IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

LG ELECTRONICS U.S.A., INC. and LG ELECTRONICS, INC., Plaintiffs, v. WHIRLPOOL CORPORATION, Defendant.	Civil Action No. 08-234 (GMS)
	Jury Trial Demanded
WHIRLPOOL CORPORATION, WHIRLPOOL PATENTS COMPANY, WHIRLPOOL MANUFACTURING CORPORATION and MAYTAG CORPORATION, Counterclaim Plaintiffs, v. LG ELECTRONICS U.S.A., INC., LG ELECTRONICS, INC. and LG ELECTRONICS MONTERREY MEXICO, S.A. DE CV, Counterclaim Defendants.	

PLAINTIFFS' REPLY BRIEF IN SUPPORT OF ITS MOTION TO STAY CERTAIN ISSUES PURSUANT TO 28 U.S.C. § 1659

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Dated: June 16, 2008

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Plaintiffs and Counterclaim Defendants LG Electronics, USA, Inc. and LG Electronics, Inc.; and Counterclaim Defendant LG Electronics Monterrey Mexico, S.A. de C.V. (collectively "LG"), respectfully submit this reply brief in support of their motion for a mandatory, statutory stay, pursuant to 28 U.S.C. § 1659(a), of all proceedings pertaining to Whirlpool's allegations of infringement of United States Patent Nos. 6,810,680 ("the '680 patent") and 6,915,644 ("the '644 patent") in this case until the final determination of *In the Matter of Certain Refrigerators and Components Thereof*, Inv. No. 337-TA-632 (the "ITC Investigation"), now pending before the United States International Trade Commission ("ITC").[1] The stay requested by LG in this case is mandatory and there is no basis for Whirlpool's opposition.

I. INTRODUCTION

Rather than address the controlling question of whether LG qualifies for the statutory stay of proceedings under 28 U.S.C. § 1659(a), Whirlpool attempts to lead this Court to error by citing to Supreme Court decisions that predate the statutory stay provision and have nothing to do with the statute or the circumstances of this case. Despite Whirlpool's insistence that these decisions somehow allow a party to ignore the statutory mandatory stay, under the guise of waiver, the cases neither hold nor suggest such a result. Rather, the explicit language of the statute controls. LG has complied with each and every requirement under 28 U.S.C. § 1659(a). The statute is clear. If a party to a civil action, who is also a respondent in a proceeding before the International Trade Commission, requests a stay of certain co-pending issues within a specified time period, that stay *shall* be granted. LG has done so and there is absolutely no basis for Whirlpool's opposition.

[1] LG is concurrently filing a pro forma Reply Brief in C.A. No. 08-332-GMS in support of LG's motion to stay for the same reasons set forth in this Reply Brief.

II. ARGUMENT

A. LG DID NOT WAIVE ITS RIGHT TO STAY BY FILING A DECLARATORY JUDGMENT ACTION IN NEW JERSEY

Whirlpool argues in its Opposition[2] ("Whirlpool's Opposition") that, by filing a declaratory judgment action in New Jersey, LG has waived its statutory right to a stay under 28 U.S.C. § 1659(a). *Whirlpool's Opposition*, p. 6. Yet, LG in both that action, and in this action, has by motion exercised its statutory right to seek a stay under the statute. The mere fact that LG filed a declaratory judgment action to establish the jurisdiction of the District Court over the very claim at issue in this motion hardly constitutes a waiver.

While ITC proceedings are still ongoing, 28 U.S.C. § 1659(a) ***requires*** a stay of the pending district court infringement proceedings ***if a party timely seeks a stay and the requirements of the statute are otherwise satisfied***. *In re Princo Corp.*, 478 F.3d 1345, 1355 (Fed. Cir. 2007). Whirlpool ignores that LG has met all of the express requirements of 28 U.S.C. § 1659(a), which provides, in pertinent part:

> (a) Stay.--In a civil action involving parties that are also parties to a proceeding before the United States International Trade Commission under section 337 of the Tariff Act of 1930, at the request of a party to the civil action that is also a respondent in the proceeding before the Commission, the district court shall stay, until the determination of the Commission becomes final, proceedings in the civil action with respect to any claim that involves the same issues involved in the proceeding before the Commission, but only if such request is made within--
>
> (1) 30 days after the party is named as a respondent in the proceeding before the Commission, or
>
> (2) 30 days after the district court action is filed, whichever is later.

[2] Whirlpool filed a pro forma Answering Brief in this case, C.A. No. 08-234-GMS ("the '234 case"). Whirlpool's substantive opposition was filed in co-pending related case C.A. No. 08-332-GMS ("the '332 case"), and is entitled Defendants' Answering Brief in Opposition to Plaintiffs' Motion to Stay Selected Patents Pursuant to 28 U.S.C. § 1659, D.I. 28. All references to "Whirlpool's Opposition" refer to the aforementioned substantive opposition.

The present action is a civil action involving parties, LG and Whirlpool, that are also parties to a proceeding before the U.S. International Trade Commission ("ITC"), entitled *In the Matter of Certain Refrigerators and Components Thereof*, Inv. No. 337-TA-632 (the "ITC Investigation"). *Memo in Support of Motion to Stay*,[3] p. 4. LG is both a party to the actions in this Court and a respondent in the ITC Investigation, and LG has made a request for a stay of proceedings in the actions in this Court with respect to certain claims that involve the same issues involved in the proceeding before the ITC. *Id.* at 4-5. Further, the request was made within 30 days after the district court action was filed. *Id.* at 5. Accordingly, all of the requirements of the statute are met, and a stay is required. *See In re Princo Corp*. at 1355.

Whirlpool attempts to support its argument by alleging that the legislative intent of Congress in creating 28 U.S.C. § 1659(a) was to limit the statute to only defendants who are subjected to district court litigation against their will. *Whirlpool's Opposition*, p. 6. The statute contains no such restriction and the language of the statute as well as its legislative history establish that there is no such restriction. Whirlpool conveniently suggests that the statutory stay is only available to LG if Whirlpool sues LG in Whirlpool's chosen forum. According to Whirlpool, the statute has no application if LG instead takes steps to protect its rights by bringing a declaratory judgment action, on the same issues, in a court of its choosing. The statutory language, however, does not favor the complainant over the respondent. Rather, the statute refers to "a party to the civil action that is also a respondent in the proceeding before the Commission." 28 U.S.C. § 1659(a). LG is a respondent in the ITC proceeding and a party to a civil action, regardless of whether LG is a defendant in an infringement action initiated by Whirlpool or a plaintiff in a declaratory judgment action initiated by LG.

[3] "Memo in Support of Motion to Stay" refers to Plaintiff's Memorandum in Support of Motion to Stay Certain Issues Pursuant to 28 U.S.C. § 1659.

Congress' decision not to include limiting language when referring to the district court parties evidences its intent to have the statute apply to district court plaintiffs and defendants alike. In fact, this provision was added in response to certain trade disputes between the U.S. and foreign countries. H.R. Rep. 103-826(I), at 140-142. Congress expressly extended to respondents in ITC proceedings the ability to institute parallel district court actions. *Id.* As part of this legislative revision, Congress also extended to the ITC respondent the right to stay any such parallel district court proceedings as to common issues. 28 U.S.C. § 1659(a).

Even if Congress intended the statute to only apply to a party subjected to litigation against its will in two different forums at the same time (which is contrary to the express language of the statute), LG falls into that category. For example, in the present action, which was not filed as a declaratory judgment action, Whirlpool has filed counterclaims based on the patents in the ITC Investigation. These counterclaims subject LG to infringement claims in both the district court and the ITC, against LG's will. Therefore, even under Whirlpool's own distorted interpretation, LG nonetheless has a statutory right to stay these issues by virtue of Whirlpool's counterclaim in the Delaware action.

Treating the filing of a declaratory judgment action as a waiver of LG's statutory right to a stay would frustrate the intent of Congress. Congress added Section 1659(a) "to ensure that U.S. procedures for dealing with alleged infringements by imported products comport with GATT 1994 'national treatment' rules." H.R. Rep. 103-826(I), at 142. Under the "national treatment" rule, importers and producers of imported products are not to be treated less favorably than producers of domestic products. H.R. Rep. 103-826(I), at 140. Were Whirlpool's position to be adopted—and it cannot be—the mere act of filing an ITC action against a party would effectively terminate that party's statutory right to file a declaratory judgment action, if their

right to stay under 28 U.S.C. § 1659(a) is to be preserved. This places importers and producers of imported products in a less favorable position than producers of domestic products, whose right to file a declaratory judgment action remains intact. Thus, Whirlpool's argument contradicts Congress' stated desire to align ITC practice with the "national treatment" rule.

B. IT IS PROPER TO STAY LESS THAN ALL OF THE PATENTS INVOLVED IN THE ITC INVESTIGATION

Whirlpool's argument that LG must stay all patent infringement allegations in an action, or none, similarly flies in the face of the statutory language. Section 1659(a) expressly extends the right to stay to any claim and is not limited to the entire action. The statute provides that "at the request of a party…the district court shall stay…proceedings in the civil action with respect to any claim." 28 U.S.C. § 1659(a). The statute does not state that proceedings in an action shall be stayed with respect to all claims. A "claim" under Section 1659(a) corresponds to an infringement claim for a single patent. There may be several infringement claims in an action, as there are in this action. Proceedings for "any claim" must be stayed "at the request of a party." *Id.* Whirlpool's effort to rewrite the statute to fit its desire in this case simply does not fit with the clear and express language Congress chose to define the right of a respondent in an ITC investigation.

In this case LG has chosen to stay proceedings with respect to only U.S. Patent Nos. 6,810,680 ("the '680 patent") and 6,915,644 ("the '644 patent").[4] Such a choice is not "contrary to the express legislative purpose," as alleged by Whirlpool. *Whirlpool's Opposition*, p. 8.

[4] In the 332 case, LG also selected U.S. Patent Nos. 6,971,730 ("the '730 patent") and 7,240,980 ("the '980 patent") to be stayed. In view of Whirlpool's outstanding motion to dismiss in the 332 case (332 case, D.I. 5), Whirlpool's non-assertion letter with respect to the '730 and '980 patents (Exh. 2 to Whirlpool's Opposition), and an order from the ITC dated June 9, 2008 granting Whirlpool's motion to partially terminate (Exh. A hereto), LG is not opposed to only staying proceedings for the '680 and '644 patents.

Rather, the choice is exclusively LG's. Section 1659(a) expressly allows a party to avoid concurrent district court and ITC proceedings on the same claims, but only if the party requests it. 28 U.S.C. § 1659(a). In this action, LG has not requested a stay with respect to U.S. Patent No. 6,082,130 ("the '130 patent") because it has chosen to pursue its defenses against the '130 patent simultaneously in both the ITC and this District Court. LG believes that this strategy will lead to a prompt and final resolution of the disputes between the parties and thereby conserve the resources of the ITC, this Court, and the parties. The mere fact that Whirlpool would prefer to pursue the claims it asserted in the ITC under the terms and conditions it feels are strategically advantageous to it hardly justifies placing its desires ahead of LG's express statutory rights.

Whirlpool asserts that staying only two of the ITC patents is inefficient, alleging that because each of the '680, '644, and '130 patents relate to ice makers, it would be logical to litigate all three patents in this Court at the same time. *Whirlpool's Opposition*, pp. 8-9. Even a cursory review of the patents and the issues, however, establish that this assertion is disingenuous. The '680 and '644 patents are logically grouped together. Both of the patents are entitled "Ice Maker Fill Tube Assembly," have the same inventors and specifications, and have similar claims. Exh. B. On the other hand, the '130 patent is entitled "Ice Delivery System for a Refrigerator," does not have any inventors in common with the '680 and '644 patents, and has a specification and claims completely unrelated to the '680 and '644 patents. Exh. C. These two different groups of patents present very different and unrelated issues. Whirlpool itself treats these two groups of patents very differently in its own papers.

III. CONCLUSION

For the reasons set forth above, LG respectfully requests that this Court stay all proceedings pertaining to the '680 and '644 patents in this case until the ITC's determination in

In the Matter of Certain Refrigerators and Components Thereof, Inv. No. 337-TA-632, becomes final and is no longer subject to judicial review.

Dated: June 16, 2008

/s/ Richard K. Herrmann

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EXHIBIT A

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

In the Matter of	
CERTAIN REFRIGERATORS AND COMPONENTS THEREOF	**Inv. No. 337-TA-632**

ORDER NO. 8: INITIAL DETERMINATION GRANTING COMPLAINANTS' MOTION FOR PARTIAL TERMINATION BASED ON WITHDRAWAL OF CERTAIN ALLEGATIONS IN THE COMPLAINT

(June 9, 2008)

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On May 1, 2008, complainants Whirlpool Patent Company, Whirlpool Manufacturing Corporation, Whirlpool Corporation, and Maytag Corporation (collectively "Whirlpool") filed a motion to partially terminate the investigation based on their withdrawal of two of the five originally-asserted patents. (Motion Docket No. 632-003.) Specifically, Whirlpool withdraws its infringement claims with respect to U.S. Patent Nos. 6,971,730 and 7,240,980 (the "withdrawn patents").

On May 12, 2008, respondents LG Electronics, Inc., LG Electronics, USA, Inc., and LG Electronics Monterrey Mexico S.A. de C.V. (collectively "LG") filed a response supporting the motion to partially terminate, but arguing that LG should still be entitled to discovery related to the withdrawn patents to support a claim that Whirlpool failed to comply with its pre-filing obligations.[1]

Under Commission Rule 210.21(a)(1), "[a]ny party may move at any time prior to the

[1] Whirlpool's motion for leave to file a reply in support of its motion for partial termination is hereby GRANTED. (Motion Docket No. 632-004.)

issuance of an initial determination on violation of section 337 of the Tariff Act of 1930 for an order to terminate an investigation in whole or in part as to any or all respondents, on the basis of withdrawal of the complaint or certain allegations contained therein...The presiding administrative law judge may grant the motion in an initial determination upon such terms and conditions as he deems proper." 19 C.F.R. § 210.21(a)(1). Based on a review of the motion and responses thereto, the Court will grant Whirlpool's motion and terminate the investigation with respect to the withdrawn patents.

While LG supports the partial termination motion, it seeks a ruling from the Court allowing it to continue with discovery related to the withdrawn patents for the purpose of supporting its argument that Whirlpool failed to conduct an adequate pre-filing investigation. The Court declines to allow such discovery and instead instructs the parties to focus on the three patents that are still active in this investigation. The Court sees no value in extending the burden and expense of discovery by allowing LG to take discovery solely for the purpose of gathering evidence for a possible sanctions motion related to patents that are no longer part of this investigation.[2]

Accordingly, it is the Court's Initial Determination that Motion No. 632-003 be GRANTED and the investigation be partially terminated with respect to U.S. Patent Nos. 6,971,730 and 7,240,980. This initial determination is hereby certified to the Commission.

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[2] The Court also rejects LG's argument that evidence related to Whirlpool's pre-filing investigation with respect to the withdrawn patents is relevant to demonstrate a "pattern of conduct" by Whirlpool in failing to perform adequate pre-filing investigations. LG Resp. at 8-11. LG is still able to take discovery related to Whirlpool's pre-filing investigation with respect to the three remaining patents, and can still move for sanctions if the evidence proves that Whirlpool failed to perform an adequate infringement analysis on the three remaining patents prior to initiating this investigation.

Pursuant to 19 C.F.R. § 210.42(h), this Initial Determination shall become the determination of the Commission unless a party files a petition for review of the Initial Determination pursuant to 19 C.F.R. § 210.43(a), or the Commission, pursuant to 19 C.F.R. § 210.44, orders, on its own motion, a review of the Initial Determination or certain issues herein.

SO ORDERED.

Theodore R. Essex
Administrative Law Judge

IN THE MATTER OF CERTAIN REFRIGERATORS AND COMPONENTS THEREOF **Inv. No. 337-TA-632**

CERTIFICATE OF SERVICE

I, Marilyn R. Abbott, hereby certify that the attached **ORDER** was served upon, **Rett Snotherly, Esq.**, Commission Investigative Attorney, and the following parties via first class mail and air mail where necessary on June 9, **2008.**

Marilyn R. Abbott, Secretary
U.S. International Trade Commission
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IN THE MATTER OF CERTAIN REFRIGERATORS AND COMPONENTS THEREOF **Inv. No. 337-TA-632**

CERTIFICATE OF SERVICE - PAGE 2

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EXHIBIT B

US006810680B2

(12) **United States Patent**
Pohl et al.

