft 25 is driven by sprocket chain 29 which passes around a driving sprocket 30 driven through the intermediacy of the disc clutch generally indicated by the numeral 31 on which it is mounted. Disc clutch 31 is mounted on the drive shaft 20 and actuated by lever 32 pivoted at 33 and hinged at its free end to the control rod 34 extending outwardly through the front wall of the base 10 toward the position occupied by an operator of the freezer.

The inner shaft 35 and quill shaft 36 are the shafts used to drive the inner and outer elements of the reversely rotating agitating mechanism of the freezer. These shafts are telescoped at their free ends into the squared sockets of the shafts 25 and 23, respectively, by means of which squared faces the reversely rotating spur gear 22 and sprocket wheel 28 impart the reverse rotation to the shafts 36 and 35, respectively, to operate the inner and outer dasher elements.

The processing cylinder construction comprises an outer envelope 15 and an inner processing shell 37 which serves as a refrigerated wall or cylinder housing the freezing chamber of the freezer. The shell 37 is surrounded by a refrigerant evaporator "C" in intimate contact therewith and spaced from envelope 15, in which space a satisfactory cover or insulation 38 is provided. Shell 37 is provided at its front end with an annular head 39, and at its opposite end with a centrally apertured head 40. Heads 39 and 40 are affixed to shell 37 and envelope 15 by any suitable means, such, for example, as welding, and head 40 is rigidly affixed to the cylinder support bracket 13 by a series of bolts. A removable end wall or door 41 including the usual inlet passage 42 and outlet passage 43 is hinged in the conventional manner to the front cylinder head 39. The outlet passage 43 is closed by valve 44, and the inlet passage 42 is associated with the usual type of mix reservoir 45 through the conventional type of valve 46, all of which are clearly shown in Figure 1. The end wall 41 is provided with a conical, central, inwardly directed bearing support 47 which supports the front end of the agitator mechanism within the shell 37.

The evaporator C comprises a helical evaporator passage defined on its inner surface by the outer periphery of shell 37 and on its outer surface by a series of angularly split hoops or ring-like elements 116. The elements 116 are superimposed over the shell 37, joined one to the other by welding the front edge 118 of each element to the adjacent rear edge of the preceding element, mounted upon shell 37 and in spaced relation thereto by the inwardly turned flanges 117 along the rear edge of each element 116. Flanges 117 are in turn welded along their inner edge to the outer periphery of shell 37, and each flange 117 is provided with an interruption or slot 119 approximately equal to the width of the ring 116 and immediately adjacent the ends 121 of the ring-like elements 116 along the line of cleavage of the split rings and advancing in a clockwise direction therefrom. To complete the helical passage 110, defined on its inner and outer surface by the shell 37 and the joined ring-like elements 116, and defined along its edges by the adjacent flange 117, baffle elements 120 are provided intermediate the flanges and intermediate the adjacent slots 119. The baffle elements 120 are inclined to the plane of the elements 116 and are mounted immediately adjacent edge 121 of each of the rings 116, having their inner edge welded to the periphery of shell 37 and their outer edge welded to and joining the angularly cut ends 121 of the ring 116. The forward end of each baffle element 120 is joined to the end of a flange 117 defining the lower edge of the associated slot 119 immediately ahead of the baffle element, and the rear edge of each baffle 120 is joined to the adjacent end of a flange 117 defining the upper edge of the adjacent, rearwardly positioned slot 119. By so joining the opposite ends of adjacent flanges 117 the helical passage 110 intermediate adjacent portions of the flange 117 is defined. The helical passage 110 is provided with an inlet port 111 at its front upper end and discharge port 112 at its lower opposite end. Liquid refrigerant is supplied to inlet port 111 through conduit 113 affixed to the outer surface of the evaporator C, and communicating with conduit 93 through nipple 114. Evaporated or gaseous refrigerant is discharged from passage 110 to the discharge port 112 joined by nipple 115 to the refrigerant discharge conduit 94.

