Oct. 11, 1938. C. F. BELSHAW 2,132,602

REFRIGERATOR

Filed July 27, 1935 2 Sheets-Sheet 1

Fig. 1.

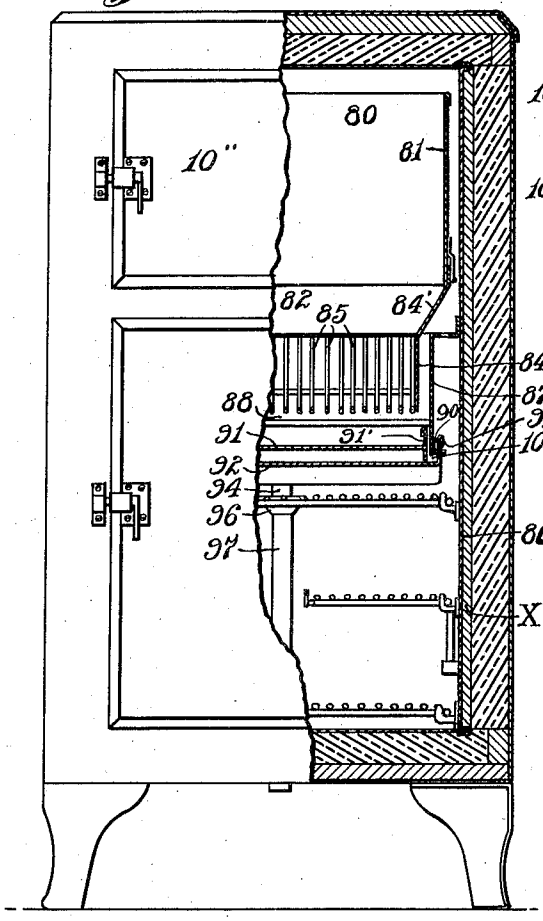


Fig. 2.

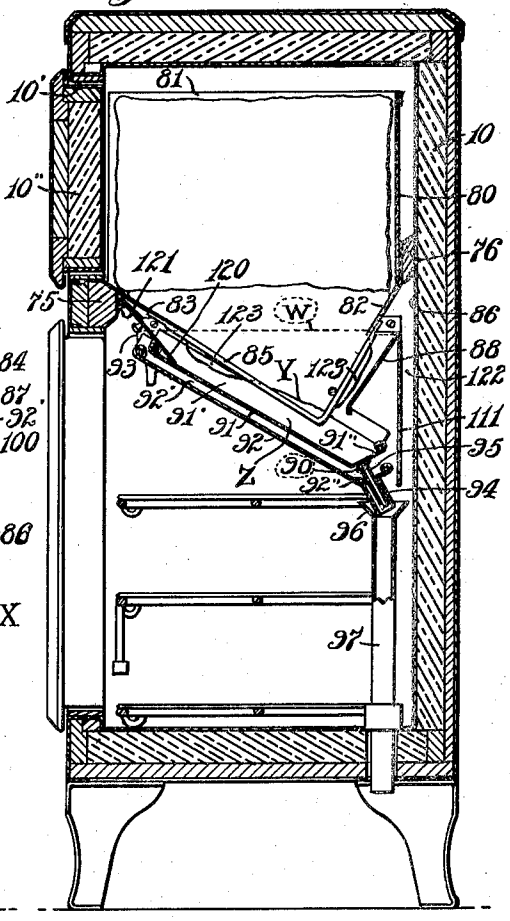


Fig. 6.

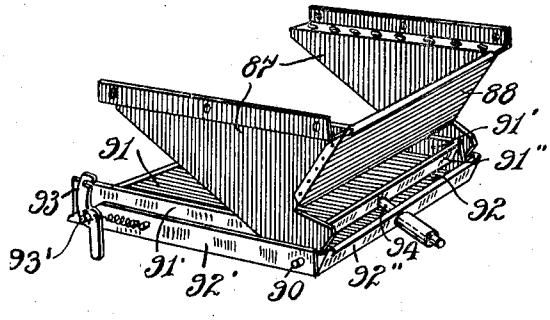
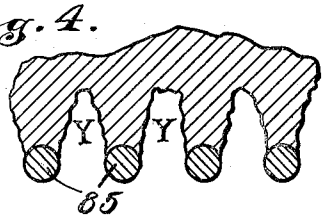


Fig. 4.



