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(54) **REFRIGERATOR ICEMAKING SYSTEM WITH TANDEM STORAGE BINS AND/OR REMOVABLE DISPENSER RECESS**

(52) **U.S. Cl.**  
CPC ..... *F25C 5/182* (2013.01); *F25C 2400/10* (2013.01); *F25C 5/22* (2018.01)

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(57) **ABSTRACT**

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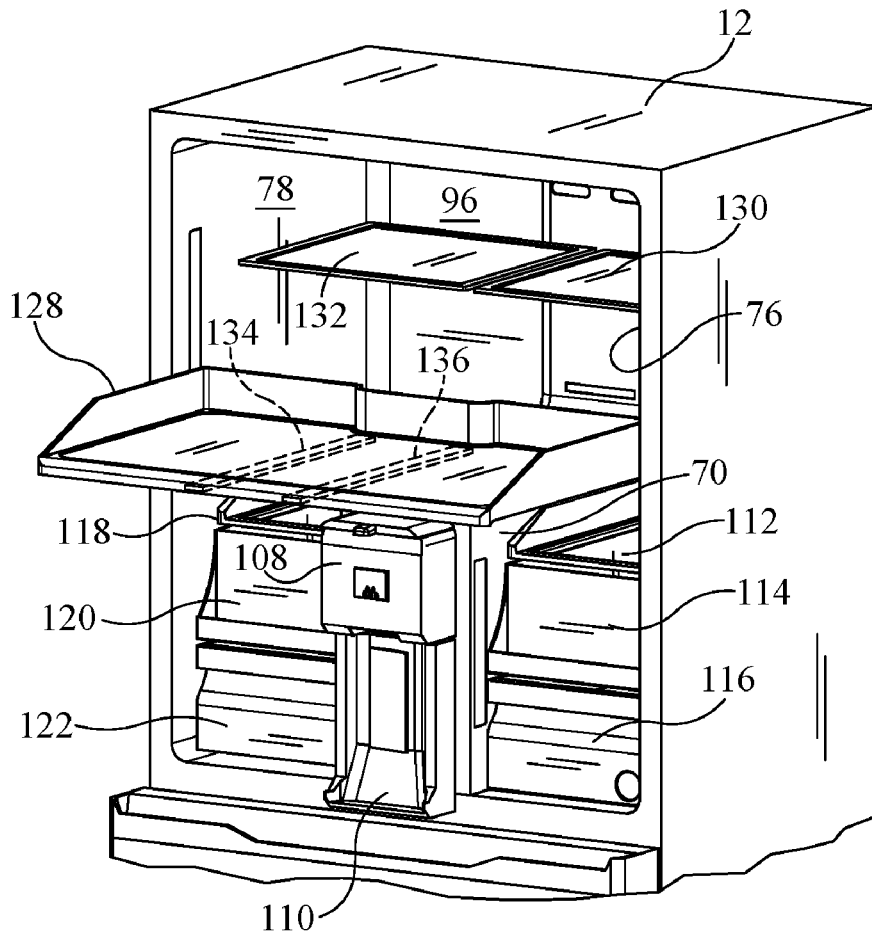
**Related U.S. Application Data**

(63) Continuation-in-part of application No. 15/836,035, filed on Dec. 8, 2017.

**Publication Classification**

(51) **Int. Cl.**  
*F25C 5/182* (2006.01)  
*F25C 5/20* (2006.01)

A refrigerator utilizes in some instances an icemaker having a tandem arrangement of storage bins. A first storage bin receives ice produced by an icemaker and includes a reversible ice mover that when operated in a first direction feeds an ice dispenser, and when operated in a second direction feeds a second storage bin disposed below the first storage bin. A refrigerator may also in another aspect include an externally-accessible ice dispenser having a dispenser recess portion that is removable from the refrigerator when the doors of the refrigerator are closed, e.g., for the purpose of accessing an ice storage bin.