The foremost or front shell 116 is also provided with an inwardly turned flange 117 at its front edge 118 as well as its rear edge, both of which flanges 117 are welded to the outer periphery of shell 37 to their inner edges to complete the enclosure of passage 110. To form a continuous helical passage utilizing the annular space between the shell-like structures 116 and the shell 37 when assembled as just described, each flange 117, excepting the front flange of the front shell and the flange of the rear shell, is provided with a slot or by-pass 119, as just described, joining the annular space on either side of the slotted flange 117. These slots are of approximately the same length as the width of the shells 117 and are arranged in staggered relation, progressing uniformly rearwardly and downwardly with the slots of the first shell 116 near the top of the shell 37, and the slot in the second to the last shell 116 slightly passing the lower portion of the shell 37. To complete the helical passage 110, baffle means 120 are pro-

vided intermediate adjacent flanges 117 at an incline to the axis of the shell 116, joining the lower edges of a slot 119 with the upper edge of the adjacent rearwardly positioned slot 119 as just described. The baffle means 120 in the foremost and rearmost shells 116 are joined at their extreme ends to the unslotted outermost flanges 117 of evaporator C, and are inclined similarly to the remaining baffles 120. Baffles 120 are welded at their respective ends to the adjoining flanges 117, and at their inner and outer edges they are welded to the shells 37 and 116, respectively.

The baffle 120 in the foremost shell is positioned immediately below the refrigerant inlet port 111 in such a manner as to cause the liquid entering therethrough to flow in a counter-clockwise direction through the annular passage formed by the foremost shell 116, thence through the slot 119 joining the passage bounded by the two foremost shells, thence in a counter-clockwise direction around the portion of the helical passage bounded by the second shell 116 due to the positioning of the second baffle 120, and thence similarly through the remaining shells 116 until the refrigerant reaches the discharge 112 in a gaseous state.

The agitating, whipping, scraping and unloading mechanism comprising part of the ice cream freezer shown in Figure 1 is set forth in detail and claimed in my co-pending application referred to previously. Generally speaking, the agitator shown in Figure 1 consists of inner and outer rotary elements. A front spider 55, by means of a bushing 72, supports the front end of the agitator mechanism on the shaft 35 which is provided at its front end with a stud bearing 63 to engage a complementary bearing seat in the freezing chamber door 41.

Similarly, a rear spider co-acts with a drive shaft to support the rear portion of the agitator assembly. The outer agitator element, in addition to being provided with scraping blades, is also provided with unloading bars 53 carrying the angularly disposed unloading wings 54. The inner agitator element is provided with two sets of beater blades 66 and 67 alternately arranged on a supporting shaft and at an angle of ninety degrees one to another. Whipping rods 68 are carried by the beater blades and are anchored at their rear extremities in a whipping rod support or spider 70.

In this divisional application some of the figures of the parent application have been appropriated and consequently the identifying numbers 49 to 81 inclusive and 106 to 109 inclusive shown in the parent case have not been referred to as they pertain primarily to the agitator element which is covered in detail in the parent application.

It is, of course, obvious that the evaporator C may be supplied with other types of cooling agents to effect a satisfactory operation of the freezing processes within the shell 37. However, the illustrations clearly set out a portion of an ammonia absorption system and the controls therefor.

In the preferred embodiment of the invention as illustrated high pressure liquid anhydrous ammonia is supplied from any satisfactory compressor condenser unit (not shown) through supply pipe 83, from which it passes through a coil 84 of the pre-cooler 85, thence through a conduit 86 to a needle valve 87 provided with a bypass through which bypass the liquid may pass during normal automatic operation to valve 88 through conduit 89, thence through conduit 89' to an automatic liquid refrigerant flow regulating valve 90 to a control valve 91 through conduit 92, and thence through the special evaporator connection 93 from which it passes through the evaporator inlet port 113 into the passage 110 of evaporator C.