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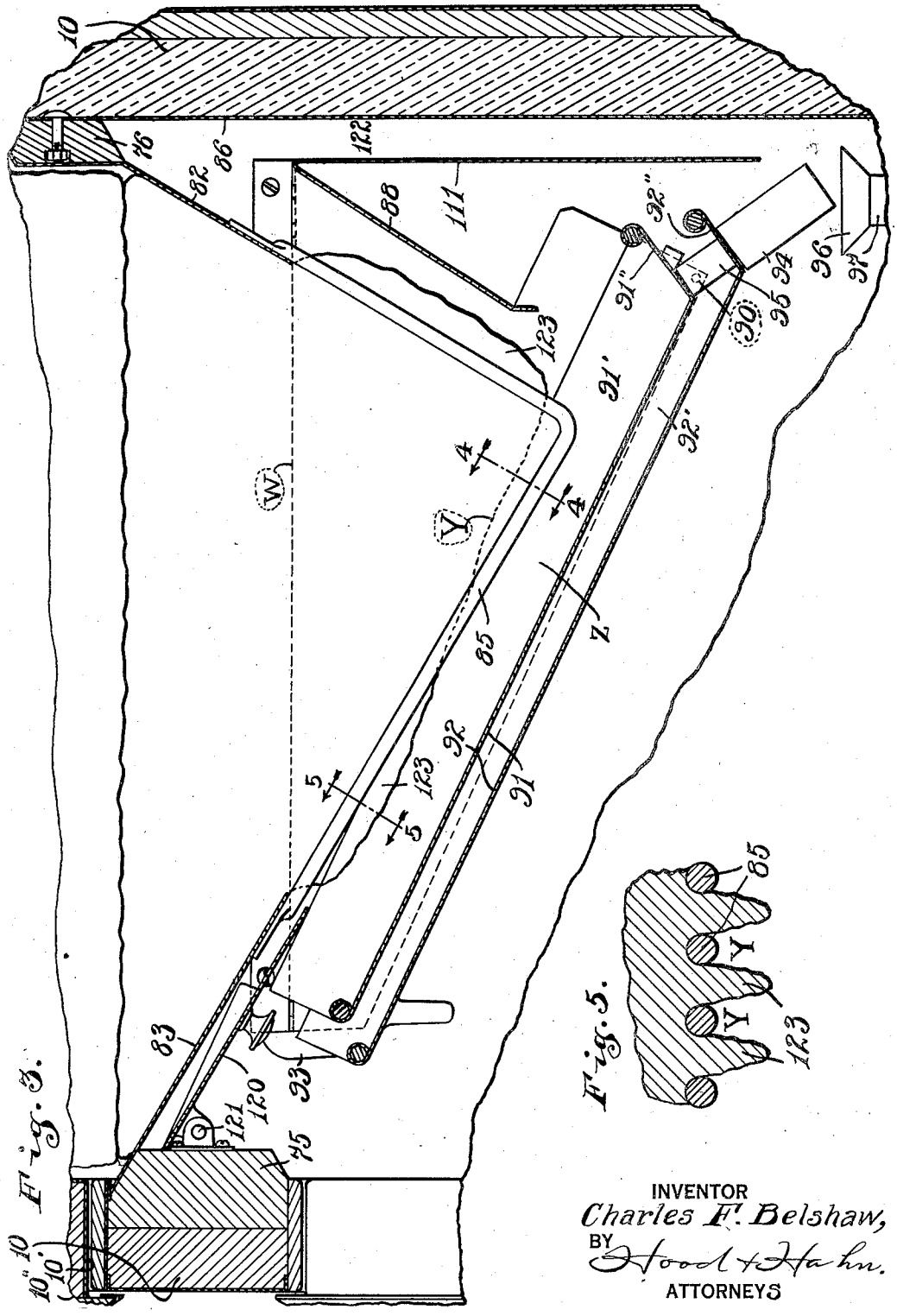


Fig. 3.