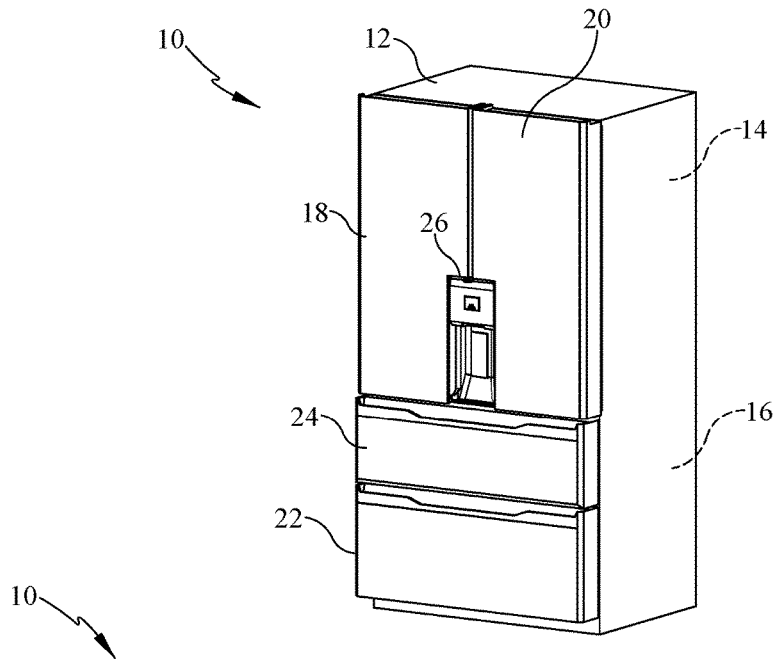


FIG. 1

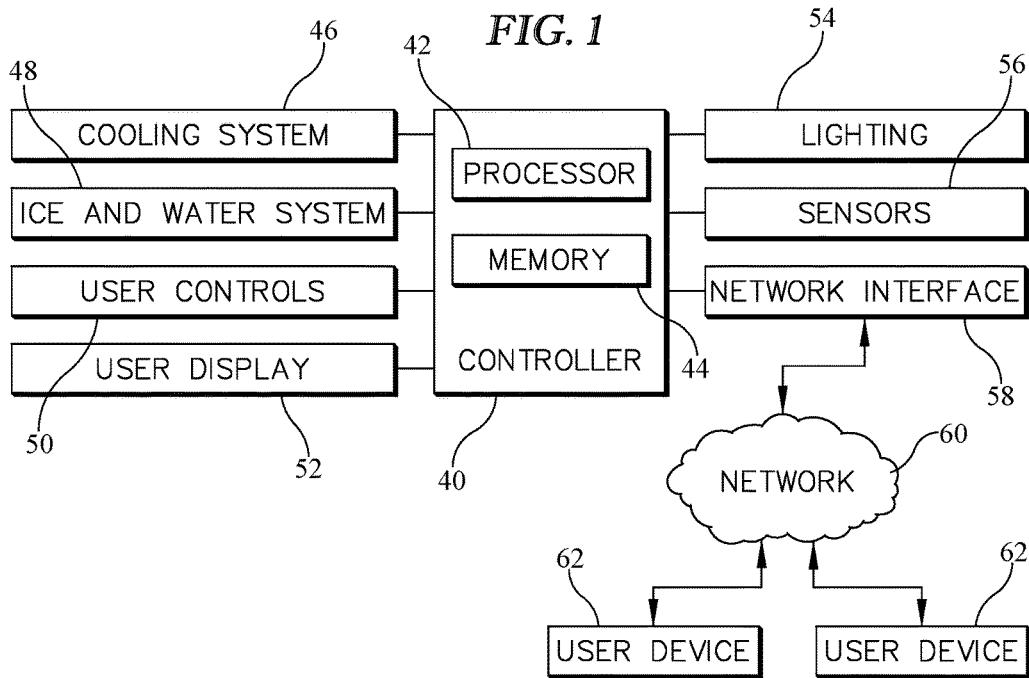


FIG. 2

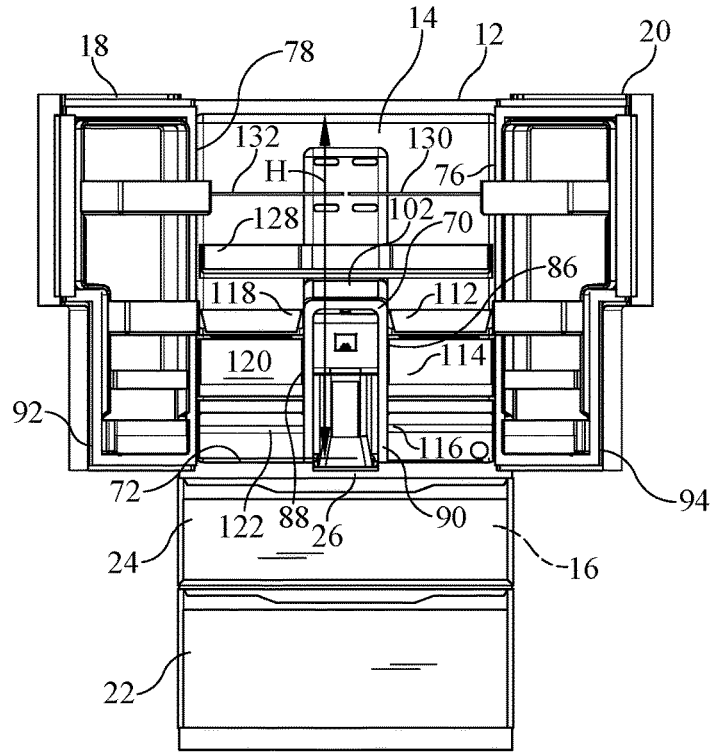


FIG. 3

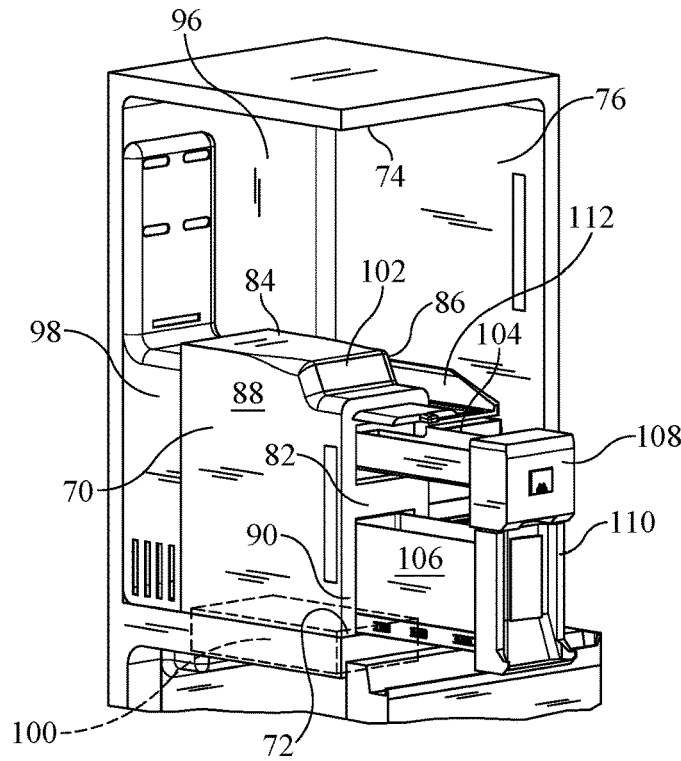


FIG. 4

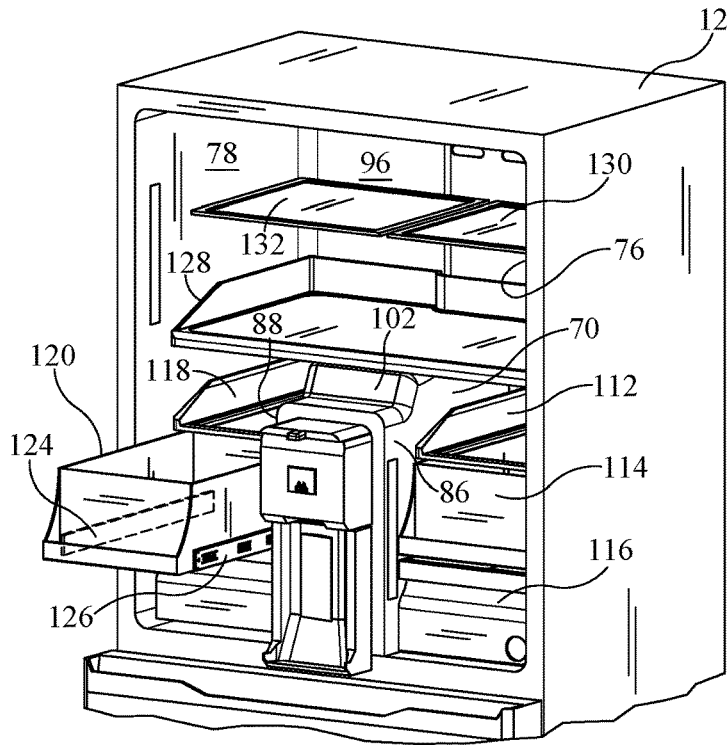


FIG. 5

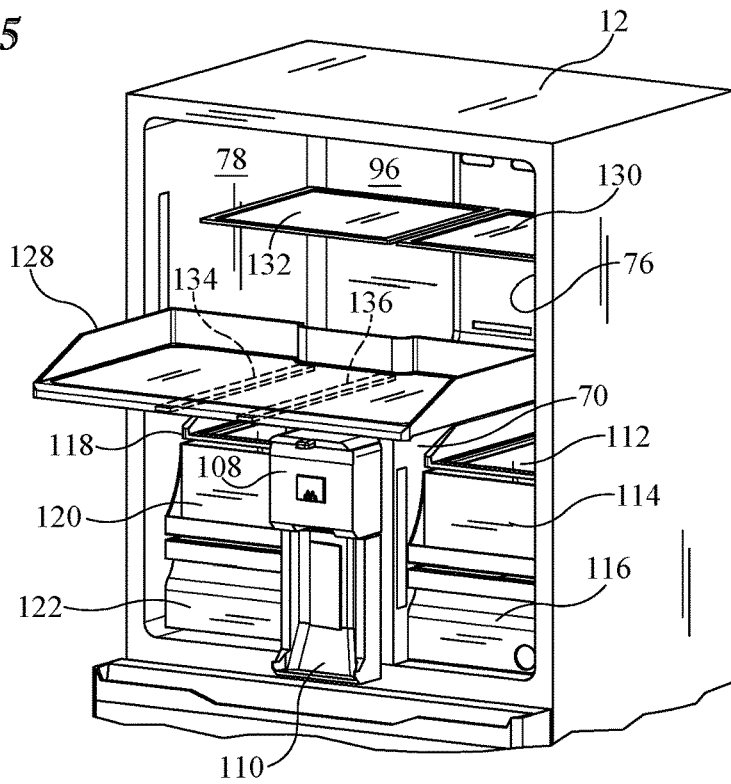


FIG. 6

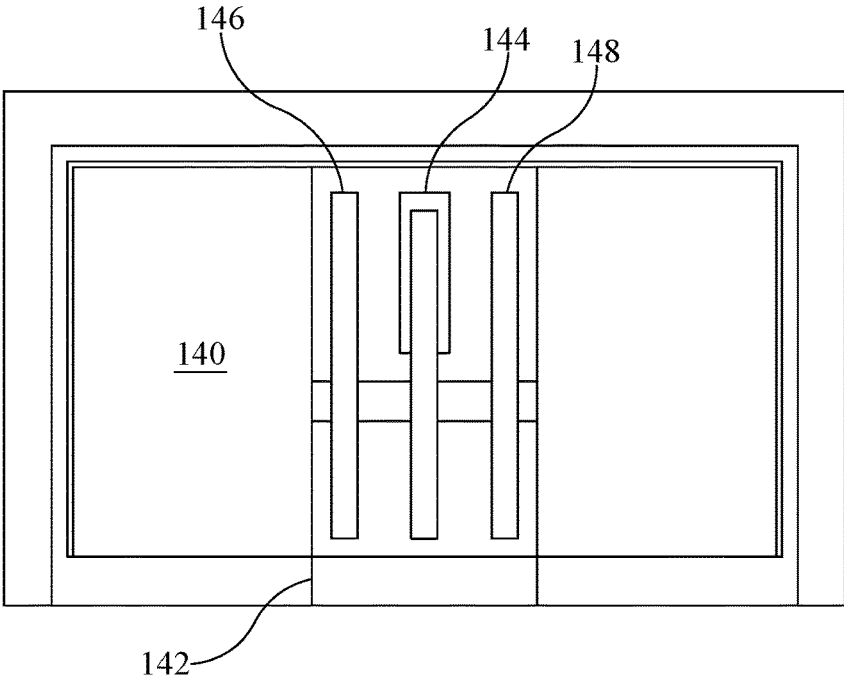


FIG. 7

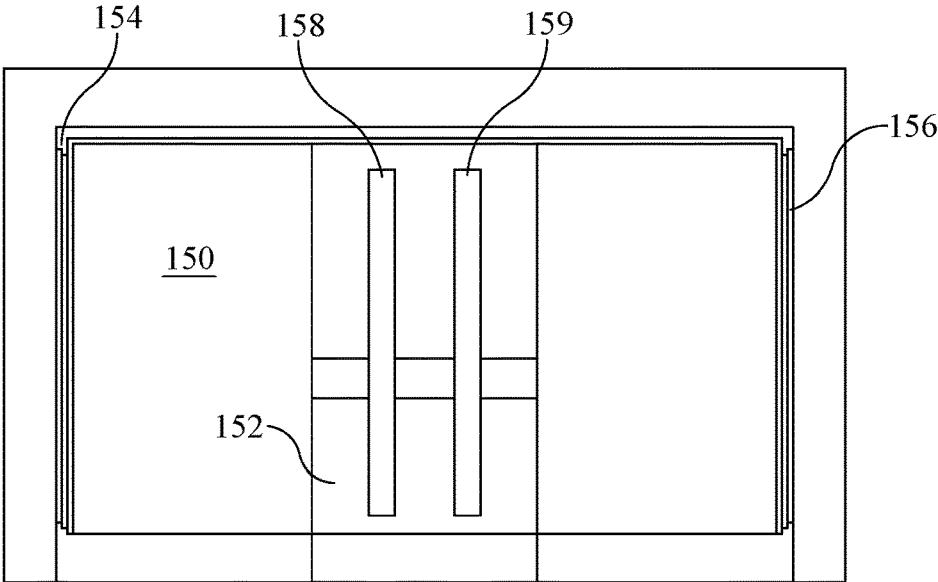


FIG. 8

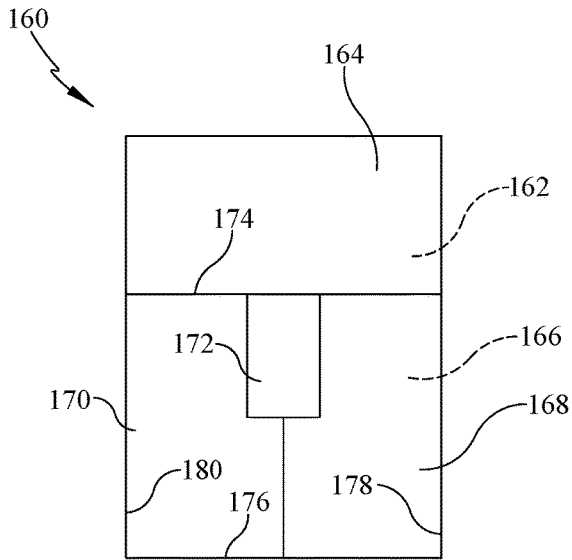