The refrigerant which has passed through the evaporator C is discharged from the port 112 of the evaporator through conduit 94 to the pre-cooler 85, in which any unevaporated liquid refrigerant will be evaporated by pre-cooling the liquid refrigerant supply in coil 84. From pre-cooler 85 the refrigerant gas is discharged to the compressor condenser unit (not shown) through conduit 95.

As a matter of safety, a poppet valve 96, conventionally referred to as a safety valve, is joined to conduit 92 by special conduit 97 and arranged to discharge, when in operation, into the exhaust conduit 94. Valve 96, as just stated, is of the conventional safety type valve and is so adjusted as to limit the liquid pressure in conduit 92 to a predetermined value.

The automatic thermal liquid flow valve 90, as illustrated in detail in Figure 2, is in the refrigerant supply line and is of the commercial type offered on the market under the trade mark of "Alco," and the details thereof do not form a part of this invention. Valve 90 will be described only sufficiently to indicate that the liquid passing through the valve is regulated by a conical valve 98 seating in a conical valve seat in the flow passage 100. The movement of the valve 98 is controlled through valve stem 101 which is fixed to a spring-loaded diaphragm 102 actuated by the pressure exerted upon it by the fluid in tube 104 communicating with the thermal-sensitive bulb 103 mounted in heat exchange relation on the exhaust conduit 94.

In the event that it is desired to manually operate the evaporator C, the valve 88 ahead of the automatic thermal valve 90 is closed and the needle and bypass valve 87 is adjusted to regulate a flow of liquid refrigerant to the conduit 92 as desired through the conduit 105 connected to one of the discharge ports of the needle and bypass valve 87. The inlet port of valve 87 is associated with the beforementioned bypass, forming a part thereof, which bypass is not shown but is constructed in accordance with conventional valve design. It should be noted that, by the use of the compound valve 87 and the additional bypass 105, an arrangement has been provided whereby a stopped-up or otherwise defective automatic control valve 90 may be bypassed and the apparatus satisfactorily operated when using the manual controls as set forth. Such manual control, for which the liquid refrigerant would be supplied through bypass 105, may also be used when a degree of refrigeration is desired outside of the scope of that permitted by the use of the automatic valve 90.

It will, of course, be evident that some of the chief advantages of the present invention reside in the evaporator per se and the method of constructing the evaporator C and the result inherent in such construction, as well as the general arrangement and system whereby the refrigerant applied to the processing shell 37 is readily controllable in the desired manner, as referred to previously.

The evaporator C is made by welding the baffles 120 onto the outer periphery of the shell 37 at an angle to the axis of the shell 37 and in