Fig. 5.

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UNITED STATES PATENT OFFICE

2,132,602

REFRIGERATOR

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Application July 27, 1935, Serial No. 33,457

9 Claims. (Cl. 62—46)

In refrigerators of various types now commonly in use wherein water ice is the refrigerating medium the rate of refrigeration (volume of ice melting per unit of time) is not only dependent upon the rate of air circulation within the structure but is also very largely dependent upon the current volume of ice, the rate and extent of refrigeration varying directly with the ice volume.

As a consequence temperature in the food compartment varies greatly between icing periods and, unless icing periods are much too short to be commercially practicable (not only from the standpoint of convenience but of expense) the refrigerating temperatures are much too low immediately following icing and these temperatures gradually rise to an ultimate undesirable degree before a supplementing icing.

It has long been well known that substantially uniformity of refrigeration temperatures is highly desirable in various regions of a household refrigerator and the ability of mechanical refrigerating mechanisms to maintain such uniformity, as well as the lack of periodic visits of the ice man, has been largely responsible for the phenomenal adoption of mechanical refrigerators in spite of the well recognized and largely unavoidable destructive dehydrating effect of such refrigeration on many foods.

The object of my present invention is to produce a refrigerator of the water-ice type of such construction that, while it may receive, at a single charging, a supply of water ice sufficient to adequately refrigerate during an abnormally long period, substantially uniform refrigerating temperatures may be maintained in various regions of the refrigerating compartments irrespective of the current volume of the water ice, so that said refrigerating temperatures will at no time be too low or too high whether the ice volume be maximum or nearly exhausted.

More specifically the object of my invention is to provide an efficient refrigerator of the water-ice type of such construction that the rate of refrigeration will be independent of the volume of the refrigerant so long as said volume exceeds a comparatively low minimum.

A further object of my invention is to provide a structure such that the diminution contour of the refrigerant will result in substantially level subsidence of the upper surface of the refrigerant so that recharging with large block refrigerant may be readily accomplished.

The accompanying drawings illustrate my invention.

Fig. 1 is a front elevation, in partial vertical section, of a refrigerator embodying my invention;

Fig. 2, a medial front-to-back vertical section;

Fig. 3, a fragmentary section, in the plane of Fig. 2, on a larger scale;

Fig. 4, a section on line 4—4 of Fig. 3;

Fig. 5, a section on line 5—5 of Fig. 3; and,

Fig. 6, a perspective of the drip-pan air-baffle structure.

In the drawings 10 indicates the main shell of the refrigerator constructed, in a well-known manner, of walls adequately heat-insulated and having a charging opening 10' closed by door 10''. At approximately the lower level of opening 10' I provide front and rear ledges 75, 76 which support the novel ice container now to be described.

This ice container comprises the rear wall 80 and two flanking side walls 81 arranged opposite the opening 10' and spaced from the adjacent vertical walls of the shell 10. The lower edges of walls 80 and 81 are separably supported upon the upper end of a hopper-like structure comprising the forwardly and downwardly-inclined rear plate 82; the rearwardly and downwardly inclined front plate 83; the side walls 84 having the upwardly and outwardly-flared intermediate portions 84'; and the bottom rods 85 the ends of which are oppositely upwardly inclined and attached respectively to the lower edges of the plates 82 and 83.

The interior of the shell 10 is preferably lined with a liner of porcelain-enameled sheeting 86 the side walls of which are conveniently spaced from shell 10, as shown in Fig. 1, by rigid heat insulation X.

Secured to each of the side walls of liner 86, slightly above the level of the lower edges of plates 82 and 83, is a depending plate 87, the major portion of which is spaced from the liner 86, and connecting the upper portions of the rear edges of these plates is a downwardly and inwardly-inclined baffle plate 88 spaced from and downwardly converging toward the upwardly and inwardly inclined portions of rods 85, the upper edge of plate 88 being preferably slightly above the lower edge of plate 82 and its lower edge being preferably somewhat above the apexes of rods 85 and slightly downturned, as shown in Fig. 2.