FIG. 9

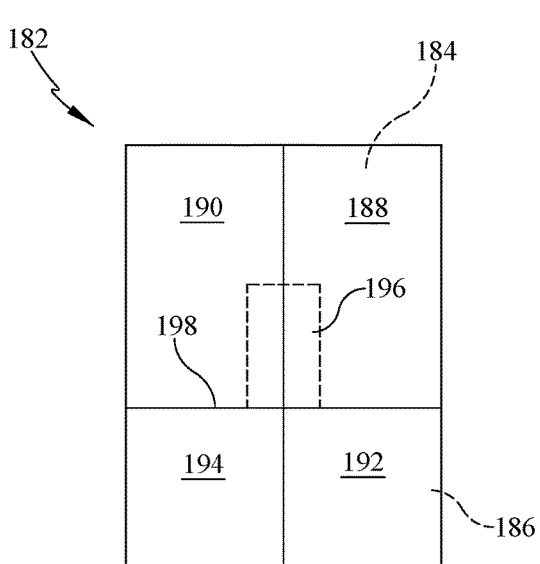


FIG. 10

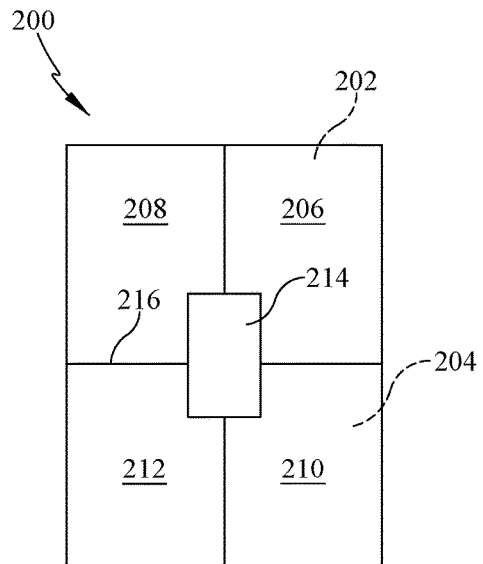


FIG. 11

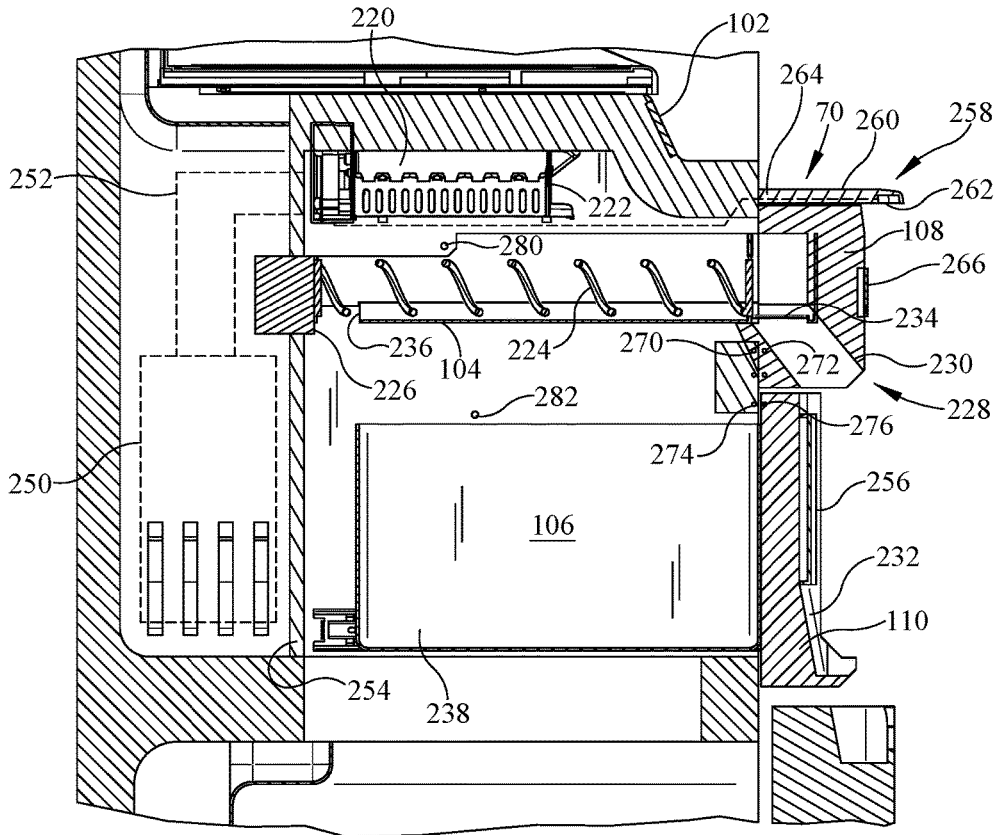


FIG. 12

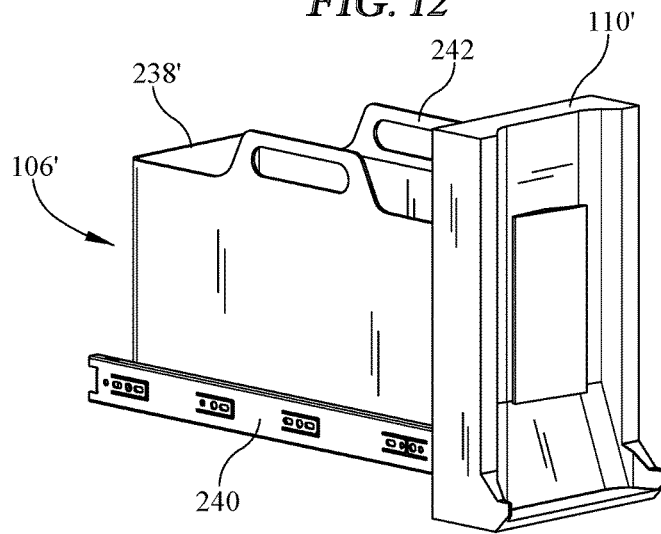


FIG. 15

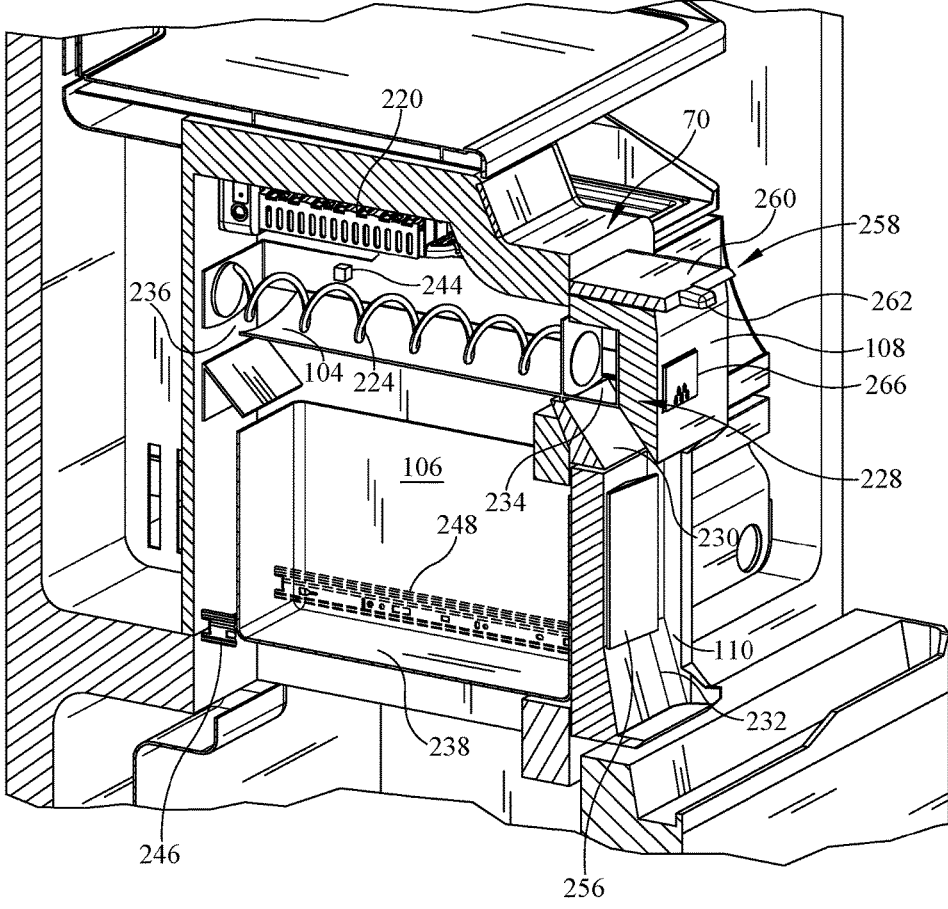


FIG. 13



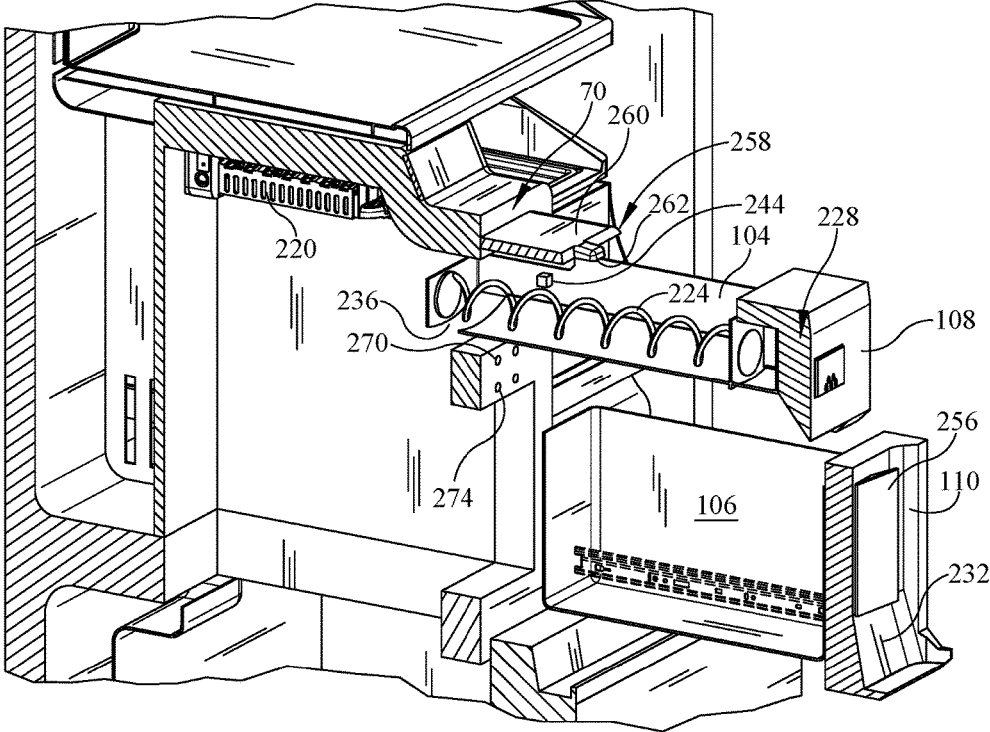


FIG. 14

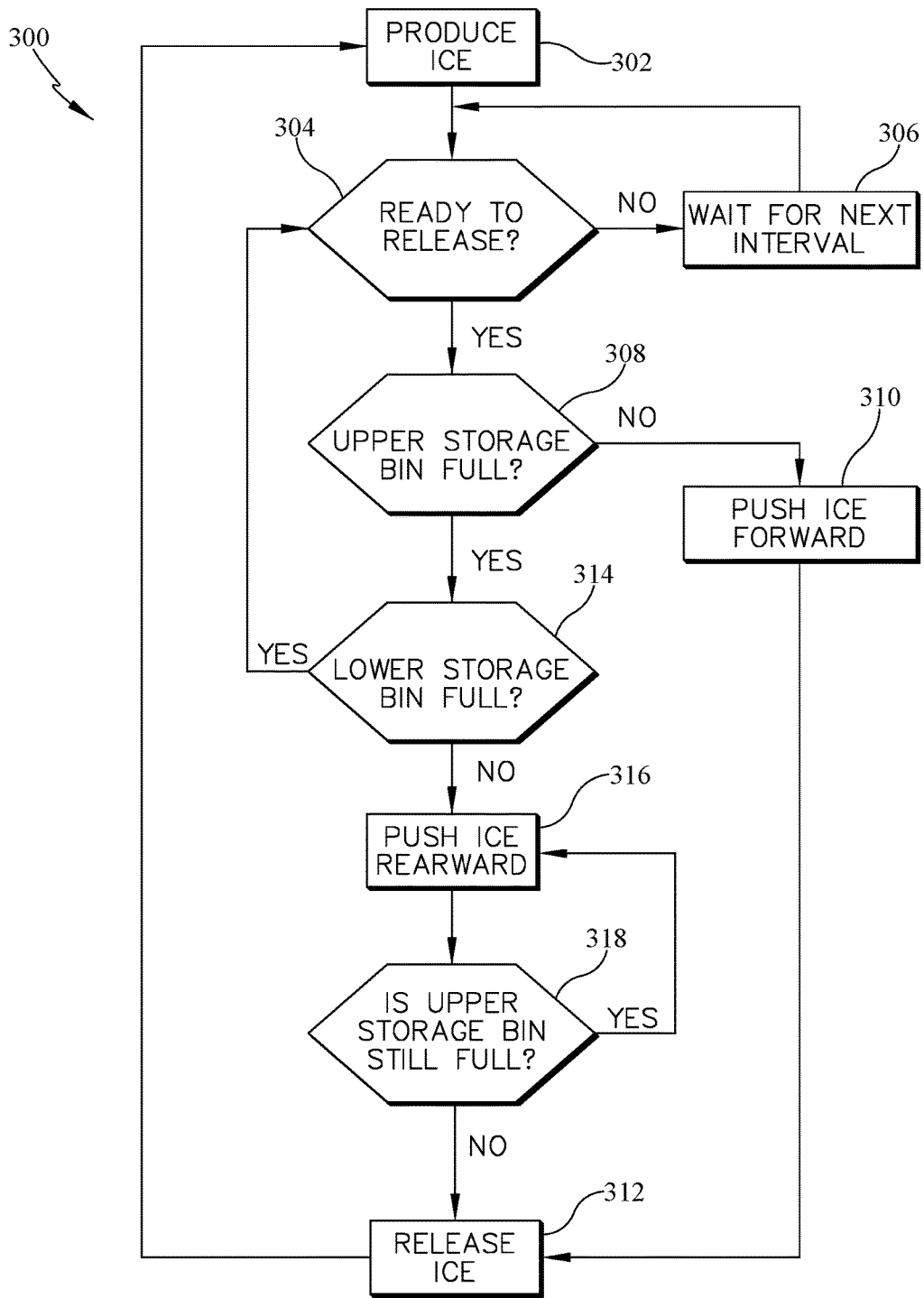


FIG. 16

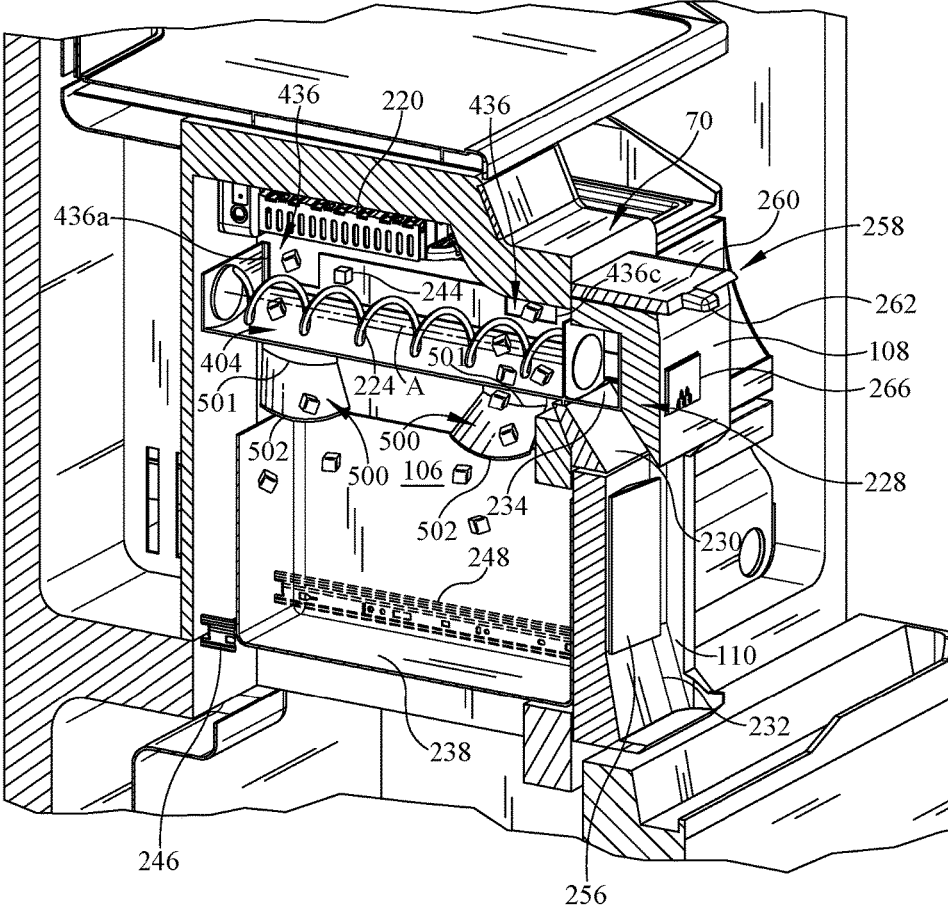


FIG. 17