(10) **Patent No.: US 6,810,680 B2**
(45) **Date of Patent: Nov. 2, 2004**

(54) **ICE MAKER FILL TUBE ASSEMBLY**

(75) Inventors: **Douglas A. Pohl**, Davenport, IA (US); **William James Vestal**, Monmouth, IL (US); **Kenton John Widmer**, Knoxville, IL (US)

(73) Assignee: **Maytag Corporation**, Newton, IA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/355,085**

(22) Filed: **Jan. 31, 2003**

(65) **Prior Publication Data**

US 2004/0148957 A1 Aug. 5, 2004

(51) **Int. Cl.**[7] **F25C 5/02**
(52) **U.S. Cl.** **62/71**; 62/420
(58) **Field of Search** 62/347, 340, 300, 62/71, 75, 353, 420

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,744,270	A		7/1973	Wilcox	
3,755,994	A		9/1973	Bidiwala	
3,775,994	A	*	12/1973	Linstromberg et al.	62/177
3,835,661	A		9/1974	Kochendorfer et al.	
3,866,434	A	*	2/1975	Pugh et al.	62/340
3,937,032	A	*	2/1976	Bright	62/135
4,020,644	A		5/1977	True, Jr. et al.	
4,142,378	A	*	3/1979	Bright et al.	62/135
4,191,025	A		3/1980	Webb	
4,272,025	A	*	6/1981	Mazzotti	239/240
4,341,087	A	*	7/1982	Van Steenburgh, Jr.	62/233
4,366,679	A	*	1/1983	Van Steenburgh, Jr.	62/347
4,632,280	A	*	12/1986	Mawby et al.	222/275
4,635,444	A		1/1987	Mawby et al.	
4,680,943	A		7/1987	Mawby et al.	
5,924,301	A	*	7/1999	Cook	62/347
5,964,617	A	*	10/1999	Hoang et al.	439/528
6,148,624	A	*	11/2000	Bishop et al.	62/137
6,157,777	A		12/2000	Banks et al.	
6,470,701	B2	*	10/2002	Tchougounov et al.	62/347
6,490,873	B2	*	12/2002	Tchougounov	62/71
6,574,982	B1	*	6/2003	Wiseman et al.	62/347
2001/0011461	A1		8/2001	Tchougounov et al.	

FOREIGN PATENT DOCUMENTS

JP	402126070	A	*	5/1990

* cited by examiner

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(57) **ABSTRACT**

An ice maker assembly in a refrigerator freezer includes a fill tube for transporting liquid to a mold. The freezer includes an outer wall spaced apart from an inner wall, with a plenum formed therebetween. An opening is formed within the inner wall, through which the fill tube extends with a clearance. Warm air generated by a defrost cycle passes through the clearance in the inner wall and around the fill tube, thereby warming the fill tube. In addition, the fill tube includes vents formed therein to allow active ventilation of the fill tube and to prevent ice formation within the fill tube.

14 Claims, 2 Drawing Sheets

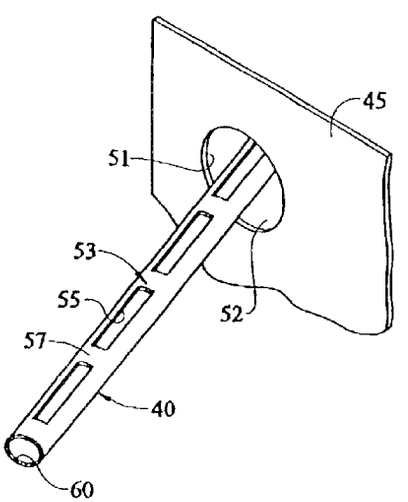


FIG. 1

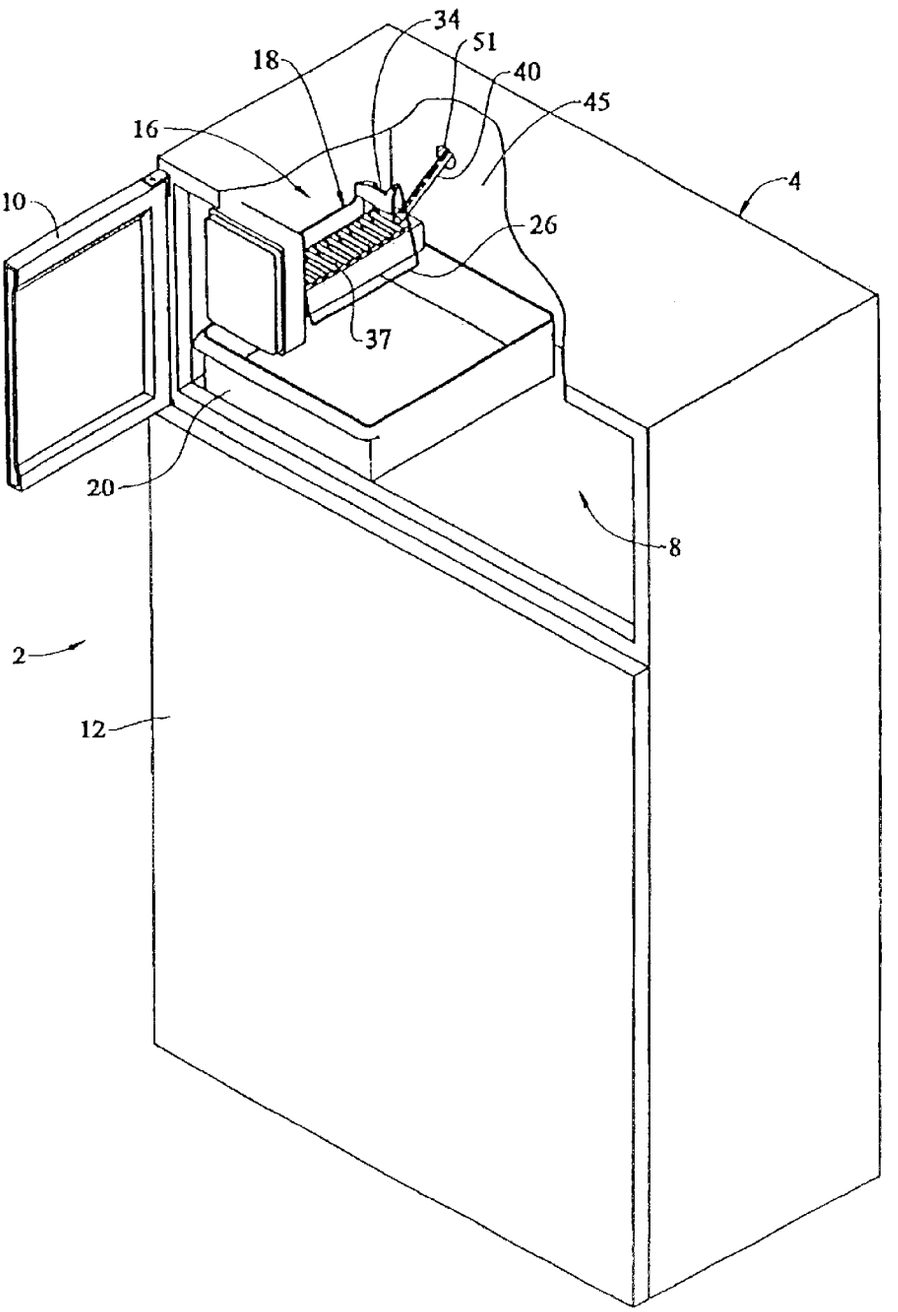


FIG. 2

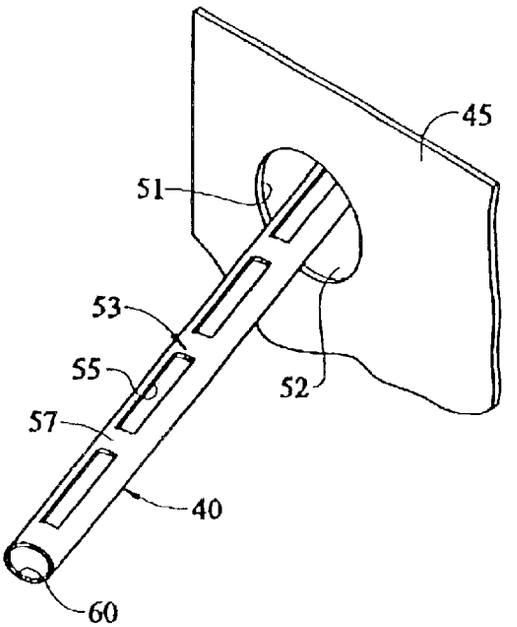
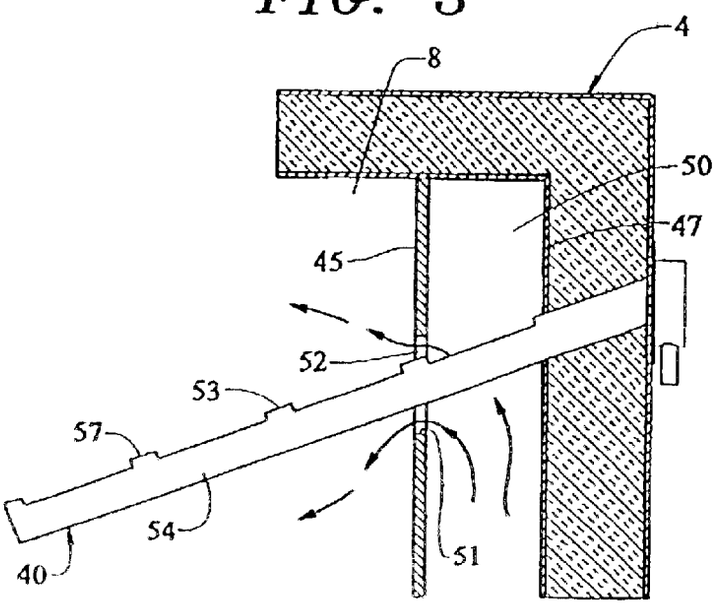


FIG. 3



ICE MAKER FILL TUBE ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to the art of refrigerators, and, more particularly, to a fill tube arrangement for an ice maker assembly provided in a freezer of a refrigerator.

2. Discussion of the Prior Art

Providing automatic ice makers in household refrigerators has become extremely commonplace. Ice makers typically include a tray that is filled by a water fill tube extending through a wall of a freezer compartment.

Since the ice maker fill tube extends into the freezer compartment, a problem exists in that water can freeze within the tube and lead to clogging of the tube. Several attempts have been made to solve this problem. For example, U.S. Pat. No. 4,020,644 discloses a water supply line that is maintained in contact with the freezer compartment outer case over a pre-selected length of the fill tube sufficient to prevent freezing of water in the fill tube. In addition, the fill tube is insulated with foam material. In the arrangement of the '644, patent, there is still a possibility that the tube may freeze. More particularly, only a portion of the tube is in heat exchange relationship with the outer case. Therefore, any heat provided by the outer case may not be sufficient to prevent freezing of other portions of the fill tube. Further, the tube is surrounded by foam and may be difficult to remove if it is necessary to clear an ice blockage within the tube.

Another attempt to solve the problem of ice formation in an ice maker fill tube is demonstrated by U.S. Pat. No. 6,157,777. In this arrangement, an ice maker fill tube includes a heater for maintaining a fluid within the tube at or above a predetermined temperature. The fill tube and heater are integrally formed so the heater is protected from physical damage. However, this arrangement adds significantly to the costs associated with manufacturing the fill tube and ice maker. Additionally, the heater arrangement will certainly affect installation and repair costs associated with the fill tube and ice maker.

Based on the known prior art, there is a need in the art for an ice maker fill tube assembly that prevents ice from freezing within the fill tube. Further, there is a need for an assembly that is inexpensive to manufacture, easy to maintain, and provides reliable protection against ice build-up.

SUMMARY OF THE INVENTION

The present invention is directed to a fill tube arranged for an ice maker assembly in a freezer compartment of a refrigerator, wherein the fill tube functions to transport liquid from a reservoir to a mold. The freezer includes an outer wall spaced apart from an inner wall, and a plenum formed therebetween. An opening is formed within the inner wall, through which the fill tube extends with a desired clearance. Warm air generated by a defrost cycle passes through the clearance in the inner wall and around the fill tube, thereby warming the fill tube.

In addition, the fill tube is formed with vents to allow active ventilation of the fill tube in order to prevent ice formation within the fill tube. Particularly, warm air generated by a defrost cycle is allowed to enter the vents formed within the fill tube to prevent freezing of the fill tube. The fill tube is also exposed to dehumidified freezer air from behind the inner wall. The dehumidified freezer air helps to prevent ice formation on the surface of the fill tube, as well as ice restrictions within the fill tube.

Additional objects, features and advantages of the present invention will become more readily apparent from the following detailed description of a preferred embodiment when taken in conjunction with the drawings wherein like reference numerals refer to corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial sectional view of a refrigerator having a freezer compartment incorporating the ice maker fill tube assembly constructed in accordance with the present invention;

FIG. **2** is a perspective view of the fill tube assembly of FIG. **1**; and

FIG. **3** is a cross-sectional view showing the fill tube assembly and a portion of the freezer compartment of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With initial reference to FIG. **1**, a refrigerator **2** includes a cabinet **4** within which is defined a freezer compartment **8**. Freezer compartment **8** can be selectively accessed through the pivoting of a freezer door **10**. Also provided is a fresh food door **12** which enables access to a fresh food compartment (not shown). As shown, refrigerator **2** constitutes a top-mount model. However, as will become fully evident below, the present invention is equally applicable to various types of refrigerators, including side-by-side models.

Arranged within freezer compartment **8** is an ice maker assembly **16**. In a manner known in the art, ice maker assembly **16** includes an ice maker unit **18** and an ice storage bin **20**. Ice maker unit **18** is shown to include a bale arm **26** which is pivotable upward and downward based on the amount of ice retained in storage bin **20**. Bale arm **26** is actually pivotally connected to a switch arm **34**.

Ice maker unit **18** also includes an ice mold **37**. In general, this construction, as well as the operation of ice maker unit **18**, is known in the art. Basically, the flow of water is directed to ice mold **37** by a fill tube **40** to fill up various cavities (not separately labeled) of ice mold **37** in order to produce ice cubes which are deposited into storage bin **20**. In a typical ice maker arrangement, when the storage bin **20** has collected a sufficient number of ice cubes, the stored ice cubes will act on bale arm **26** to cause bale arm **26** to be lifted which, in turn, operates on switch arm **34** to de-activate ice maker unit **18**. Bale arm **26** is biased downward to an ice making position such that, when a sufficient number of ice cubes are removed from storage bin **20**, ice maker unit **18** will be automatically reactivated. Since the operation of automatic ice makers are widely known in the art, further details thereof will not be discussed here.

The present invention is particularly directed to aspects of fill tube **40** of overall ice maker assembly **16**. As previously mentioned, ice maker assembly **16** is located within freezer compartment **8**. Freezer compartment **8** includes an evaporator coil cover **45**, which includes air flow openings (not shown), and an insulated rear wall **47** (also see FIGS. **2** and **3**) which is defined by a freezer liner. As best shown in FIG. **3**, within cabinet **4**, evaporator coil cover **45** and insulated rear wall **47** have a plenum **50** formed therebetween. Fill tube **40** extends through insulated rear wall **47**, plenum **50**,

and evaporator coil cover **45**. More specifically, evaporator coil cover **45** includes an opening **51** through which fill tube **40** passes, with a clearance **52** therebetween.

By positioning fill tube **40** so that it passes through plenum **50** and opening **51** in evaporator coil cover **45** with clearance **52**, fill tube **40** is exposed to active ventilation with dehumidified freezer air. More particularly, air from plenum **50** is directed around fill tube **40** due to clearance **52** between fill tube **40** and evaporator coil cover **45**. Ventilation with dehumidified freezer air sublimates ice from the surface of fill tube **40** and prevents ice restrictions within fill tube **40**. In addition, fill tube **40** is exposed to heat which develops behind evaporator coil cover **45** during a freezer defrost cycle. This heat serves to melt any ice which may form within fill tube **40**.

In accordance with the most preferred form of the invention, fill tube **40** includes a top or upper portion **53** and a bottom or lower portion **54**. The top portion **53** of fill tube **40** includes a plurality of axially spaced vents **55** formed therein. Preferably, vents **55** take the form of elongated slots and fill tube **40** is formed of a flexible PVC material. As shown in FIG. **2**, vents **55** are alternated with cross ribs **57** to help maintain the structure of fill tube **40** while allowing active venting of fill tube **40**. On the other hand, bottom portion **54** of fill tube **40** is solid to allow water to flow through fill tube **40** to an outlet **60**.

As indicated above, when refrigerator **2** performs a defrost cycle, warm air fills plenum **50**. The warm air passes through opening **51** and surrounds fill tube **40**. Warm air generated by a defrost cycle also enters vents **55** formed within fill tube **40** to prevent freezing of water within fill tube **40**. Fill tube **40** is also exposed to dehumidified freezer air from behind inner wall **45** which helps to prevent ice formation on the surface of fill tube **40** and prevents ice restrictions within fill tube **40**. Therefore, with this overall construction, an unobstructed supply of water to make ice cubes is available.