spaced relation one to another, staggered rearwardly and downwardly as shown in Figure 10. The baffles 120 as a group extend rearwardly and downwardly in uniformly spaced staggered relation one to another in a somewhat helical alignment with the foremost baffles 120 positioned approximately at the top of the forward end of the shell 37. The rearmost baffle 120 is positioned approximately at the bottom of the rear portion of the shell 37. The front discontinuous or split ring 116 having an inwardly directed flange 117 at both of its edges is next superimposed over the forward end of the shell 37 with the ends 121 of the split ring 116 embracing the front baffle 120. The edges of the inwardly turned flange 117 of the front ring 116 are each welded to the periphery of the shell 37 and the ends 121 of the ring 116 are joined to the outer edge of the baffle 120 and the ends of the baffle 120 are each welded to the adjacent flange 117. The lower end of the rear flange 117 of the front ring 116 is welded to the front edge of the second baffle element 120 positioned immediately adjacent the rear edge of the front ring 116. The second ring 116 is then superimposed over shell 37 with the ends 121 of the second ring 116 embracing the outer edge of the second baffle 120 and having the front edge 118 of the second ring 116 abutting against the rear edge of the front element 116. The front edge 118 of the second element 116 is then welded to the rear edge of the first element 116 and the ends 121 of the second element 116 are welded to the upper edge of the second element 120. The ends of the flange 117 of the second element 116 which defines the top edge of the slot 119 in the second element 116 is then welded to the rear edge of the second baffle 120 and the other end of the same flange 117 is welded to the front edge of the third baffle 120. The third and other elements 116 are mounted on shell 37 in like manner with the exception of the last and rearmost element 116 which is not provided with a slot 119 in its flange 117. In the instance of the last ring-like element 116 the rear flange 117 is welded to the shell 37 throughout its entire length which in this instance extends throughout the entire length of element 116 from each of the edges 121 thereof. The unique method of constructing an evaporator for an ice cream freezer, as just described, forms a passage 110 which is made continuous throughout all of the elements 116 by providing connecting bypasses in the form of slots 119 in the flanges 117 intermediate any two adjacent hoop or shell-like elements 116 so associated with defining baffles 120 as to direct the refrigerant flowing through the passages 110 in a circuitous helical path in intimate contact with the outer periphery of the freezing shell 37. Due to the welding of the inwardly directed flange 117 to the outer surface of the shell 37, the flanges 117 in actuality constitute heat exchange fins extending into the evaporator C, thereby greatly increasing the heat transfer efficiency of the evaporator due to the inherent advantages incidental to the structure of the evaporator, whereby the efficient heat transfer surface has been increased.

In the operation of the freezer, ice cream mix supplied to the reservoir is admitted to the freezing or processing chamber defined by the shell 37 through valve 46 and the refrigerant is started or stopped by means of the stop valve 91, which valve admits the pre-cooled refrigerant from the automatic control valve 90 into the conduits associated with the evaporator C. Any unevaporated or liquid refrigerant which may pass through the evaporator C passes through the conduit 94 into the pre-cooler 85 where it will be evaporated to avoid the passage of any liquid refrigerant into the exhaust line 95 associated with the compressor condenser unit (not shown). This arrangement is well adapted for the efficient and satisfactory operation of batch freezing processes in which frequent starting and stopping of the freezing operation is essential. In the event manual control of the refrigeration system is desired the automatic thermal control valve 90 is turned off by closing valve 88 immediately ahead of valve 90 and opening the needle valve 87 which is then used to regulate the flow of liquid refrigerant to the evaporator C through the stop valve 91.

The foregoing detailed description has been given for clearness of understanding only and no unnecessary limitations shall be understood therefrom. Various changes in arrangement of the various elements of the freezer, as shown and described to explain the invention, may be made in accordance with the common knowledge of those skilled in the art and yet come within the scope of the invention as set forth in the appended claims.

The invention is hereby claimed as follows:

1. An evaporator for refrigeration apparatus comprising a freezing chamber defined by a shell forming the inner wall of said evaporator, an outer wall structure fabricated of contiguous sheet metal elements, each having a continuous inwardly extending flange fixed to said shell throughout its entire length, and a continuous substantially helical refrigerant passage formed intermediate said shell and said outer wall, said passage being defined along its sides by adjacent flanges of said sheet metal elements.

2. A heat exchange medium passage for attempering a chamber comprising a shell defining the outer wall of said chamber, a plurality of liquid baffle means sealed to the outer periphery of said shell along their inner edge, a plurality of discontinuous ring-like elements sealed together along their adjacent edges and superimposed over said shell to embrace said baffle means in a sealing contact along their outer edge intermediate the ends of said ring, and uninterrupted inwardly directed flange means carried along a portion of an edge of each of said rings having their respective ends sealed to alternate ends of adjacent baffle means and having their free edge sealed to the outer periphery of said shell.