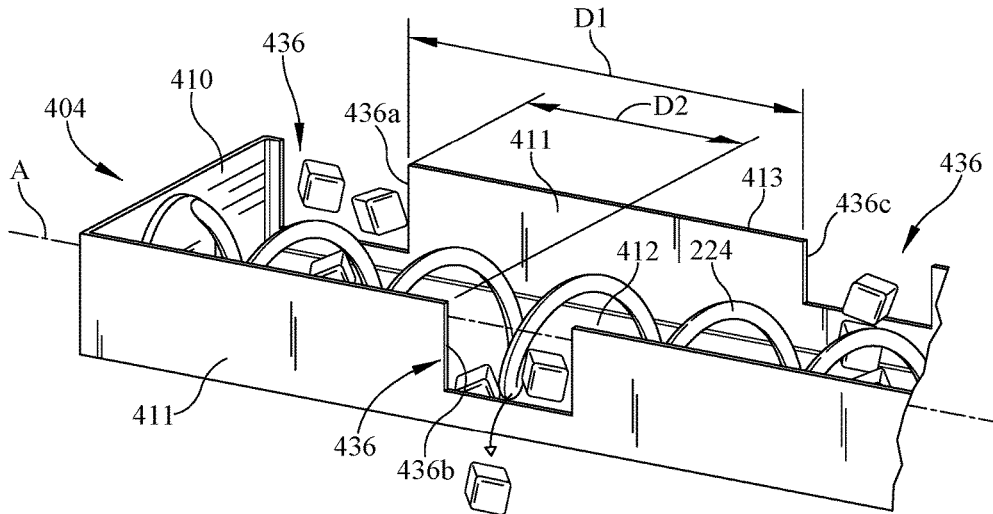


FIG. 18

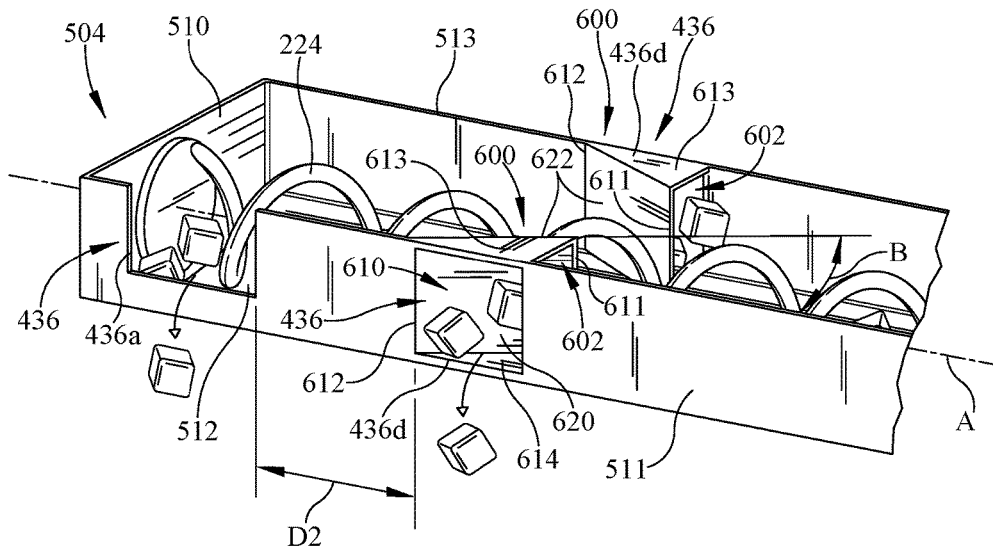


FIG. 19

**REFRIGERATOR ICEMAKING SYSTEM  
WITH TANDEM STORAGE BINS AND/OR  
REMOVABLE DISPENSER RECESS**

CROSS-REFERENCE TO RELATED  
APPLICATIONS

[0001] This application claims the benefit of priority of U.S. patent application Ser. No. 15/836,035, filed on Dec. 8, 2017, the entire contents of which are hereby incorporated by reference.

BACKGROUND

[0002] Residential refrigerators generally include both fresh food compartments and freezer compartments, with the former maintained at a temperature above freezing to store fresh foods and liquids, and the latter maintained at a temperature below freezing for longer-term storage of frozen foods. For many years, most refrigerators have fallen in to one of two categories. Top mount refrigerators, for example, include a freezer compartment near the top of the refrigerator, either accessible via a separate external door from the external door for the fresh food compartment, or accessible via an internal door within the fresh food compartment. Side-by-side refrigerators, on the other hand, orient the freezer and fresh food compartments next to one another and extending generally along most of the height of the refrigerator.

[0003] Door-mounted ice dispensers (which are often combined with water dispensers) are common convenience features on many of these residential refrigerators. Incorporating these features into top mount and side-by-side refrigerators has generally been straightforward because it is generally possible to mount such dispensers on the external door for the freezer compartment at a convenient height for a user, as well as at a location suitable for receiving ice produced by an ice maker mounted in the freezer compartment.