Although described with reference to a preferred embodiment of the invention, it should be readily understood that various changes and/or modifications can be made to the invention without departing from the spirit thereof. In general, the invention is only intended to be limited by the scope of the following claims.

We claim:

1. A refrigerator freezer comprising:

an outer wall spaced apart from an inner wall, said inner wall being formed with an opening; and

an ice maker assembly including:

a mold cavity for collecting liquid to be frozen; and

a fill tube for transporting liquid to the mold cavity, said fill tube including at least one vent formed along its length, wherein the fill tube extends through the opening in the inner wall with a clearance between said inner wall and said fill tube to permit a flow of air about the fill tube through the clearance.

2. An ice maker assembly comprising:

a mold cavity for collecting liquid to be frozen; and

a fill tube for transporting liquid to the mold cavity, said fill tube including at least one vent formed along its length, wherein said ice maker assembly is positioned in a refrigerator freezer having an outer wall spaced apart from an inner wall, said inner wall including an opening through which the fill tube extends, said fill tube extending through the opening with a clearance between said inner wall and said fill tube to permit a flow of the air about the fill tube through the clearance.

3. The ice maker assembly of claim **2**, wherein the at least one vent includes a plurality of axially spaced vents.

4. The ice maker assembly of claim **3**, wherein each of said vents takes the form of a slot.

5. The ice maker assembly of claim **4**, wherein the fill tube includes an upper surface portion and a lower surface portion, said vents being formed in the upper surface portion.

6. A refrigerator freezer comprising:

an outer wall spaced apart from an inner wall, said inner wall being formed with an opening; and

an ice maker assembly including:

a mold cavity for collecting liquid to be frozen; and

a liquid fill tube for transporting liquid to the mold cavity, wherein the liquid fill tube extends through the opening in the inner wall with a clearance between said inner wall and said liquid fill tube to permit a flow of air about the fill tube through the clearance.

7. The refrigerator freezer of claim **6**, wherein the liquid fill tube is formed with a plurality of longitudinally spaced vents.

8. The refrigerator freezer of claim **7**, wherein each of said vents takes the form of a slot.

9. The refrigerator freezer of claim **8**, wherein the fill tube includes an upper surface portion and a lower surface portion, said vents being formed in the upper surface portion.

10. The refrigerator freezer of claim **6**, wherein said inner wall constitutes an evaporator coil cover.

11. The refrigerator freezer of claim **6**, wherein said outer wall constitutes an insulated wall of a freezer liner.

12. A method of preventing ice from forming in an ice maker fill tube of a refrigerator comprising the steps of:

generating a flow of warm air in a plenum located between an inner wall, which is formed with an opening, and an outer wall of a refrigerator freezer compartment by running a defrost cycle in the refrigerator; and

warming the fill tube, that extends through the plenum and the opening in the inner wall, by allowing the warm air to flow around the fill tube through a clearance formed between the fill tube and the opening of the inner wall.

13. The method of claim **12**, further comprising: warming the fill tube by allowing the warm air to enter at least one hole formed within the fill tube.

14. The method of claim **13**, further comprising: allowing the warm air to enter any one of a plurality of axially spaced holes formed along an upper surface portion of the fill tube.

* * * * *

US006915644B2

(12) **United States Patent**
Pohl et al.

(10) **Patent No.: US 6,915,644 B2**
(45) **Date of Patent: Jul. 12, 2005**

(54) **ICE MAKER FILL TUBE ASSEMBLY**

(75) Inventors: **Douglas A. Pohl**, Davenport, IA (US); **William James Vestal**, Monmouth, IL (US); **Kenton John Widmer**, Knoxville, IL (US)

(73) Assignee: **Maytag Corporation**, Newton, IA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/942,994**

(22) Filed: **Sep. 17, 2004**

(65) **Prior Publication Data**

US 2005/0028548 A1 Feb. 10, 2005

Related U.S. Application Data

(63) Continuation of application No. 10/355,085, filed on Jan. 31, 2003, now Pat. No. 6,810,680.

(51) **Int. Cl.**[7] **F25C 5/02**
(52) **U.S. Cl.** **62/71**; 62/420
(58) **Field of Search** 62/71, 74, 75, 62/137, 344, 347, 352, 353, 420; 141/82; 137/588, 592

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(74) *Attorney, Agent, or Firm*—Diederiks & Whitelaw

(57) **ABSTRACT**

An ice maker assembly in a refrigerator freezer includes a fill tube for transporting liquid to a mold. The freezer includes an outer wall spaced apart from an inner wall, with a plenum formed therebetween. An opening is formed within the inner wall, through which the fill tube extends with a clearance. Warm air generated by a defrost cycle passes through the clearance in the inner wall and around the fill tube, thereby warming the fill tube. In addition, the fill tube includes vents formed therein to allow active ventilation of the fill tube and to prevent ice formation within the fill tube.

13 Claims, 2 Drawing Sheets

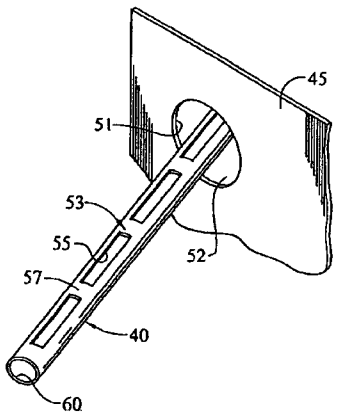


FIG. 1

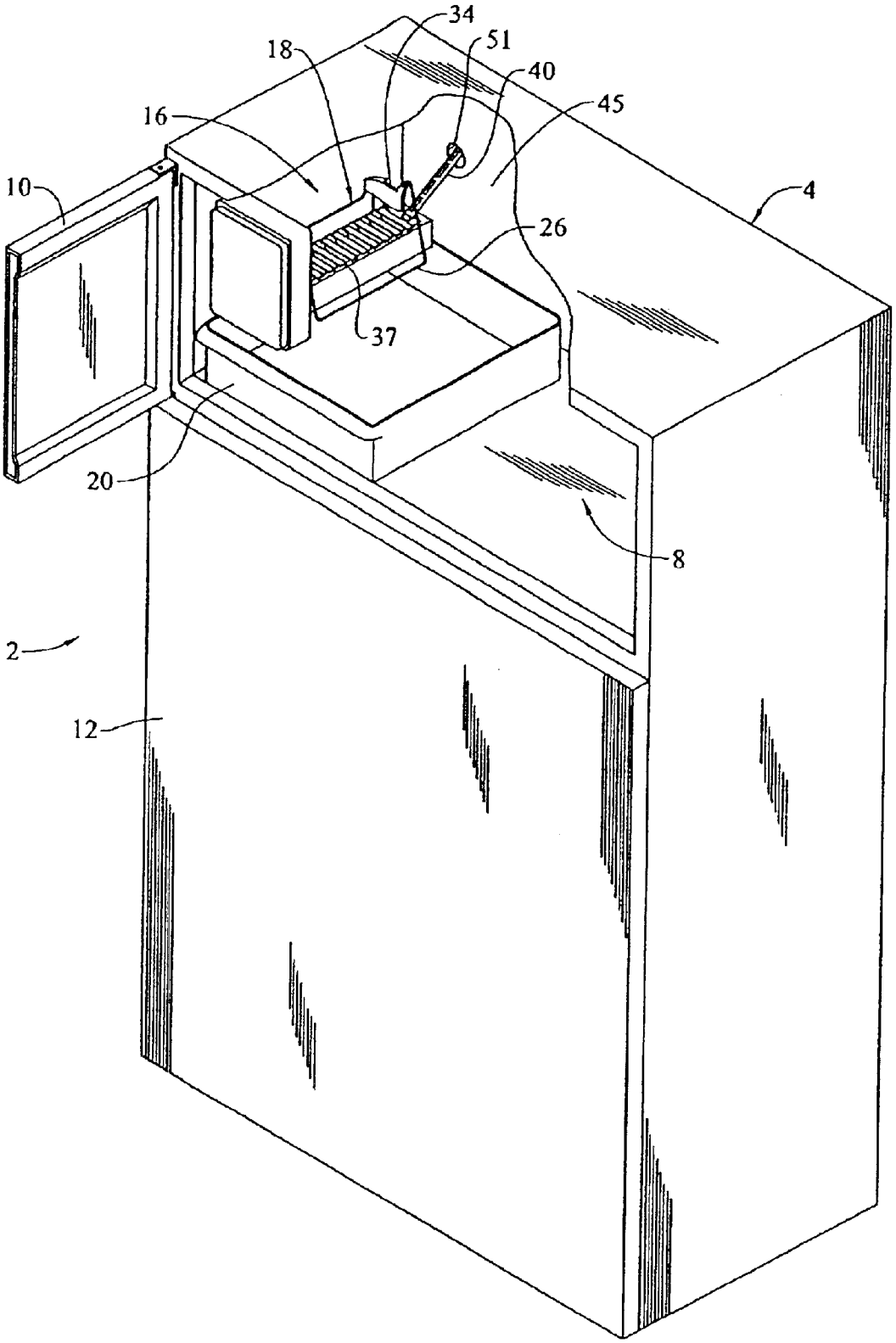


FIG. 2

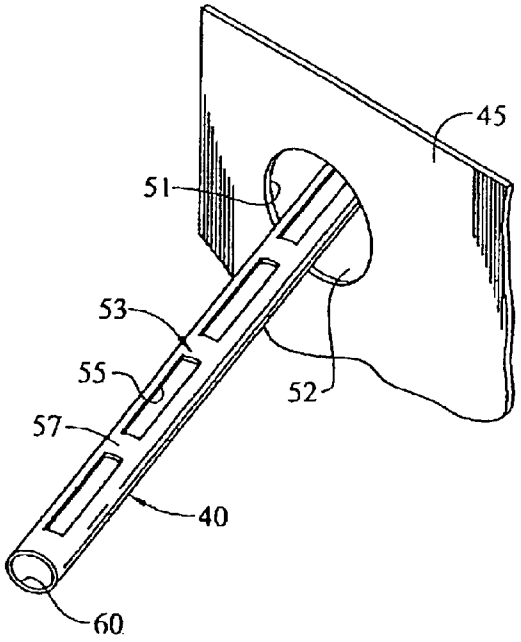
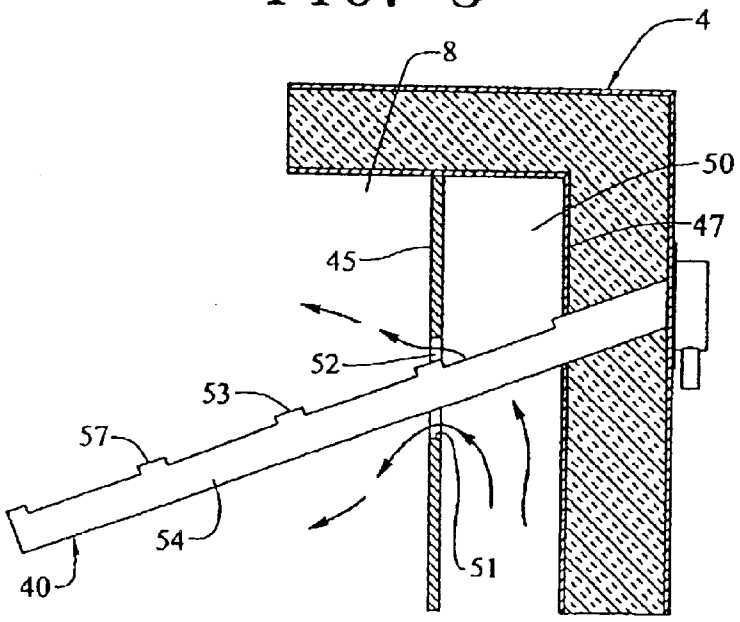


FIG. 3



ICE MAKER FILL TUBE ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application represents a continuation of U.S. patent application Ser. No. 10/355,085 filed Jan. 31, 2003, now U.S. Pat No. 6,810,680.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to the art of refrigerators, and, more particularly, to a fill tube arrangement for an ice maker assembly provided in a freezer of a refrigerator.

2. Discussion of the Prior Art

Providing automatic ice makers in household refrigerators has become extremely commonplace. Ice makers typically include a tray that is filled by a water fill tube extending through a wall of a freezer compartment.

Since the ice maker fill tube extends into the freezer compartment, a problem exists in that water can freeze within the tube and lead to clogging of the tube. Several attempts have been made to solve this problem. For example, U.S. Pat. No. 4,020,644 discloses a water supply line that is maintained in contact with the freezer compartment outer case over a pre-selected length of the fill tube sufficient to prevent freezing of water in the fill tube. In addition, the fill tube is insulated with foam material. In the arrangement of the '644 patent, there is still a possibility that the tube may freeze. More particularly, only a portion of the tube is in heat exchange relationship with the outer case. Therefore, any heat provided by the outer case may not be sufficient to prevent freezing of other portions of the fill tube. Further, the tube is surrounded by foam and may be difficult to remove if it is necessary to clear an ice blockage within the tube.

Another attempt to solve the problem of ice formation in an ice maker fill tube is demonstrated by U.S. Pat. No. 6,157,777. In this arrangement, an ice maker fill tube includes a heater for maintaining a fluid within the tube at or above a predetermined temperature. The fill tube and heater are integrally formed so the heater is protected from physical damage. However, this arrangement adds significantly to the costs associated with manufacturing the fill tube and ice maker. Additionally, the heater arrangement will certainly affect installation and repair costs associated with the fill tube and ice maker.

Based on the known prior art, there is a need in the art for an ice maker fill tube assembly that prevents ice from freezing within the fill tube. Further, there is a need for an assembly that is inexpensive to manufacture, easy to maintain, and provides reliable protection against ice build-up.

SUMMARY OF THE INVENTION

The present invention is directed to a fill tube arranged for an ice maker assembly in a freezer compartment of a refrigerator, wherein the fill tube functions to transport liquid from a reservoir to a mold. The freezer includes an outer wall spaced apart from an inner wall, and a plenum formed therebetween. An opening is formed within the inner wall, through which the fill tube extends with a desired clearance. Warm air generated by a defrost cycle passes through the clearance in the inner wall and around the fill tube, thereby warming the fill tube.

In addition, the fill tube is formed with vents to allow active ventilation of the fill tube in order to prevent ice formation within the fill tube. Particularly, warm air generated by a defrost cycle is allowed to enter the vents formed within the fill tube to prevent freezing of the fill tube. The fill tube is also exposed to dehumidified freezer air from behind the inner wall. The dehumidified freezer air helps to prevent ice formation on the surface of the fill tube, as well as ice restrictions within the fill tube.

Additional objects, features and advantages of the present invention will become more readily apparent from the following detailed description of a preferred embodiment when taken in conjunction with the drawings wherein like reference numerals refer to corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial sectional view of a refrigerator having a freezer compartment incorporating the ice maker fill tube assembly constructed in accordance with the present invention;

FIG. **2** is a perspective view of the fill tube assembly of FIG. **1**; and

FIG. **3** is a cross-sectional view showing the fill tube assembly and a portion of the freezer compartment of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With initial reference to FIG. **1**, a refrigerator **2** includes a cabinet **4** within which is defined a freezer compartment **8**. Freezer compartment **8** can be selectively accessed through the pivoting of a freezer door **10**. Also provided is a fresh food door **12** which enables access to a fresh food compartment (not shown). As shown, refrigerator **2** constitutes a top-mount model. However, as will become fully evident below, the present invention is equally applicable to various types of refrigerators, including side-by-side models.

Arranged within freezer compartment **8** is an ice maker assembly **16**. In a manner known in the art, ice maker assembly **16** includes an ice maker unit **18** and an ice storage bin **20**. Ice maker unit **18** is shown to include a bale arm **26** which is pivotable upward and downward based on the amount of ice retained in storage bin **20**. Bale arm **26** is actually pivotally connected to a switch arm **34**.

Ice maker unit **18** also includes an ice mold **37**. In general, this construction, as well as the operation of ice maker unit **18**, is known in the art. Basically, the flow of water is directed to ice mold **37** by a fill tube **40** to fill up various cavities (not separately labeled) of ice mold **37** in order to produce ice cubes which are deposited into storage bin **20**. In a typical ice maker arrangement, when the storage bin **20** has collected a sufficient number of ice cubes, the stored ice cubes will act on bale arm **26** to cause bale arm **26** to be lifted which, in turn, operates on switch arm **34** to de-activate ice maker unit **18**. Bale arm **26** is biased downward to an ice making position such that, when a sufficient number of ice cubes are removed from storage bin **20**, ice maker unit **18** will be automatically reactivated. Since the operation of automatic ice makers are widely known in the art, further details thereof will not be discussed here.