3. An ice cream freezer comprising, in combination, a freezing chamber defined by a shell forming the inner wall of an evaporator and gas separating means, an outer wall structure fabricated of sheet metal and defining the outer wall of said evaporator, said outer wall structure having a continuous, inwardly extending, helical flange fixed to said shell throughout its entire length, a continuous substantially helical refrigerant passage intermediate said shell and said outer wall, said passage being defined along its edges by adjacent elements of said helical flange, refrigerant supply and discharge conduits associated with the opposite ends of the passage within said evaporator and gas separating means, automatic valve means in said supply conduit for controlling the flow of refrigerant to said evaporator and gas separating means, said automatic valve means being responsive to the temperature of refrigerant in said discharge conduit,

and heat exchange means associated with said refrigerant supply and discharge conduits for pre-cooling refrigerant supplied to said evaporator and gas separating means without substantially reducing the pressure of said refrigerant.

4. An ice cream freezer comprising, in combination, a freezing chamber defined by a shell forming the inner wall of an evaporator and gas separating means, an outer wall structure fabricated of sheet metal and defining the outer wall of said evaporator, said outer wall structure having a continuous, inwardly extending, helical flange fixed to said shell throughout its entire length, a continuous substantially helical refrigerant passage intermediate said shell and said outer wall, said passage being defined along its edges by adjacent elements of said helical flange, refrigerant supply and discharge conduits associated with the opposite ends of the passage within said evaporator and gas separating means, automatic valve means in said supply conduit for controlling the flow of refrigerant to said evaporator and gas separating means, said automatic valve means being responsive to the temperature of refrigerant in said discharge conduit, and heat exchange means associated with said refrigerant supply and discharge conduits for evaporating any unevaporated refrigerant discharged from said evaporator and gas separating means.

5. An evaporator and gas separator for an ice cream freezer comprising a freezing cylinder, a plurality of baffles welded to the outer surface of said cylinder, and a plurality of fabricated sheet metal elements superimposed over the outer surface of said cylinder in such a manner that each of said elements embraces one of said baffle means, said fabricated sheet metal elements being sealed one to another and to said baffle means to form a segment of a fluid flow passage, said fluid flow passages communicating with each adjacent flow passage in such a manner as to form from the segmental fluid flow passage a series-connected refrigerant flow passage encircling said freezing cylinder.

6. An evaporator and gas separator for an ice cream freezer comprising a freezing cylinder, baffle means welded to the outer surface of said cylinder, and a discontinuous metal ring-like element superimposed over said cylinder to embrace a baffle means intermediate the ends of said ring-like element, said ring-like element having its edges welded to the outer periphery of said cylinder and to the top edge of said embraced baffle means.

7. An article of manufacture comprising a freezing cylinder, a plurality of baffle means welded to the outer surface of said cylinder, a discontinuous metal ring-like element superimposed over said cylinder and embracing one of said baffle means intermediate the ends of said ring-like element, said ring-like element having its edges welded to the outer periphery of said cylinder and to the top edge of said embraced baffle means, and a second ring-like element superimposed over said cylinder and abutting against said first mentioned ring-like element and embracing one of said baffle means intermediate its ends, said second ring-like element being welded to said first ring-like element along the line of contact therewith and having its free edges welded to said baffle means embraced thereby and to said cylinder.

8. In an ice cream freezer, a cylinder for containing material from which heat is to be extracted, a plurality of outwardly extending fins having their inner edges fixed to the outer periphery of said cylinder in intimate permanent union therewith and arranged in side by side order one with respect to another, a laterally disposed outer portion on each fin overlying the space between two adjacent fins and fixed to the outwardly extending portion of the adjacent fin in intimate permanent union therewith, the outwardly and laterally extending portions of said adjacent fins and the outer periphery of said cylinder, when joined in intimate permanent union one with another, forming a fluid passageway, and fluid passage connections between adjacent fluid passageways so arranged as to form a helic-like circuitous refrigerant passage encircling said cylinder, whereby the heat exchange between said cylinder and refrigerant flowing within said circuitous passage is improved.

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