Pivoted at 90 from plates 87 is a double drip pan comprising the spaced and substantially parallel pan bottoms 91 and 92, respectively associated with pan sides 91', 92' and lower end walls 91'', 92''. The upper end of this pan structure is normally supported by a spring latch 93 in such position that bottom 91 slightly converges,

downwardly and rearwardly, toward the downwardly and rearwardly inclined portions of rods **85**. This convergence is for the purpose of causing more rapid air movement, downwardly and rearwardly, adjacent the apexes of rods **85** than adjacent the upper front end of said rods, and while the rate of convergence may vary somewhat I have attained very desirable results by spacing bottom **91** about ¾ inch below the apexes of rods **85** and about 1¾ inches from the upper forward ends of said rods, say 10 or 11 inches away from said apexes.

Latch **93** is pivoted at **93'** on the side wall **92'** of pan **92** (Fig. 6) and its free end is notched to engage the front end of the horizontal ledge of plate **87**.

Release of latch **93** permits dropping of the drip pan structure to facilitate cleaning.

Drainage from bottom **92** is through a tube **94** and drainage from bottom **91** is through a tube **95** which is sleeved within tube **94** and the two tubes deliver into the funnel **96** at the upper end of an appropriate water-sealed drainage tube **97**.

When the drip pan structure is in operative position as shown in Figs. 2 and 3, the upwardly and forwardly inclined lower edges of the walls **87** lie in troughs **100** between the side walls of the two pans.

The two bottoms **91** and **92** are spaced apart so that an air current may be established between these two bottoms to minimize sweating on the under face of the lower bottom **92**.

Depending from the upper edge of plate **88** (integral therewith if desired), and extending between the rear edges of plates **87**, is a baffle plate **111**, spaced from and substantially parallel with rear wall **86**.

Damper **120** is pivotally supported at its upper edge by the friction hinge **121** below plate **83** and extends from ledge **75** into the upper open end of the upper drip pan so as to overlie bottom **91** and is therefore adjustable to adjust the throat between the forward upper region of the refrigeration chamber and the upper end of the front ends of rods **85**.

When the refrigerant chamber is filled with ice, as indicated in Figs. 2 and 3, the warmer air in the refrigeration chamber rises in two well defined currents, one through passage **122** behind baffle **111** and thence downwardly and forwardly between plate **88** and the ice body, and the other into mouth of the upper drip pan and thence downwardly and rearwardly between the bottom of said pan and the ice body.

The ice, in melting, forms fins **123** which project between the rods **85**.

In order to provide the maximum storage space in the refrigeration chamber, the apexes of bars **84** lie somewhat to the rear of the transverse median plane of the refrigeration chamber and therefore the rear arms of bars **85** lie at a steeper angle than the front arms of said bars and, as plates **82** and **83** are most conveniently to be placed in alignment with the ends of the bars which are attached thereto, plate **82** is at a steeper angle than plate **83**.

The heating effect of the steeper plate **82** per unit of horizontal dimension of the contacting portion of the ice body is, therefore, greater than the same heating effect of less steep plate **83** and it would appear that consequently the melting of the rear shoulder of the ice body resting on plate **82** would be more rapid and would permit a rearward tilting of the ice body. But the volume of air flowing across the under surface of plate **83** is greater per unit of time than that flowing across plate **82** and the temperature of the warm air flowing beneath plate **83** is the higher (because of the leakage through the access door), so that lack of inclination of plate **83** is compensated by the greater rate of heat transferred to said plate. In fact, such compensation may be too much and plate **83** is therefore guarded by baffle **120** so that the effects of plates **82** and **83** on the ice body in contact therewith are balanced so as to insure substantially vertical subsidence of the ice body considered as a whole.