The present invention is particularly directed to aspects of fill tube **40** of overall ice maker assembly **16**. As previously mentioned, ice maker assembly **16** is located within freezer compartment **8**. Freezer compartment **8** includes an evaporator coil cover **45**, which includes air flow openings (not shown), and an insulated rear wall **47** (also see FIGS. **2** and

3) which is defined by a freezer liner. As best shown in FIG. **3**, within cabinet **4**, evaporator coil cover **45** and insulated rear wall **47** have a plenum **50** formed therebetween. Fill tube **40** extends through insulated rear wall **47**, plenum **50**, and evaporator coil cover **45**. More specifically, evaporator coil cover **45** includes an opening **51** through which fill tube **40** passes, with a clearance **52** therebetween.

By positioning fill tube **40** so that it passes through plenum **50** and opening **51** in evaporator coil cover **45** with clearance **52**, fill tube **40** is exposed to active ventilation with dehumidified freezer air. More particularly, air from plenum **50** is directed around fill tube **40** due to clearance **52** between fill tube **40** and evaporator coil cover **45**. Ventilation with dehumidified freezer air sublimates ice from the surface of fill tube **40** and prevents ice restrictions within fill tube **40**. In addition, fill tube **40** is exposed to heat which develops behind evaporator coil cover **45** during a freezer defrost cycle. This heat serves to melt any ice which may form within fill tube **40**.

In accordance with the most preferred form of the invention, fill tube **40** includes a top or upper portion **53** and a bottom or lower portion **54**. The top portion **53** of fill tube **40** includes a plurality of axially spaced vents **55** formed therein. Preferably, vents **55** take the form of elongated slots and fill tube **40** is formed of a flexible PVC material. As shown in FIG. **2**, vents **55** are alternated with cross ribs **57** to help maintain the structure of fill tube **40** while allowing active venting of fill tube **40**. On the other hand, bottom portion **54** of fill tube **40** is solid to allow water to flow through fill tube **40** to an outlet **60**.

As indicated above, when refrigerator **2** performs a defrost cycle, warm air fills plenum **50**. The warm air passes through opening **51** and surrounds fill tube **40**. Warm air generated by a defrost cycle also enters vents **55** formed within fill tube **40** to prevent freezing of water within fill tube **40**. Fill tube **40** is also exposed to dehumidified freezer air from behind inner wall **45** which helps to prevent ice formation on the surface of fill tube **40** and prevents ice restrictions within fill tube **40**. Therefore, with this overall construction, an unobstructed supply of water to make ice cubes is available.

Although described with reference to a preferred embodiment of the invention, it should be readily understood that various changes and/or modifications can be made to the invention without departing from the spirit thereof. In general, the invention is only intended to be limited by the scope of the following claims.

What is claimed is:

1. An ice maker assembly comprising:

a mold cavity for collecting liquid to be frozen; and

a fill tube for transporting liquid to the mold cavity, said fill tube including at least one vent formed along its length, wherein the at least one vent includes a plurality of axially spaced vents for a ventilating flow of air.

2. The ice maker assembly of claim **1**, wherein each of said vents takes the form of a slot.

3. The ice maker assembly of claim **2**, wherein the fill tube includes an upper surface portion and a lower surface portion, said vents being formed in the upper surface portion.

4. The ice maker assembly of claim **1**, further comprising: a plurality of cross ribs alternating with the plurality of vents axially along the fill tube.

5. The ice maker assembly of claim **1**, wherein the fill tube has an upper portion and a bottom portion, said bottom portion being solid to allow water to flow through the fill tube, said vents being defined along the upper portion of the fill tube.

6. A refrigerator freezer comprising:

an outer wall spaced apart from an inner wall, said inner wall being formed with an opening; and

an ice maker assembly including:

a mold cavity for collecting liquid to be frozen; and

a liquid fill tube for transporting liquid to the mold cavity, wherein the liquid fill tube extends through the opening in the inner wall, said fill tube being formed with a plurality of axially spaced vents for a ventilating flow of air.

7. The refrigerator freezer of claim **6**, wherein the liquid fill tube is formed with a clearance between said inner wall and said liquid fill tube.

8. The refrigerator freezer of claim **6**, wherein each of said vents takes the form of a slot.

9. The refrigerator freezer of claim **8**, wherein the fill tube includes an upper surface portion and a lower surface portion, said vents being formed in the upper surface portion.

10. The refrigerator freezer of claim **6**, wherein said inner wall constitutes an evaporator coil cover.

11. The refrigerator freezer of claim **6**, wherein said outer wall constitutes an insulated wall of a freezer liner.

12. A method of preventing ice from forming in an ice maker fill tube of a refrigerator comprising the steps of:

generating a flow of warm air in a plenum located between an inner wall, which is formed with an opening, and an outer wall of a refrigerator freezer compartment by running a defrost cycle in the refrigerator; and

warming the fill tube, that extends through the plenum and the opening in the inner wall, by allowing the warm air to enter at least one hole formed within the fill tube.

13. The method of claim **12**, further comprising: allowing the warm air to enter any one of a plurality of axially spaced holes formed along an upper surface portion of the fill tube.

* * * * *

EXHIBIT C

US006082130A

United States Patent [19]

Pastryk et al.

[11] **Patent Number: 6,082,130**

[45] **Date of Patent: Jul. 4, 2000**

[54] **ICE DELIVERY SYSTEM FOR A REFRIGERATOR**

[75] Inventors: **Jim J. Pastryk**, New Troy; **Mark H. Nelson**, Berrien Springs; **Verne H. Myers**, St. Joseph, all of Mich.; **Daryl L. Harmon**, Newburgh, Ind.; **Andrew M. Oltman**; **Gregory G. Hortin**, both of Evansville, Ind.; **Devinder Singh**, St. Joseph, Mich.

[73] Assignee: **Whirlpool Corporation**, Benton Harbor, Minn.

[21] Appl. No.: **09/221,534**

[22] Filed: **Dec. 28, 1998**

[51] **Int. Cl.**[7] **F25C 5/18**

[52] **U.S. Cl.** **62/344**; 222/146.6

[58] **Field of Search** 62/344; 222/146.6

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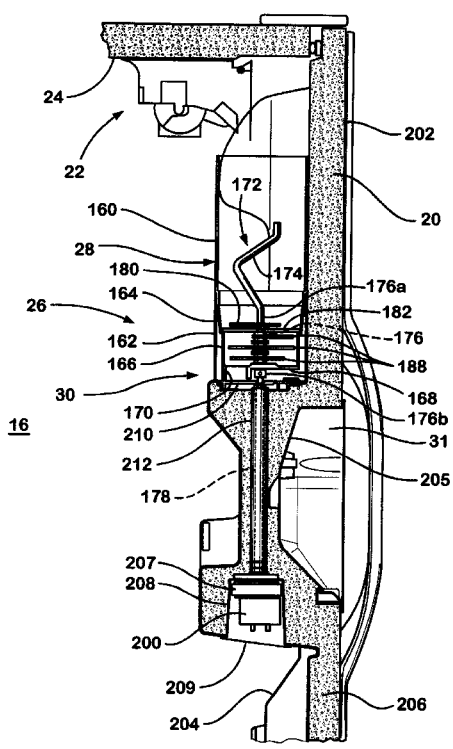
Primary Examiner—William E. Tapolcai

Attorney, Agent, or Firm—Stephen D. Krefman; Joel M. Van Winkle; Robert O. Rice

[57] **ABSTRACT**

A refrigerator having a cabinet defining a freezer compartment having an access opening and a closure member for closing the access opening. An ice maker is disposed within the freezer compartment for forming ice pieces and an ice storage bin is removably mounted to the closure member below the ice maker for receiving ice from the ice maker. The ice storage bin has an upper portion which is transparent and has a bottom opening. An ice discharge chute extends through the closure member below the bottom opening of the ice storage bin. A motor is mounted on the closure member. An auger is vertically disposed within the ice storage bin and is drivingly connected to the motor. Upon energization of the motor, the auger moves ice pieces from the ice storage bin through the bottom opening to the ice discharge chute for dispensing ice pieces from the ice storage bin.

25 Claims, 7 Drawing Sheets



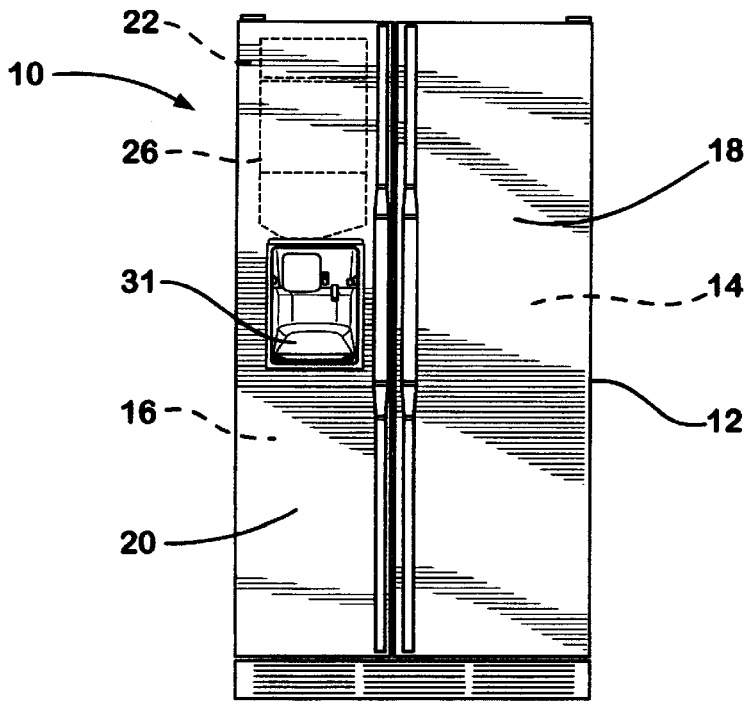


Fig. 1

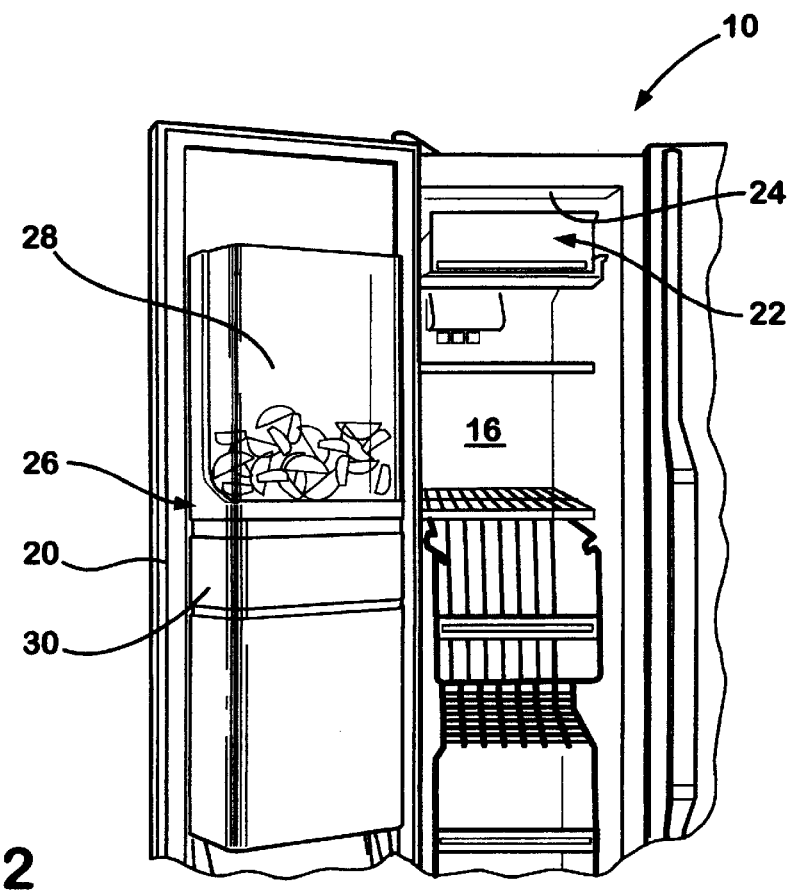


Fig. 2

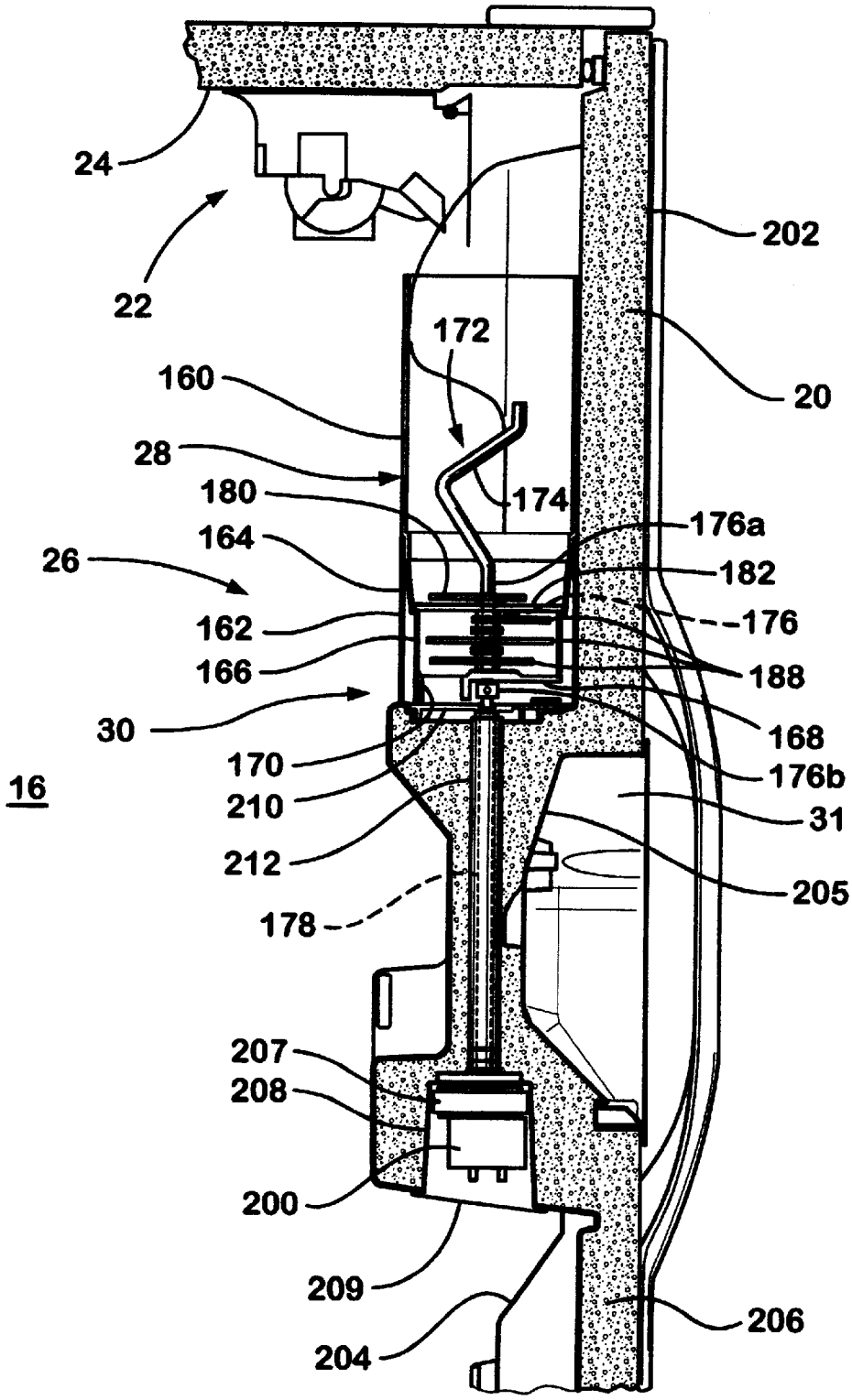

24
22
202
172
20
160
28
180
174
176a
164
26
182
176
162
166
188
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168
170
176b
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210
31
212
205
178
207
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200
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206
204

Fig. 3

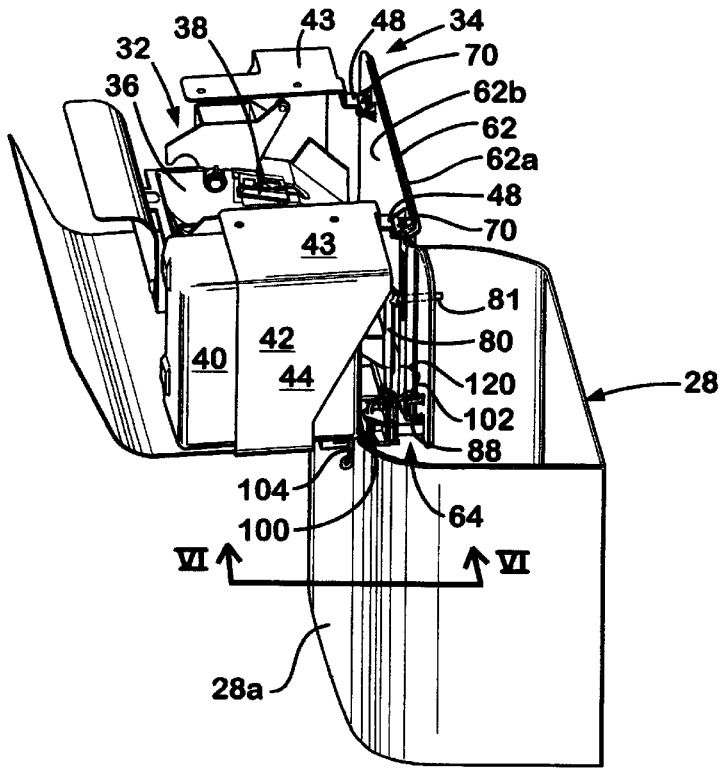

38
43
48
34
32
70
36
62b
62
62a
48
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42
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120
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102
88
104
64
100
VI
VI
28a

Fig. 4

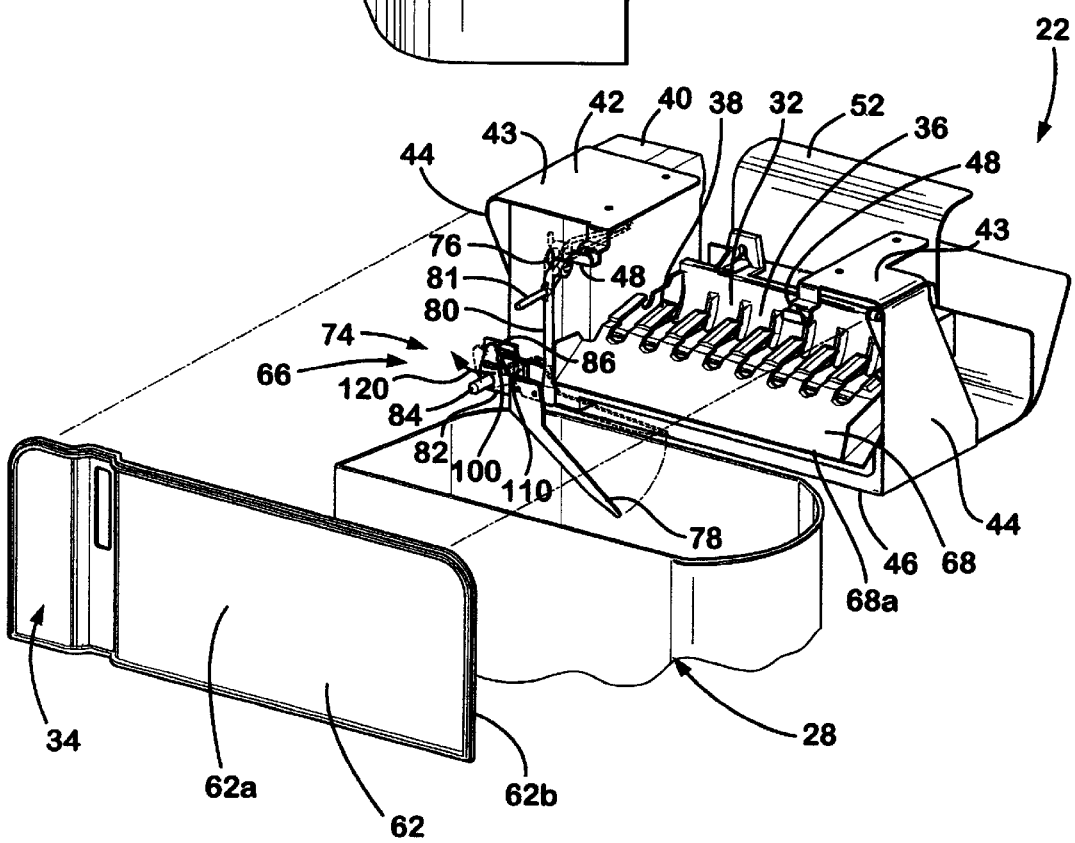

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68a
34
62a
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62b
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Fig. 5

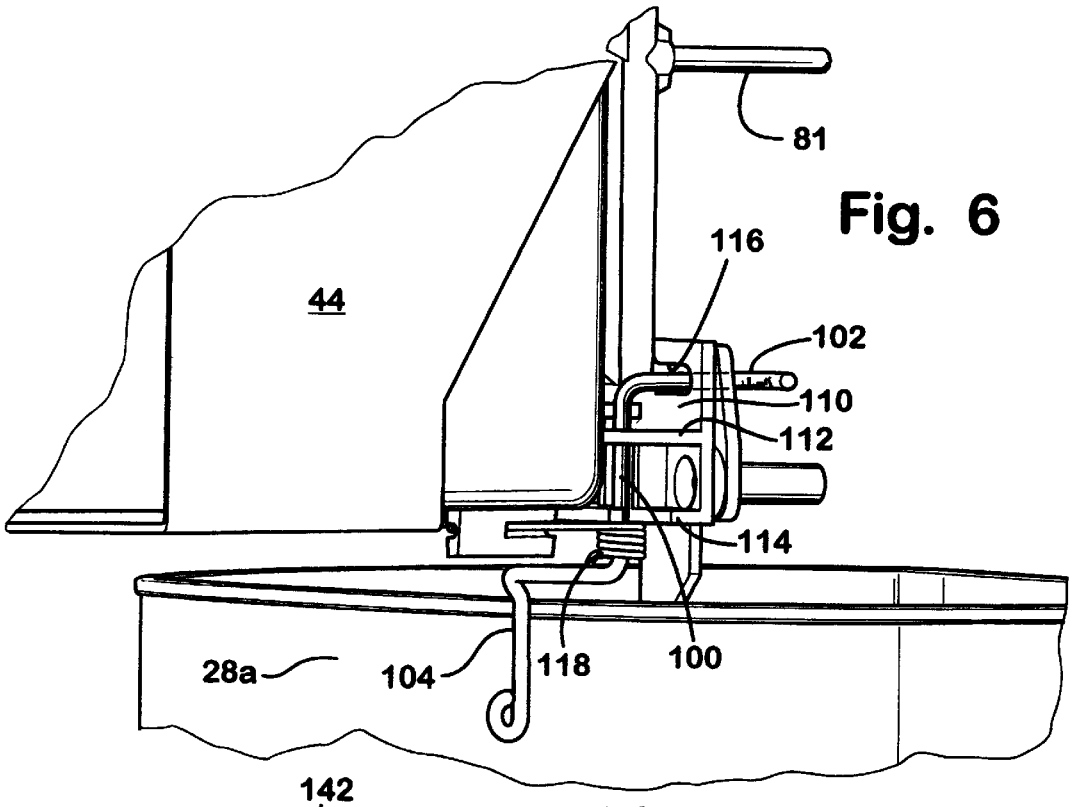

81
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44
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110
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28a
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118
100

Fig. 6

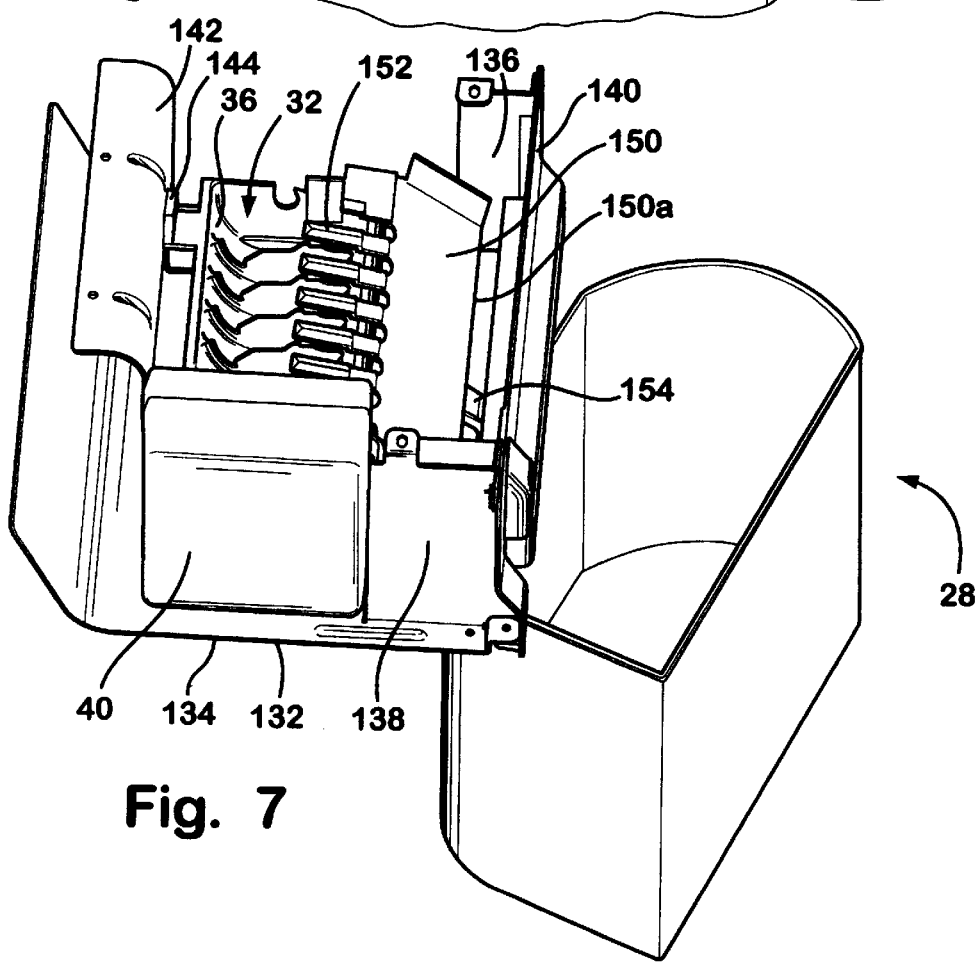

142
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136
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150
150a
154
28
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134
132
138

Fig. 7

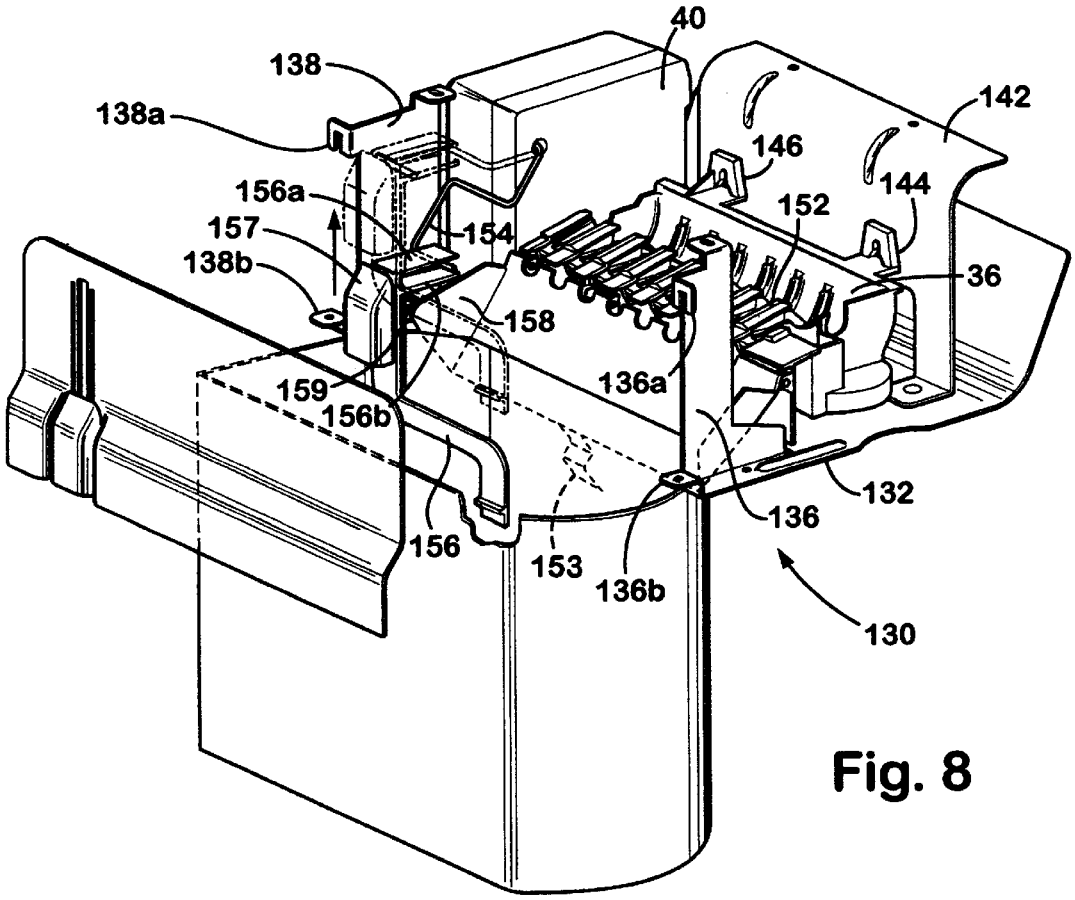

40
138
138a
142
146
144
156a
157
154
152
138b
36
158
159
156b
136a
132
136
156
153
136b
130

Fig. 8

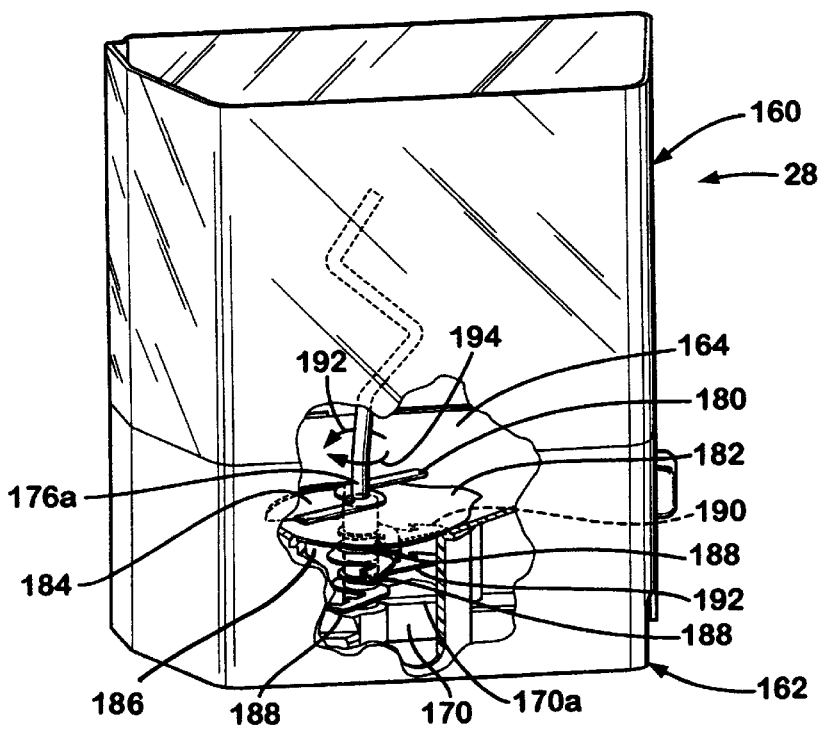

160
28
194
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164
180
182
176a
190
188
184
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170a
162