The ice body is, in part, supported by bars **85**, and baffles **88** and **91** are so placed (Fig. 3) that fins **123** of ice are developed, portions of said fins depending between the bars **85** as indicated. The throat Z between the apexes of bars **85** and pan **91** being somewhat constricted causes the warm air to erode the ice between the bars in the immediate neighborhood of said apexes (as shown in Fig. 4), the fins and grooves thereby increasing severalfold the area of ice exposed at the lower end of the ice body and it is this largely increased ice area which bears at all times, a film of water at 32° F. (which is actually the refrigerant contacted by the air currents) which serves to scrub the warm air currents and extract therefrom undesirable odors, as well as to furnish increased heat-absorbing area.

The primary purpose of the above described proportioning of parts is to insure maintenance of ice contact with all of plates **82**, **83** and **84** so long as there is any substantial body of ice above the plane of the lower edges of said plates.

The melting which occurs as a result of contact with plates **82** and **83** occurs at a temperature somewhat below 32° F. (due to pressure developed by the ice load) and there is some fin accretion, immediately subjacent the lower edges of these plates, due to refreezing.

Melting due to contact with plates **82** and **83** is relatively slow but vertical diminution of the ice body above plate **82** is more rapid than above plate **83**, due to the difference of inclinations of these plates.

The major portion of ice melting therefore occurs in the zone of bars **85**, and, as stated above, the most rapid rate of melting occurs above and forwardly of the apexes of said bars.

As a consequence of this construction the total area of ice subjected to heat transfer conditions remains substantially constant so long as the ice body extends to any extent above the zone of the lower edges of plates **82**, **83**, and consequently the refrigeration efficiency remains substantially constant irrespective of the volume of refrigerant.

In fact, the efficiency curve will not begin to drop until some little time after the ice body has become depleted below the zone W because, when depletion results in air gaps at the lower edges of plates **82**, **83** a greater area of ice becomes exposed to warm air, thereby accelerating depletion. Ice depletion to this extent should be avoided as far as possible if the highest degree of efficiency is desired. Charging of additional refrigerant preferably should occur by the time the upper surface of the ice body is about in the plane of the upper edges of the inclined plates **82**, **83** because at that time the upper surface of the ice body is low enough to permit the insertion of an ice block of maximum size through the charging opening **10'**.

It will be understood that the main shell may

be provided with a top charging opening, instead of the front charging opening shown, without modifying refrigeration.

Adjustment of damper **120** permits control of ice melting to insure a substantially level subsidence of the ice.

It will be noted that the imperforate plates **82** and **83** are narrow as compared with the distance between the facing edges thereof and that the upwardly converging arms of the rods **85** bridge the space between said facing edges, said space having a horizontal dimension which is considerably greater than the horizontal extent of either one of the plates.

It will also be noticed that the plates **84'** connect the ends of plates **82** and **83** and that these four converging plates form a hopper-like support for a block of ice of commercial dimension throughout the major portion of the melting period, so that tilting of the ice block, during its descent due to melting is prevented. The ice block, resting on these four converging plates, forms an air seal which prevents upward warm air currents entering the ice box, above the level of the lower edges of these plates, and this arrangement insures a non-tilting descent of the ice body.

By this arrangement, I provide an ice supporting basket which provides for the automatic continuous presentation, to warm air currents arising from the refrigeration chamber, of a definitely limited area of ice surface which is subject to the direct action of the warm air currents from the time the refrigerant chamber is fully charged until the ice is nearly exhausted.

The relative proportions of imperforate plate area, and direct ice-body exposure, due to the spaced rods **85**, should be such (as indicated in the drawings) that the directly-exposed ice area will be adequate for the degree of refrigeration desired in the refrigeration chamber, and such that the rate of ice-melting, in the vertical zones above the imperforate side plates **82**, **83** (due primarily to heat conduction through said plates) will be such that the basket, formed by the rods **85**, will be substantially filled with ice so long as there is ice enough for that purpose.

Figures 2 and 3 are substantially scale drawings and with this information, as well as the preceding description, any refrigeration engineer, with knowledge common in the art, will have no difficulty in arriving at effective proportions for different sizes of main shells.

This application is a continuation, in part, of applicant's companion application, Serial Number 710,207, filed Feb. 8, 1934, which has matured into Patent 2,064,515.