Fig. 9

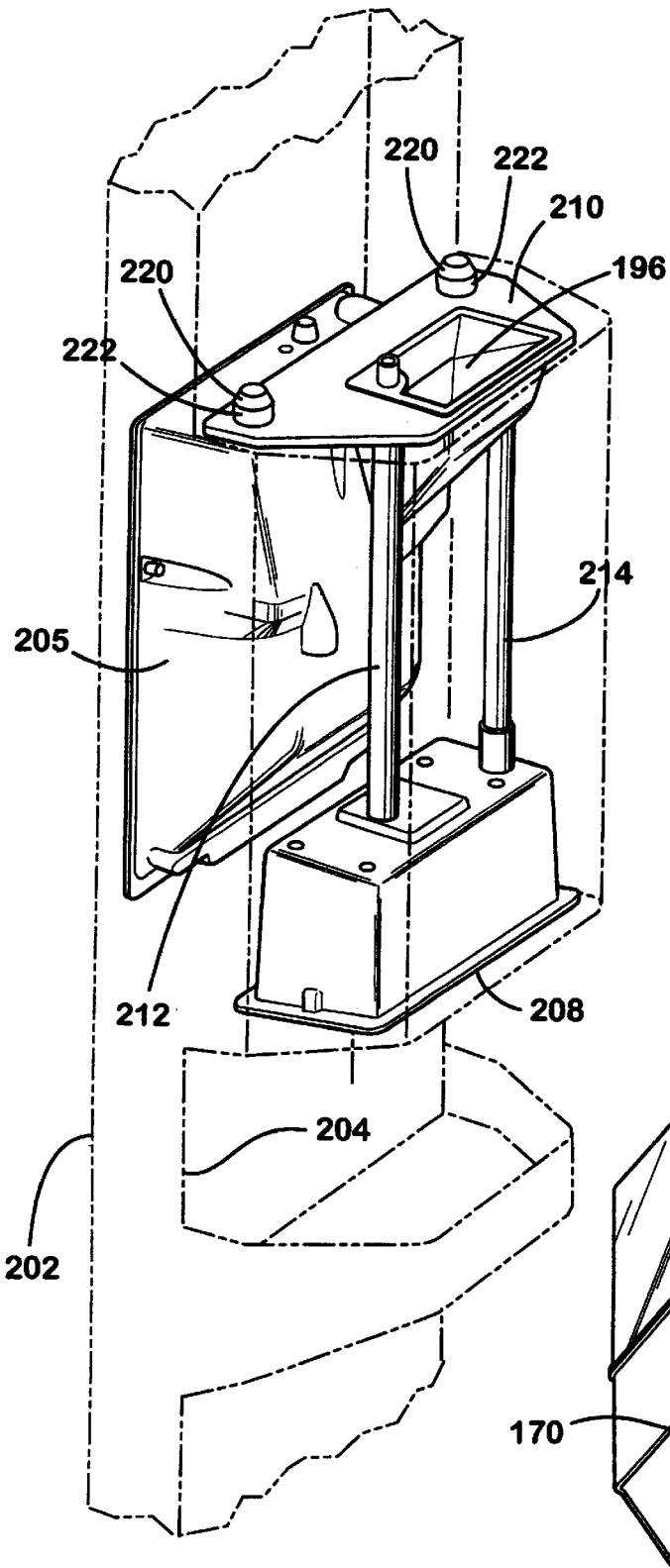

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222
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202

Fig. 10

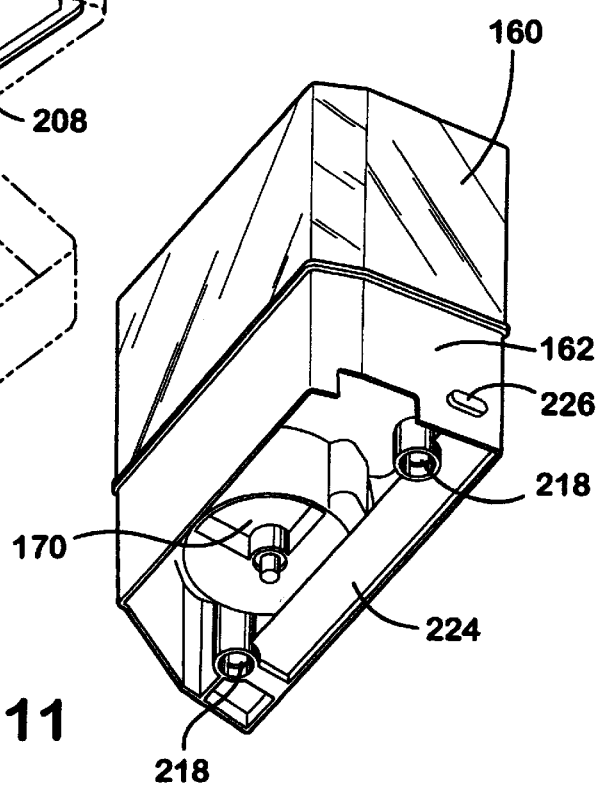

160
162
226
218
170
224
218

Fig. 11

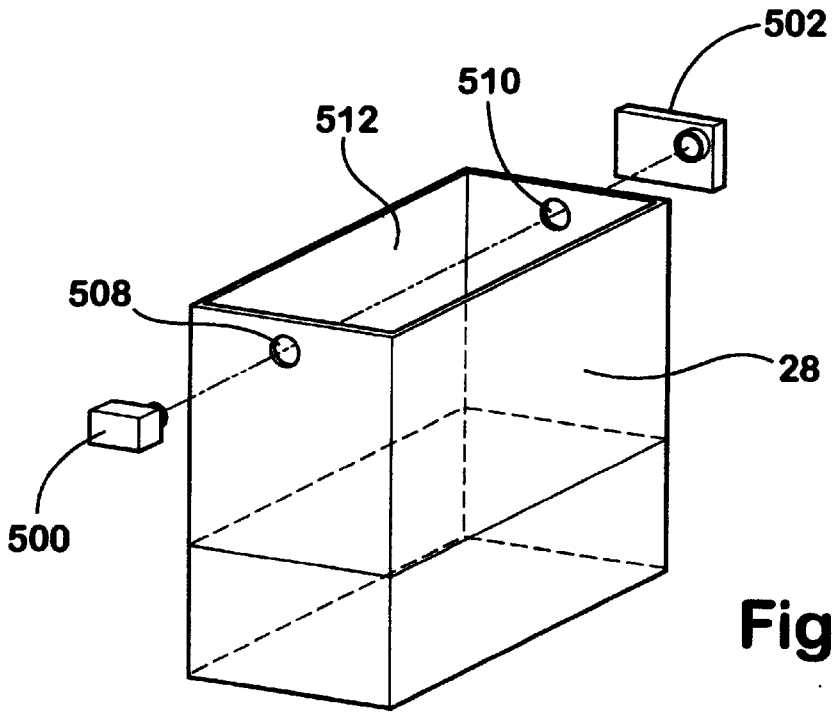


Fig. 12

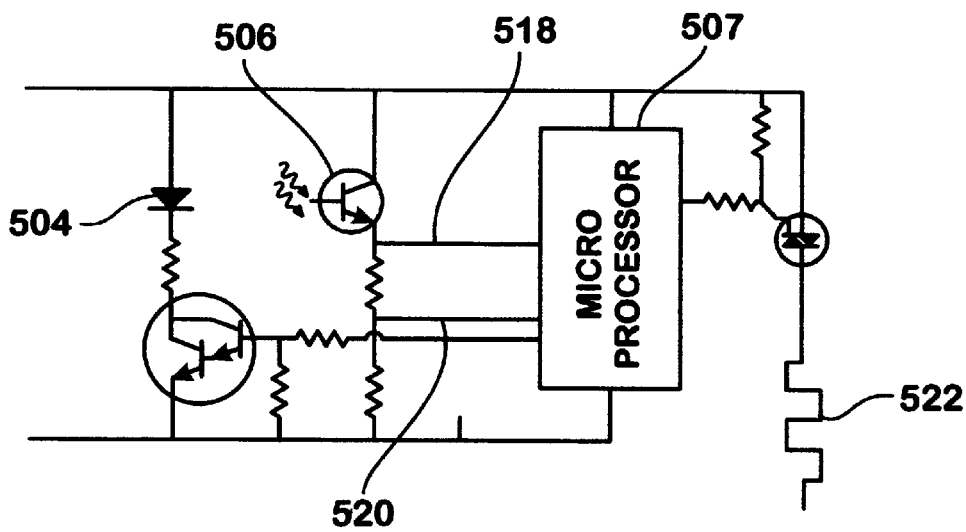


Fig. 13

ICE DELIVERY SYSTEM FOR A REFRIGERATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to an ice making system for a refrigerator and more particularly to an ice delivery system mounted to a refrigerator closure member or door.

2. Description of Related Art

Automatic ice making systems for use in a home refrigerator are well known. Typically, ice making systems include an ice maker mounted within the freezer compartment of the refrigerator and an ice storage receptacle or bin supported beneath the ice maker for receiving the formed ice from the ice maker. The ice maker is commonly mounted within the freezer compartment adjacent the side or rear wall of the freezer compartment such that water and power can be readily supplied to the ice maker. The ice storage receptacle is generally supported by a shelf structure beneath the ice maker within the freezer compartment. U.S. Pat. No. 4,942,979, to Linstromberg et al. is an example of a prior art ice making system.

Ice making systems may also include ice delivery systems for automatically delivering ice pieces or bodies from the ice storage bin to a dispensing position or space provided on the external surface of the refrigerator. Conveying means, conventionally in the form of horizontally arranged augers disposed within the ice storage receptacle, have been used for transferring ice pieces from the ice storage bin through an opening provided in the freezer compartment door such that ice pieces may be automatically dispensed.

Illustratively, U.S. Pat. No. 4,084,725, to Buchser, discloses an ice dispensing apparatus for use in a domestic refrigerator having an ice maker and an ice storage receptacle mounted within a freezer compartment. The ice storage receptacle extends across the freezer compartment and has a front end adjacent the freezer door. As illustrated, a wire auger is horizontally positioned within the bottom of the ice storage receptacle and is selectively rotated by a motor when ice dispensing is desired. Ice cubes are delivered from the storage receptacle to an external service area in the freezer door by means of a rotatable tubular drum having an internal helical auger blade. The tubular drum is mounted to the end of the wire auger. When the wire auger and tubular drum are rotated, ice pieces are moved horizontally forward in the ice storage receptacle to fall into a chute for passing the ice pieces through the freezer door to the service area.

Another ice dispensing apparatus is illustrated in U.S. Pat. No. 4,176,527, to Linstromberg et al., which discloses an ice dispensing apparatus for use in a domestic refrigerator having an ice maker and an ice storage receptacle wherein ice pieces are delivered by a delivery means from the ice storage receptacle to an external service area either in the form of crushed ice or integral whole ice pieces. As shown, the ice maker and ice storage receptacle are mounted within the freezer compartment of the refrigerator. The ice storage receptacle extends across the freezer compartment and has a front end adjacent the freezer door. The transfer means comprises a rotatable wire auger horizontally disposed within the bottom of the ice storage receptacle. The wire auger has mounted at its distal end an auger blade. A motor is supported along the back wall of the freezer compartment and is drivingly connected to the wire auger. When the motor is energized, the wire auger conveys ice pieces horizontally forward toward the auger blade such that ice pieces are supplied into a delivery chute wherein ice pieces are passed through the freezer door to the external service area. An ice crushing system may be selectively engaged such that the ice pieces may be crushed prior to delivery to the chute.

As can be seen in all of the above mentioned patent references, one aspect of conventional ice making and dispensing systems is that they occupy a relatively large amount of freezer shelf space. In particular, the ice storage bin extends across the freezer compartment and occupies a large amount of freezer compartment space. This is perceived as a disadvantage by many consumers who generally prefer to have more available shelf space. Accordingly, it would be an improvement to provide an ice making system which occupied less freezer shelf space.

Another disadvantage of prior art ice making and delivery systems is that a relatively large motor is required to rotate the ice conveying auger which is commonly provided. The motor size is related to the force necessary to break up frozen ice and move ice pieces horizontally forward within the ice receptacle.

Another disadvantage of the prior art is that the amount of ice in the ice storage receptacle is not readily visually apparent. Moreover, conventional ice making systems having automatic ice dispensing systems do not allow for easy removal of the ice storage receptacle and bulk removal of ice pieces.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a refrigerator having a cabinet defining a freezer compartment having an access opening and a closure member for closing the access opening. An ice maker is disposed within the freezer compartment for forming ice pieces and an ice storage bin is removably mounted to the closure member below the ice maker for receiving ice from the ice maker. The ice storage bin has an upper portion which is transparent and has a bottom opening. An ice discharge chute extends through the closure member below the bottom opening of the ice storage bin. A motor is mounted on the closure member. An auger is vertically disposed within the ice storage bin and is drivingly connected to the motor. Upon energization of the motor, the auger moves ice pieces from the ice storage bin through the bottom opening to the ice discharge chute for dispensing ice pieces from the ice storage bin.

The ice storage bin may define an ice crushing region through which the ice pieces must pass when ice pieces are discharged through the bottom opening. The ice crushing region has an inlet opening. The auger has a shaft portion passing through the ice crushing region. At least one ice crusher blade is rotatably connected to the shaft portion for rotation within the ice crushing region. At least one stationary blade is mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade. When the motor is rotated in a first direction the ice pieces are crushed by the ice crusher blade and stationary blade prior to being dispensed through the chute and when the motor is rotated in a second direction whole ice pieces are dispensed through the ice chute.

The closure member of the present invention is a door including an inner liner, a outer wrapper and a foam material therebetween. A mounting plate is connected to the inner liner. The ice discharge chute extends through the door adjacent the mounting plate. A cup shaped support member is connected to the inner liner below the mounting plate. The ice storage bin is removably mounted to the mounting plate for receiving ice pieces. The motor is supported by the

support member below the ice storage bin and the motor drive shaft extends from the support member to the mounting plate. The foam material is added to the door after the inner liner, outer wrapper, mounting plate and support member have been assembled such that the foam bonds to these components and secures them into position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view of a refrigerator apparatus having an ice storing and dispensing system embodying the present invention;

FIG. **2** is a fragmentary perspective view illustrating the ice storing and dispensing system within the freezer compartment of the refrigerator apparatus with the freezer door open;

FIG. **3** is a fragmentary, side sectional view of the ice storing and dispensing system of FIG. **1**;

FIG. **4** is a fragmentary, perspective view of a first embodiment of the ice storage and dispensing system of the present invention;

FIG. **5** is a fragmentary, perspective view of the first embodiment of the ice storage and dispensing system of the present invention wherein the front cover of the ice maker has been removed;

FIG. **6** is a fragmentary, enlarged perspective view of the first embodiment of the ice storage and dispensing system of the present invention wherein the front cover has been removed, illustrating the bin lever and associated components;

FIG. **7** is a fragmentary, perspective view of a second embodiment of the ice storage and dispensing system of the present invention, illustrating the freezer door partially open;

FIG. **8** is a fragmentary, perspective view of the second embodiment of the ice storage and dispensing system of the present invention wherein the front cover has been removed, illustrating the freezer door in a closed position;

FIG. **9** is a fragmentary, enlarged, perspective view of the ice storage bin with a cut away portion illustrating the ice crusher assembly;

FIG. **10** is an enlarged, perspective view of the components of the ice storage and dispensing system of the present invention which are mounted to the freezer door wherein the freezer door liner, wrapper and insulation have been removed; and

FIG. **11** is an enlarged, perspective view of the bottom of the ice storage bin of the ice storage and dispensing system of the present invention.

FIG. **12** is a simplified, elevational view of the ice storage bin and the optical ice level sensing system.

FIG. **13** is a schematic electrical diagram illustrating the circuitry of the optical ice level sensing system of FIG. **12**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the illustrative embodiment of the invention as shown in FIGS. **1–3**, a refrigerator **10**, comprising a side-by-side fresh food/freezer configuration, is provided having a cabinet **12** forming an above freezing fresh food compartment **14** and a below freezing freezer compartment **16**. Both the fresh food compartment **14** and the freezer compartment **16** are provided with access openings. A fresh food closure member or door **18** and a freezer closure member or door **20** are hingedly mounted to the cabinet **12** for closing the access openings, as is well known.

An ice making assembly **22** is disposed within the freezer compartment **16**. The ice making assembly **22** is mounted to the inside surface of the top wall **24** of the freezer compartment **16**. An ice dispensing system **26**, mounted to the freezer door **20**, is provided below the ice making assembly **22** for receiving ice pieces therefrom. The ice dispensing system **26** includes an ice storage receptacle or bin **28** having an ice crushing system **30**. When operated, the ice dispensing system **26** transfers ice pieces from the bin **28** through the freezer door **20** whereby ice pieces may be dispensed through a conventional, forwardly exposed ice dispenser station or external ice service area **31**.

A first embodiment of the ice making assembly **22** can be described in greater detail by referring now to FIGS. **4** and **5**. The ice maker assembly **22** generally comprises an ice maker **32** and an ice discharge assembly **34**. The ice maker **32** is a conventional ice piece making apparatus which forms crescent shaped ice pieces. The ice maker **32** includes an ice mold body **36**, an ice stripper **38**, a rotatable ejector (not shown) and a housing **40**. The housing surrounds a drive motor and drive module (not shown) which operate to rotate the ejector (not shown) when ice harvesting is necessary. The ice maker disclosed in U.S. Pat. No. 4,649,717, herein incorporated by reference, is illustrative of the type of ice maker used in the present invention.

The ice maker **32** is supported by a mounting bracket **42** along the upper, front portion of the freezer compartment **16**. The mounting bracket **42** is attached to the top wall **24** (FIG. **3**) of the freezer compartment and forms a member having a generally U-shaped cross section. The bracket **42** includes top mounting surfaces **43** which attach to the top wall **24**. Side walls **44** extend downwardly along the sides of the ice maker **32**. A bottom wall **46** joins the side walls **44** and forms a heat shield beneath the bottom of the ice maker **32**. Downwardly directed tabs **48** depend from the top mounting surfaces **43**. The ice maker **32** is attached to the mounting bracket **42** via mounting legs (not shown). An air baffle member **52** is connected to the back of the ice maker **32** and acts to direct the flow of air within the freezer compartment **16** across the ice mold **36** as will be further discussed hereinbelow.

The ice discharge assembly **34** is designed to prevent ice harvesting when the ice storage bin **28** is full of ice pieces. The need for this function is well recognized in the ice maker art. If ice harvesting is not appropriately controlled, the ice maker **32** may make an excessive quantity of ice and overfill the ice storage receptacle **28**. In addition to limiting the quantity of ice produced, the ice discharge assembly **34** operates to control the discharge of ice pieces from the ice maker **32** such that ice pieces are not discharged when the freezer door **20** is open. If ice pieces are discharged when the door **20** is open, the ice pieces will fall onto the floor since the ice storage bin **28** is mounted on the door **20**. To achieve these dual purposes, the ice discharge assembly **34** includes a front cover **62**, a latching mechanism **64** and an ice level sensing mechanism **66** which operate together to achieve the above describe functions.

The ice stripper **38** includes a ramp **68** for directing harvested ice into the ice storage bin **28**. The ramp **68** may be integrally formed with the ice stripper, as shown, or may be a separate member. The front cover **62** is pivotably supported by the tabs **48** in front of the ice maker **32**. The front cover **62** is a generally flat member having a front surface **62***a* and a back surface **62***b*. The front cover includes a pair of support extensions **70** extending from the back surface **62***b* which are rotatably captured by the tabs **48** and allow the cover **62** to swing or pivot freely as long as the

latching mechanism **64** is not engaged. The ramp **68** is angled downwardly and forwardly toward the back surface of the front cover **62**. A bottom terminal edge **68***a* of the ramp **68** is disposed adjacent the back surface of the cover **62** wherein a small gap separates the bottom edge **68***a* and the back surface **62***b* of the cover **62**.

When ice pieces are ready to be harvested from the ice mold body **36**, the ejector and stripper **38** cooperate to remove ice pieces from the mold body **36** and urge the harvested ice pieces to slide forwardly along the stripper **38**. The ice pieces slide forward off the stripper **38** and are directed to slide down the ramp **68**. The spacing between the back wall of the cover **62** and the bottom edge **68***a* of the ramp **68** is such that ice pieces are not able to fit through the elongated gap which separates the ramp **68** and the cover **62**. Accordingly, ice pieces sliding down the ramp **68** make contact with the cover **62**. However, the mass of the ice pieces and the slope of the ramp **68** is such that the ice pieces push the cover **62** forward upon contact, rotating the cover **62** about the tabs **48**, wherein the ice pieces are able to fall into the storage bin **28**.

As mentioned above, the ice discharge assembly **34** serves to prevent overfilling of the ice storage receptacle by sensing the level of ice in the ice storage bin **28** and to prevent ice discharge when the door **20** is open. The ice level sensing mechanism **66** of the first embodiment of the ice discharge assembly, shown in FIGS. **4**, **5** and **6**, operates to prevent overfilling of the bin **28**. The ice level sensing mechanism **66** includes a shut-off arm **76** extending from the housing **40**. The shut-off arm **76** is lifted by a cam located within the housing **40** prior to and during the harvesting of ice cubes. The actuation of the shut-off arm **76** is described in U.S. Pat. No. 5,160,094 which is herein incorporated by reference.

The shut-off arm **76** is connected to a sensing finger **78** through a connecting rod **80**. The finger is connected to base **82** or alternatively, the base **82** and finger may be one integral part. The base **82** is pivotably supported by a pin **84**. As shown, the connecting rod **80** is rotatably connected to the shut-off arm **76** and the base **82** to allow for rotational motion of the finger **78** about the pin **84**. Thus, as the shut-off arm **76** is raised during the ice harvesting cycle, the finger **78** is pivotably raised out of the storage bin **28**. Once the ice pieces are harvested and have fallen into the bin **28**, the finger **78** is lowered back into the bin **28**.

When a sufflcient amount of ice pieces have been delivered to the ice storage bin **28** so as to cause the level therein to rise to a preselected full level, the operation of the ice maker **32** will be interrupted by preventing the shut-off arm **76** from returning to its normal position. This occurs when the finger **78** contacts ice pieces when it is lowered back into the ice storage bin **28** such that it is prevented from fully descending into the bin **28**. The ice maker operation will be interrupted until such time as the level of ice pieces in the bin **28** is lowered as by removing some or all of the ice bodies therein. When this occurs, the finger **78** is allowed to fully descend into the bin **28** permitting the shut-off arm **76** to return to its normal position wherein the ice maker operation is resumed. A lever **81** extends from the connecting rod through the front cover **62** to allow a user to manually deenergize the ice maker **32** by lifting the shut-off arm **76** via the lever **81**.

As can be readily appreciated from the above description, every time the freezer door **20** is opened, the ice storage bin **28**, being mounted on the door **20**, is removed from beneath the ice making assembly **22**. Accordingly, it is necessary to completely lift the ice level sensing finger **78** out of the ice storage bin **28** when the freezer door **20** is opened. Failure to lift the finger **78** out of the bin **28** when the door **20** is open could result in damage to the finger **78** and to the entire ice level sensing system **66**.

FIG. **6** in combination with FIGS. **5** and **6** illustrate the mechanism used to lift the finger **78** out of the bin **28** when the door **20** is opened. A bin lever **100** is rotatably supported adjacent the rear wall **28***a* of the bin **28**. The bin lever **100** is preferably a wire member having an upper latching portion **102** and a lower bin engagement portion **104** joined by a center portion. As shown in the FIG. **6**, the bin lever **100** may be supported by a side extension portion **110** extending from the main body of the ramp **68**. The bin lever **100** is snap fit into a pair of slotted openings provided on a support walls **112** and **114** which extend from the side extension **110**. The upper latching portion **102** extends forwardly through a guide slot **116** formed into the side extension **110**. The guide slot **116** ensures the proper vertical orientation of the upper latching portion **102** of the bin lever **100**. It should be noted that the bin lever **100** could be supported in other ways, such as by structure extending from the housing **40**.

A spring **118** engages the bin lever **100** and biases it to rotate clockwise when viewed from above, as shown by arrow **120**, such that the bin engagement portion **104** is biased toward the rear wall of the bin **28***a*. When the door **20** is closed, the rear wall **28***a* of the bin **28** engages the bin engagement portion **104** winding the spring **118** and causing the bin lever **100** to rotate counterclockwise, opposite of the arrow **120**. However, when the door **20** is opened, the bin lever **100** is free to rotate clockwise until the latching portion **102** engages the base of the guide slot **116**.

As described above, the finger **78** is connected to the base **82** and the base is pivotally supported about the pin **84**. The pin **84** extends outwardly from the side extension **110**. Accordingly, lowering and raising the finger **78** is accomplished by rotating the finger about the pin **84**. The base has a ramp surface **86**. The ramp surface **86** is positioned within the travel of the latching portion **102** of the bin lever **100**. When the door **20** is closed, the bin lever is rotated to a position which allows the finger to descend into the bin **28**. However, when the door **20** is opened, the clockwise rotation of the bin lever **100** causes the latching portion **102** to engage the ramp surface **86**, rotating the finger **78** up out of the bin **28**. In this manner, whenever the door **20** is opened the finger **78** is lifted completely clear of the bin **28**. To further ensure that damage does not occur to the finger **78** when the freezer door **20** is opened, the finger **78** may be formed from flexible plastic or elastomeric material such that finger **78** will flex if forced into contact with the bin **28**.

The lifting of the finger **78**, caused by the sliding engagement between the ramp surface **86** and the latching portion **102**, also lifts the connecting rod **80** and the shut-off arm **76** such that the ice maker **32** is deenergized, preventing ice harvesting when the door **20** is open, thereby preventing ice from falling from the ice discharge assembly **34** when the door **20** is open.

The latching mechanism **64** further provides a means for preventing ice from falling from the ice discharge assembly **34** when the door **20** is open. The latching mechanism **64** operates to secure the front cover **62** in a closed position when the door **20** is open. The front cover **62** includes a catch **88** which extends from the back surface **62***b*. The catch **88** is positioned adjacent the latching portion **102** of the bin lever **100**. As described above, when the door **20** is opened, the bin lever **100** rotates clockwise, as shown by arrow **120**. This rotation of the bin lever **100** causes the latching portion

102 to rotate into a position wherein the latching portion engages the catch 88 thereby preventing the cover 62 from pivoting about the tabs 48. Accordingly, whenever the door 20 is open, the bin lever 100 rotates to a position wherein the cover 62 is latched closed. When the cover 62 is latched closed, the gap between the back surface 62*b* and the bottom edge 68*a* of the ramp is insufficient for ice pieces to pass therebetween. Thus, any ice pieces which are on the ice stripper 38 or ramp 68 when the door 20 is opened are prevented from falling out of the ice discharge assembly 34 until the door 20 is again closed.

While the bin lever 100 is shown rotatably supported about a vertical axis, it can be readily understood that the bin lever could be rotatably supported about a horizontal axis. Moreover, the bin lever could be operated to lift an ice sensing finger which is slidably supported above the ice storage bin rather than an ice sensing finger which is rotatably supported.

FIGS. 7 and 8 disclose an alternative embodiment ice discharge assembly 130. In this embodiment, the ice maker 32, which is similar to the first embodiment, is supported by mounting bracket 132. The mounting bracket 132 includes a bottom shield portion 134 positioned below the ice maker 32. A pair of arms 136, 138 extend upwardly from the bottom shield portion toward the top wall 24 (FIG. 3) of the freezer compartment and provide means for rigidly mounting a front cover 140. As shown, the connection means for the front cover may include a pair of slotted tabs 136*a*, 138*a* and a pair of tabs 136*b*, 138*b*. A rear air deflector 142 also extends upwardly from the bottom shield portion 134. Both the arms 136, 138 and the rear air deflector 142 mount to the top wall 24 of the freezer compartment. The ice maker 32 is mounted to the rear air deflector 142 by a pair of mounting feet 144, 146.

A rotatable ramp 150 is connected to the ice maker 32 and may preferably be pivotably connected to an ice stripper 152. However, the ramp 150 may be pivotably connected to other ice maker components such as the ice mold. The ramp 150 is biased to rotate upwardly toward a horizontal position. The ramp 150 is preferably biased by a spring (not shown) which is between the ramp 150 and the ice maker 32. An arm portion 153 extends downwardly and outwardly from the ramp 150 and engages the ice storage bin 28 when the door 20 is closed. In this manner, as the door 20 is closed and the ice storage bin 28 is positioned beneath the ice making assembly 22, the bin 28 engages the arm 153 and rotates the ramp 150 approximately 70° into a downward position.

The ramp 150 includes a bottom terminal edge 150*a*. When the ramp 150 is rotated into its horizontal position, due to the door 20 being open, the terminal edge 150*a* is positioned adjacent the back of the front cover 140 such that any ice that is dispensed from the ice maker 32 is trapped between the ramp 150 and the front cover 140. In this manner, ice can not be discharged from the ice discharge assembly 130 when the door 20 is open. When the ramp 150 is rotated down, due to the door 20 being closed, the bottom edge 150*a* is moved away from the front cover 140 such that ice pieces can slide down the ramp 150 and fall into the ice storage bin 28.

In addition to preventing the discharge of ice when the freezer door 20 is open, the ice discharge assembly serves to prevent overfilling of the ice storage bin 28 by sensing the level of ice in the bin 28. To that end, a shut-off arm 154 is provided extending from the housing 40. The shut-off arm 154, similar to the shut-off arm 76, is lifted by a cam located within the housing 40 prior to and during the harvesting of ice cubes. The actuation of the shut-off arm 154 is described in U.S. Pat. No. 5,160,094 which was previously incorporated by reference.

The shut-off arm is a wire member having a terminal portion which is drivingly connected to an ice sensing finger 156. In particular, the terminal portion of the shut-off arm 154 is disposed between a pair of horizontal walls 156*a*, 156*b* extending from the upper end of the ice sensing finger 156. The ice sensing finger 156 is slidingly supported by the front cover 140 for vertical movement and has a bottom portion which extends down into the ice storage bin 28. During ice harvesting from the ice maker 32, the shut-off arm 154 lifts the ice sensing finger 156 up out of the bin 28 and then lowers the finger 156 back into the bin. When a sufflcient amount of ice pieces have been delivered to the storage bin 28 so as to cause the level therein to rise to a preselected full level, the operation of the ice maker 32 will be interrupted by preventing the shut-off arm 154 from returning to its normal position. In addition to deenergizing the ice maker in response to the ice level sensing operation, a knob 157 extends from the finger 156 through the front cover 140 to allow a user to manually deenergize the ice maker 32 by lifting the shut-off arm 154 via the knob 157.

The motion of the rotatable ramp 150 during the opening of the freezer door 20 also acts to lift the finger 156 out of the bin 20 when the door 20 is opened, thereby preventing damage to the finger 156. The ramp 150 includes a side wall 158 having a rod-like extension 159. The extension 159 is disposed beneath the wall 156*b* of the finger 156. Upon opening the door 20, the ramp 150 rotates upwardly wherein the extension 159 engages the wall 156*b* and raises the finger 156 and rotates the shut-off arm up from its normal position. In this manner, the ice maker 32 is deenergized, preventing ice harvesting when the door 20 is open and thereby preventing ice pieces from falling from the ice discharge assembly 130 when the freezer door 20 is open. To further ensure that damage does not occur to the finger 156 when the freezer door 20 is opened, the finger 156 may be formed from flexible plastic or elastomeric material such that finger 156 will flex if forced into contact with the bin 28.

In the ice discharge assembly 34 of the first embodiment, shown in FIGS. 4–6, and the ice discharge assembly 130 of the second embodiment, shown in FIGS. 7 and 8, the mechanical ice level sensing systems may be replaced by an electronic optical system as shown in FIGS. 12 and 13. In an optical ice level sensing system, light (electromagnetic radiation of any wavelength) is used to sense the presence of ice pieces. An optical ice level sensing system takes advantage of the fact that ice pieces formed by a conventional ice maker, as described above, have a cloudy core which is due to air bubble entrapment, crazing during the freezing process, and water impurities among other things. This cloudy core of the ice pieces blocks a wide range of wave lengths that are generated and sensed by many standard infrared (IR) radiation products.

As shown in FIGS. 12 and 13, an optical ice level sensing system includes a light emitter 500 and receiver 502. The emitter 500 may be a printed circuit board (PCB) having a IR photo diode 504 which emits an IR light while the receiver may be a photo transistor 506 mounted to a PCB along with a microprocessor 507 and the necessary electronic circuitry to operate the optical ice level sensing system. The microprocessor 507 controls the operation of the ice level sensing system. The emitter 500 may be mounted to a side wall of the freezer compartment 16 adjacent the top of the ice storage bin 28 while the receiver

502 is mounted to the side wall of the freezer compartment 16 opposite from the emitter. A pair of openings 508 and 510 are disposed in the ice storage bin 28 near the top surface of the bin 28 such that a line of sight or clear path 512 is created between the emitter and the receiver.

During operation of the optical system, IR radiation is generated by the emitter 500 which is directed to pass along the path 512 through the ice storage bin 28 to be received by the receiver 502. As discussed above, ice pieces, due to there cloudy core, will impede the transmission of the IR radiation such that the level of the level the IR signal received by the receiver can be used as an indicator of the ice level. When the IR photo diode 504 is pulsed, if the photo transistor 506 senses an IR signal, this indicates that the ice bin 28 is not completely filled with ice and the ice maker 32 will be operated to produce and harvest more ice pieces. If the photo transistor 506 does not sense an IR signal when the emitter 500 is pulsed, this indicated that the ice bin 28 is full of ice pieces and further ice will not be harvested.

One problem with an optical ice level sensing system is that ice can coat the photo diode 504 and the photo transistor 506 such that sending and receiving IR signals is impaired. The signal may be degraded to a point where the optical system provides a false full ice bin signal when in fact the ice storage bin is not full of ice pieces. This occurs particularly quickly when the refrigerator is operated in a hot and humid location wherein when the freezer door 20 is opened, moisture immediately condenses onto the cold surfaces within the freezer compartment 16.

This degradation can be sensed and distinguished from a normal situation as shown in FIG. 13. The microprocessor 507 receives signal 1 across line 518 and signal 2 across line 520. With clean optics, both signal 1 and 2 are read as a logic level "1" when the bin is empty and a logic level "0" when the bin is full. At some point during the degradation process, the lesser voltage at signal 2 will fall below the microprocessor input threshold and be read as a logic level "0" while the greater signal 1 is still large enough to be read as a logic level "1". Whenever signals 1 and 2 differ, ice build up has occurred and it is necessary to clean the optic system.

Heater resistors are shown as 522 which are used to clean the optics system. The heaters are physically located adjacent the photo transistor 506 and the photo diode 504. When optic cleaning is necessary, the heaters 522 are energized to warm the photo transistor 506 and the photo diode 504 such that the accumulated ice is melted away.