The term "annular" as used herein to designate the ice-supporting elements **82**, **83**, **84'** is intended to designate a collar-like structure defining an exit opening for defining the size and shape of a depending portion of ice extruded therethrough from a main body or block of ice which, so long as there is any portion thereof above the plane of said exit opening, will be supported on said annular structure by contact between the ice block and annular structure of such character as to block air flow, immediately adjacent the upper portion of the ice block, between the upper and lower chambers of the refrigerator shell.

It will be readily apparent, from the above disclosure, that the mechanism which has been disclosed is in the nature of an air cooling and conditioning apparatus, the advantages of which are not necessarily confined to that class of devices ordinarily referred to as refrigerators, i. e., devices for the reception and preservation of foods, and I therefore wish it understood that the term refrigerator in the claims may appropriately be considered of such scope to include any device where a heat surrendering air current is caused to flow over the exposed surface of a limited portion of a solid refrigerant which diminishes in volume as a result of abstraction of heat from the air current.

I claim as my invention:

1. A refrigerator comprising a main shell having a closable opening leading into its upper region and a closable opening leading into its lower region, and a comparatively-narrow inwardly-projecting completely-annular shelf arranged within the shell intermediate said upper and lower regions, the arrangement being such that, a block of water ice (of larger cross dimensions than the opening defined by the inner periphery of said annular shelf) being supported on said shelf, the contact between said shelf and ice will block air flow from the lower shell region to the upper shell region through said opening and the resultant melting of the ice will result in the downward extrusion of an ensmalled lower portion of the ice block through the opening defined by said shelf, sufficient to maintain effective refrigeration.

2. A refrigerator of the character specified in claim 1, wherein the annular shelf is downwardly and inwardly inclined.

3. A refrigerator of the character specified in claim 1 and including air baffles arranged below the plane of the opening defined by the annular shelf so as to direct downwardly-flowing air currents against the extruded portion of the ice body.

4. A refrigerator of the character specified in claim 1 and including laterally spaced downwardly-converging bars below the plane of the opening defined by the annular shelf, said bars serving to support the remnants of ice blocks which have ensmalled to dimensions less than the dimensions of the opening defined by the inner periphery of the annular shelf.

5. A refrigerator of the character specified in claim 1 and including laterally spaced downwardly-converging bars below the plane of the opening defined by the annular shelf, and also including downwardly-converging air baffles flanking said bars, said bars serving to support the remnants of ice blocks which have ensmalled to dimensions less than the dimensions of the opening defined by the inner periphery of the annular shelf.

6. A refrigerator of the character specified in claim 1 wherein the annular shelf is downwardly funnel shaped and is supplemented, below the plane of the opening formed thereby, by downwardly-converging laterally-spaced bars, said bars serving to support the remnants of ice blocks which have ensmalled to dimensions less than the dimensions of the opening defined by the inner periphery of the annular shelf.

7. A refrigerator of the character specified in claim 1 wherein the annular shelf is downwardly funnel shaped and is supplemented, below the plane of the opening formed thereby, by downwardly-converging laterally-spaced bars, and also including downwardly-converging air baffles flanking said bars, said bars serving to support the remnants of ice blocks which have ensmalled to dimensions less than the dimensions of the

opening defined by the inner periphery of the annular shelf.

8. A refrigerator comprising a main shell having a closable opening into its upper portion and a closable opening into its lower portion through the front wall, an ice support supported within the shell in the zone between the two closable openings, a downwardly and rearwardly inclined air-baffling drip-pan pivotally supported near its lower rear end, and releasable means normally supporting the upper forward end of said drip-pan, whereby the drip-pan may be swung down opposite the lower opening to expose its upper surface for cleansing.

9. In a refrigerator the combination with the main shell having upper and lower closable openings and an ice-support in an intermediate zone, of an air-baffling unit comprising side plates attached at their upper ends to opposite side walls of the shell and their major lower portions inwardly spaced from the side walls of the shell, a downwardly and forwardly inclined air baffle spanning the distance between the side plates at the rear thereof, a drip-pan air-baffling structure pivotally supported from the lower rear corners of the side plates, and releasable means for normally supporting said drip-pan in an upwardly and forwardly inclined position opposite the lower closable opening.

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