Turning now back to FIGS. 2 and 3, the ice dispensing system 26 can be further explained. The ice storage bin 28 is mounted to the freezer door and includes an upper ice bin member 160 and a lower ice bin member 162. The upper ice bin member 160 is formed from a clear plastic material such that the quantity of ice pieces stored within the ice bin 28 is easily visually determined. The lower ice bin member 162 is rigidly connected to the upper ice bin member 160 and includes a funnel wall portion 164, a cylindrical wall portion 166 and a bottom wall portion 168. The bottom wall portion 168 includes an ice outlet opening 170 through which the ice pieces must pass to be dispensed.

Rotatably supported within the ice bin 28 is an auger 172 having a shaped upper end 174 and a bottom shaft 176. The upper end 174 is supported within the upper ice bin member 160 and is designed to break up any large clumps of ice pieces which may be formed when ice pieces partially melt and then refreeze. Accordingly, rotation of the auger 172 ensures that the ice pieces are free to move downwardly, under the urgings of gravity, though the lower ice bin member and the ice crushing system 30 such that ice pieces may be dispensed. The upper end 174 of the auger 172 is also configured to avoid pushing ice pieces up and over the rim of the upper ice bin member 160.

As best seen in FIGS. 3 and 9, the bottom shaft 176 of the auger 172 is disposed within the lower ice bin member. The bottom shaft 176 is provided with a flat surface such that various parts may be assembled to the shaft for co-rotation therewith. The upper end 176*a* of the bottom shaft 176 is positioned within the funnel wall portion 164 and the bottom end 176*b* of the bottom shaft 176 extends through the bottom wall for coupling to a drive shaft 178. The coupling between the drive shaft 178 and the bottom shaft 176 may be accomplished through use of a coupling member.

Drivingly connected to the upper end 176*a* of the bottom shaft 176 is a bridge breaker blade 180. The bridge breaker blade 180 rotates above a blade cover 182. The blade cover 182 is a plate which is attached to the lower ice bin member at the junction between the funnel wall portion 164 and the cylindrical wall portion 166. The cover 182, together with the funnel wall portion 164, forms a bottom wall of the upper ice bin member 160. An inlet opening 184 is formed into the cover 182 through which ice pieces must pass to be discharged. The inlet opening 184 is positioned 180° opposite of the outlet opening 170. As the auger 172 rotates, ice pieces are directed by the funnel wall portion 164 toward the inlet opening 184. The bridge breaker blade 180 ensures that the inlet opening 184 does not become jammed or bridged by ice pieces thereby preventing ice dispensing.

Once ice pieces pass through the inlet opening 184 they are disposed within a cylindrical ice crushing region 186 defined by the cylindrical wall portion 166, the cover 182 and the bottom wall portion 166. The bottom shaft 176 passes through the center of this region. Extending from the bottom shaft 176 are a plurality of ice crusher blades 188. The ice crusher blades 188 are connected to the bottom shaft for co-rotation therewith. A plurality of stationary blades 190 extend between the bottom shaft 176 and the cylindrical wall portion 166. The stationary blades 190 are positioned adjacent the side edge 170*a* of the ice outlet opening.

Rotation of the auger 172 causes the ice pieces to pass through the inlet opening 184 and fall into the ice crushing region 186. If the auger 172 is rotated counterclockwise, as shown by arrow 192, the ice pieces within the crushing region 186 are swept by the ice crushing blades 188 from the inlet opening 184 around within the crushing region 186 to fall through the outlet opening 184. The ice pieces move from the inlet opening 184 to the outlet opening 170 without having to pass through the stationary crusher blades. In this manner, when the auger 172 is rotated in the direction of arrow 192, whole ice pieces are dispensed though the outlet opening 170 and no ice crushing occurs.

If the auger 172 is rotated clockwise, as shown by arrow 194, the ice pieces within the crushing region 186 are swept by the ice crushing blades 188 from the inlet opening and are driven into the stationary ice crushing blades 190. The rotation of the auger 172 rotates the blades 188 past the stationary blades 190 resulting in the ice pieces being crushed. The crushed ice pieces, once past the stationary blades 190, fall through the outlet opening 170. In this manner, when the auger 172 is rotated in the direction of arrow 194, crushed ice pieces are dispensed though the outlet opening 170. Once the ice pieces, in either a whole or crushed form, are passed through the ice outlet opening 170, they fall through a chute 196 formed into the freezer door 20 to a waiting receptacle positioned within the service area 31.

While the dispensing of the ice pieces have been described with regard to the use of a plurality of crusher blades **188**, the invention could readily be practiced with just one crusher blade **188** and one stationary blade **190**. Moreover, the invention could dispense ice from the ice storage bin **28** without use of rotating and stationary crushing blades. For example, the rotary blades **188** and stationary blades **190** could be omitted and replaced with a paddle or other valving devices such as a pivotable or rotary door.

As just described, rotation of the auger **172** and the associated ice crusher blades **188** causes ice to be moved from the area of the upper ice bin member **160**, through the ice inlet opening **184** and outlet opening **170** such that ice pieces are dispensed. The auger **172** is rotated by the drive shaft **178** which extends from a motor **200**. The motor **200** is supported on the freezer door **20** below the ice service. The drive shaft **178** extends a relatively large distance between the motor and the ice bin **28**.

To ensure proper operation of the ice delivery system of the present invention, it is important to rigidly and securely support the motor **200** and the ice bin **28** on the freezer door **20** since these parts must align for proper operation. The construction of the freezer door, as shown in FIG. **3**, provides the necessary strength and rigidity. The freezer door **20** comprises a metallic outer wrapper **202**, an inner liner **204** with a foam material **206** disposed between the wrapper **202** and the liner **204**. The ice service area **31** is formed by a service housing **205** which attaches to an opening in the wrapper **202**. The fabrication of the door **20** may be such that the foam material **206** is foamed in place between the wrapper **202**, the liner **204** and service housing **205** and bonds to the inner surfaces of the wrapper **202**, liner **204** and service housing **205** providing a great deal of strength and rigidity.

FIGS. **3** and **10** illustrate the components used to support the motor and the ice storage bin **28**. The motor **200** is mounted to a bracket **207** within a cup-shaped support member or housing **208** which is connected to the inner liner **204** prior to the foaming operation. A motor cover plate **209** is placed over the open end of the housing **208** after the motor is assembled to the door. The ice bin **28** is mounted to a mounting plate **210** which is connected to the inner liner **204**. A conduit **212** extends between the mounting plate **210** and the housing **208** through which the drive shaft **178** can extend. A wiring conduit **214** is also connected to the motor housing **208** and extends upwardly to connect to the housing **205**. In this manner, wiring can be routed between the motor **200** and controls placed in the ice service area **31**.

Accordingly, it can be understood that during fabrication of the freezer door **20**, the housing **208**, the mounting plate **210**, the conduit **212** and the wiring conduit **214** are assembled to the inner liner **204** and then the foam **206** is foamed between the liner **204** and the wrapper **202** such that the components are bonded into position. Moreover, it can be readily appreciated by one skilled in the art that the conduits **212** and **214** may be integrally formed as part of the mounting plate **210** or the housing **208**. Likewise, the mounting plate **210** or the housing **208** may be able to be integrally formed as part of the service housing **205**.

One of the benefits of the present invention is that the ice bin **28** is removable from the freezer door. This allows a user to readily remove the ice bin **28** and dump a large quantity of ice into a receptacle such as an insulated cooler. FIGS. **10** and **11** best show how this is accomplished. The lower ice bin member **162** is provided with a pair of cylindrical bosses **218** or receptacles which correspond to mounting pins **220** provided on the mounting plate **210**. When the ice storage bin **28** is properly set upon the mounting plate **210**, the receptacles **218** and pins **220** align. Moreover, when the bin **28** is properly placed on the plate **210**, the drive shaft **178** is coupled with the auger **172** and the ice outlet **170** is disposed over the chute **196**.

Means are provided for securing the bin **28** to the mounting plate **210**. Each of the pins **220** are provided with an annular groove **222**. A retention bar **224** is slidingly supported by the lower ice bin member **162**. A button **226**, connected to the bar **224**, is provided for longitudinally moving the retention bar **224** which is biased toward the button **226**. The retention bar **224** has a pair of cut out portions (not shown) corresponding to the grooves **222**. When the bin **28** is placed onto the mounting plate **210**, the pins **220** are received into the receptacles **218** and the cut out portions of the retention bar **224** are engaged into the grooves **222** provided on the pins **220**. When it is desired to remove the bin **28**, the button **226** is depressed such that the cut out portions of the retention bar **224** are disengaged from the grooves **222**, allowing separation between the plate **210** and the bottom bin member **162**.

While the retention means are shown in the present description as a retention bar and a pair of pins, the present invention is not limited to this structure. For example, only on pin could be used. Moreover, the retention means could be something other than a pin and bar such as a hook and latch arrangement.

It can be seen, therefore, that the present invention provides a unique ice delivery system wherein the ice maker is located along the top wall of the freezer and the ice storage bin is mounted to the freezer door. A dispensing system including a motor is also supported on the freezer door. The present invention provides an ice storage bin which is a vertically elongated storage container with a vertically arrange auger disposed therein such that the dispensing of ice is readily accomplished. The ice storage bin is partially transparent which allows for the easy visual determination of the amount of ice in the storage bin. The present invention further provides a manner of assembling the ice storage bin and motor to the freezer door which is designed to provide adequate strength and rigidity.

While the present invention has been described with reference the above described embodiment, those of skill in the Art will recognize that changes may be made thereto without departing from the scope of the invention as set forth in the appended claims.

We claim:

1. A refrigerator including a freezer compartment having an access opening and a closure member for closing the access opening, the refrigerator comprising:

an ice maker being disposed within the freezer compartment for forming ice pieces;

an ice storage bin mounted to the closure member below the ice maker for receiving ice from the ice maker, the ice storage bin having a bottom opening;

a motor mounted on the closure member; and

an auger disposed within the ice storage bin and drivingly connected to the motor,

wherein upon energization of the motor, the auger moves ice pieces from the ice storage bin through the bottom opening for dispensing from the ice storage bin.

2. The refrigerator according to claim **1**, further comprising:

an ice discharge chute through the closure member below the bottom opening of the ice storage bin wherein upon

energization of the motor, the auger moves ice pieces from the ice storage bin through the bottom opening to the ice discharge chute.

3. The refrigerator according to claim **1**, further wherein the auger is supported in a vertical orientation within the ice storage bin.

4. The refrigerator according to claim **1** further wherein the ice storage bin is at least partially formed out of a transparent material such that the amount of ice pieces in the ice storage bin can be readily visually determined.

5. The refrigerator according to claim **1** further comprising:

a breaker blade rotatably connected to the auger, the breaker blade being disposed within the ice storage bin adjacent the bottom opening of the ice storage bin.

6. The refrigerator according to claim **1** further wherein the ice storage bin comprises:

the ice storage bin defines an ice crushing region through which the ice pieces must pass when ice pieces are discharged through the bottom opening, the ice crushing region having an inlet opening;

the auger having a shaft portion passing through the ice crushing region;

at least one ice crusher blade rotatably connected to the shaft portion for rotation within the ice crushing region; and

at least one stationary blade mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade.

7. The refrigerator according to claim **6** further comprising:

a breaker blade rotatably connected to the auger, the breaker blade being disposed adjacent the inlet opening of the ice crushing region.

8. The refrigerator according to claim **1** further wherein the ice storage bin comprises:

an upper ice bin member having a bottom edge;

a lower ice bin member connected to the lower edge of the upper ice bin member, the lower ice bin member defining an ice crushing region through which the ice pieces must pass when ice pieces are discharge through the bottom opening;

the auger having a shaft portion passing through the ice crushing region;

at least one ice crusher blade rotatably connected to the shaft portion for rotation within the ice crushing region; and

at least one stationary blade mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade.

9. The refrigerator according to claim **1** wherein the ice storage bin is removable from the freezer compartment closure member.

10. A refrigerator including a cabinet for defining a freezer compartment having top wall and an access opening, the refrigerator comprising:

a closure member for closing the access opening;

an ice maker being disposed within the freezer compartment adjacent the top wall for forming ice pieces;

an ice storage bin removably mounted to the closure member below the ice maker for receiving ice from the ice maker, the ice storage bin having a bottom opening;

an ice discharge chute forming an opening through the closure member below the bottom opening of the ice storage bin;

a motor mounted on the closure member; and

an auger vertically disposed within the ice storage bin and drivingly connected to the motor,

wherein upon energization of the motor, the auger moves ice pieces from the ice storage bin through the bottom opening to the ice discharge chute.

11. The refrigerator according to claim **10** further wherein the ice storage bin is formed out of a clear material such that the amount of ice pieces in the ice storage bin can be readily visually determined.

12. The refrigerator according to claim **10** further comprising:

a breaker blade rotatably connected to the auger, the breaker blade being disposed within the ice storage bin adjacent the bottom opening of the ice storage bin.

13. The refrigerator according to claim **10** further wherein the ice storage bin comprises:

the ice storage bin defines an ice crushing region through which the ice pieces must pass when ice pieces are discharged through the bottom opening, the ice crushing region having an inlet opening;

the auger having a shaft portion passing through the ice crushing region;

at least one ice crusher blade rotatably connected to the shaft portion for rotation within the ice crushing region; and

at least one stationary blade mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade,

wherein when the motor is rotated in a first direction the ice pieces are crushed prior to being dispensed through the chute and when the motor is rotated in a second direction whole ice pieces are dispensed through the ice chute.

14. The refrigerator according to claim **13** further comprising:

a breaker blade rotatably connected to the auger, the breaker blade being disposed adjacent the inlet opening of the ice crushing region.

15. The refrigerator according to claim **10** further wherein the ice storage bin comprises:

an transparent upper ice bin member having a bottom edge;

a lower ice bin member connected to the lower edge of the upper ice bin member, the lower ice bin member defining an ice crushing region through which the ice pieces must pass when ice pieces are discharge through the bottom opening, the ice crushing region having an inlet opening;

the auger having a shaft portion passing through the ice crushing region;

at least one ice crusher blade rotatably connected to the shaft portion for rotation within the ice crushing region; and

at least one stationary blade mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade,

wherein when the motor is rotated in a first direction the ice pieces are crushed prior to being dispensed through the chute and when the motor is rotated in a second direction whole ice pieces are dispensed through the ice chute.

16. The refrigerator according to claim 10, further comprising:

a mounting plate connected to the closure member wherein the ice storage bin is removably mounted to the mounting plate for support on the closure member.

17. The refrigerator according to claim 16 further wherein:

the mounting plate includes at least one pin;

the ice storage bin includes at least one receptacle corresponding to the pin and a locking mechanism to secure the ice storage bin to the mounting plate.

18. A refrigerator including a cabinet defining a freezer compartment having an access opening, the refrigerator comprising:

a door hingedly mounted to the cabinet for closing the access opening, the door including an inner liner, a outer wrapper and a foam material therebetween;

a mounting plate connected to the inner liner;

an ice discharge chute extending through the door adjacent the mounting plate;

a support member connected to the inner liner below the mounting plate;

an ice storage bin removably mounted to the mounting plate for receiving ice pieces, the storage bin having a bottom opening;

a motor supported by the support member below the ice storage bin, the motor having a drive shaft extending from the support member to the mounting plate; and

an auger rotatably disposed within the ice storage bin for coupling with the drive shaft wherein upon energization of the motor, the auger moves ice pieces from the ice storage receptacle through the bottom opening to the ice discharge chute.

19. The refrigerator according to claim 18 further comprising:

an ice maker mounted within the freezer compartment for delivering ice pieces to the ice storage bin.

20. The refrigerator according to claim 18 wherein the foam material is added to the door after the inner liner, outer wrapper, mounting plate and support member have been assembled such that the foam bonds to these components and secures them into position.

21. The refrigerator according to claim 18 wherein the support member is a cup-shaped housing for receiving the motor.

22. The refrigerator according to claim 18 further comprising:

a conduit extending from the support member to the mounting plate through which the drive shaft extends.

23. The refrigerator according to claim 22 further comprising:

a housing mounted onto the outer wrapper defining an ice service area;

a wiring conduit extending from the support member to the housing.

24. The refrigerator according to claim 18 further wherein the ice storage bin is at least partially formed from a transparent material such that the amount of ice pieces in the ice storage bin can be readily visually determined.

25. The refrigerator according to claim 18 further wherein the ice storage bin comprises:

an upper ice bin member having a bottom edge;

a lower ice bin member connected to the lower edge of the upper ice bin member, the lower ice bin member defining an ice crushing region through which the ice pieces must pass when ice pieces are discharge through the bottom opening, the ice crushing region having an inlet opening;

the auger having a shaft portion passing through the ice crushing region;

at least one ice crusher blade rotatably connected to the shaft portion for rotation within the ice crushing region; and

at least one stationary blade mounted within the ice crushing region such that the ice crusher blade rotates past the stationary blade.

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