[0004] More recently, however, various types of bottom mount refrigerator designs have become more popular with consumers. Bottom mount refrigerators orient the freezer compartment below the fresh food compartment and near the bottom of the refrigerator. For most people, the fresh food compartment is accessed more frequently than the freezer compartment, so many of the items that a user accesses on a daily basis are accessible at a convenient height for the user. Some bottom mount refrigerators include a single door for each of the fresh food and freezer compartments, while other designs commonly referred to as "French door" refrigerators include a pair of side-by-side doors for the fresh food compartment. Some designs may also utilize sliding doors instead of hinged doors for the freezer compartment, and in some designs, multiple doors may be used for the freezer compartment.

[0005] Placing the freezer compartment at the bottom of a refrigerator, however, complicates the design of door-mounted ice dispensers, since every freezer compartment door is generally located too low for a door-mounted ice dispenser, and since placement of an ice dispenser on a fresh food compartment door orients the ice dispenser opposite the above-freezing fresh food compartment. Most ice dispensers rely at least in part on gravity to convey ice from an ice maker mold to a storage receptacle and/or to convey ice from the storage receptacle to an exit chute for the ice

dispenser, so it is generally desirable to orient the ice maker at a higher elevation than the ice dispenser.

[0006] Moreover, while bottom mount refrigerators generally provide a relatively large fresh food compartment that extends the full width of the refrigerator, access to some food items maintained by shelves and/or bins may be difficult, particularly when many food items are stored in the refrigerator.

[0007] Accordingly, a need continues to exist in the art for an improved manner of providing externally-accessible ice dispensing, particularly within a bottom mount refrigerator, as well as of providing convenient access to food items stored in a refrigerator.

SUMMARY

[0008] The herein-described embodiments address these and other problems associated with the art by providing in one aspect a refrigerator that utilizes an icemaker having a tandem arrangement of storage bins. A first storage bin receives ice produced by an icemaker and includes a reversible ice mover that when operated in a first direction feeds an ice dispenser, and when operated in a second direction feeds a second storage bin disposed below the first storage bin. In addition, the herein-described embodiments address these and other problems associated with the art by providing in another aspect a refrigerator that includes an externally-accessible ice dispenser having a dispenser recess portion that is removable from the refrigerator when the doors of the refrigerator are closed, e.g., for the purpose of accessing an ice storage bin.

[0009] Therefore, consistent with one aspect of the invention, a refrigerator may include a cabinet, an icemaker disposed within the cabinet, a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin, an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover, and a second storage bin disposed below the first storage bin and configured to receive ice disposed in the first storage bin and moved in the second direction by the reversible ice mover.

[0010] In some embodiments, the reversible ice mover includes an auger or a conveyor. Also, in some embodiments, the first storage bin includes an aperture disposed proximate an opposite end of the first storage bin from the ice dispenser such that ice moved in the second direction by the reversible ice mover falls into the second storage bin through the aperture. Further, in some embodiments, the aperture is disposed in a bottom wall, a side wall, or an end wall of the first storage bin.

[0011] In some embodiments, the icemaker extends generally from front to back within the cabinet, where the ice dispenser is disposed on a front of the refrigerator, where the reversible ice mover moves ice in a generally forward direction when moving ice to the ice dispenser, and where the reversible ice mover moves ice in a generally rearward direction when moving ice to the second storage bin.

[0012] In addition, in some embodiments, the first and second storage bins are removable. In some embodiments, the second storage bin includes an ice bucket disposed within the second storage bin and removable therefrom. In addition, in some embodiments, the ice bucket includes at

least one handle. Moreover, in some embodiments, the first and second storage bins are slidably removable. Some embodiments may also include at least one stop configured to restrict removal of the first storage bin beyond a stop position, and the first storage bin is configured to provide access to the icemaker and the reversible ice mover to clear an obstruction.

**[0013]** Some embodiments may further include a controller coupled to the reversible ice mover and a level sensor configured to sense a level of ice within the first storage bin, where the icemaker is positioned to drop ice into an intermediate area of the first storage bin, and where the controller is configured to, upon detecting a not full condition in the first storage bin with the level sensor, operate the reversible ice mover to move ice dropped into the intermediate area of the first storage bin in the first direction toward the ice dispenser, and upon detecting a full condition in the first storage bin with the level sensor, operate the reversible ice mover to move ice in the first storage bin in the second direction and into the second storage bin. Some embodiments may also include a second level sensor configured to sense a level of ice within the second storage bin, where the controller is further configured to inhibit a release of ice by the icemaker upon detecting a full condition in the first and second storage bins with the first and second level sensors.

**[0014]** In addition, some embodiments may also include a freezer compartment disposed in the cabinet, a fresh food compartment disposed in the cabinet above the freezer compartment and having a top wall, a bottom wall, and first and second side walls, the bottom wall separating the fresh food compartment from the freezer compartment, and an icemaking console extending upwardly from the bottom wall of the fresh food compartment only a portion of a height of the fresh food compartment and spaced apart from each of the top wall, the first side wall, and the second side wall, the icemaking console including one or more walls that insulate an interior compartment of the icemaking console from the fresh food compartment, where the icemaker, the first storage bin, the second storage bin, and the reversible ice mover are disposed within icemaking console.

**[0015]** In some embodiments, the ice dispenser is disposed on a front surface of the icemaking console. Moreover, in some embodiments, a first portion of the ice dispenser is disposed on a front surface of the first storage bin and a second portion of the ice dispenser is disposed on a front surface of the second storage bin. In addition, some embodiments may further include a dispenser control disposed on the front surface of the second storage bin. Some embodiments may also include a dispenser shut off circuit configured to deactivate the ice dispenser in response to movement of the second storage bin away from an operating position. In addition, some embodiments may also include a controller and a user control that activates the ice dispenser, where the dispenser shut off circuit includes at least one switch that disconnects the user control from the controller when the second storage bin is moved away from the operating position. Also, in some embodiments, the switch is a contact switch or a magnetic switch.

**[0016]** Consistent with another aspect of the invention, a refrigerator may include a cabinet including one or more food compartments, one or more doors coupled to the cabinet and configured to provide access to the one or more food compartments, an icemaker disposed within the cabinet, an externally-accessible ice dispenser configured to

dispense ice produced by the icemaker when the one or more doors are closed, where the externally-accessible ice dispenser includes a dispenser recess portion configured to receive a container to which ice may be dispensed, and where the dispenser recess portion is removably mounted within the cabinet for removal from the cabinet when the one or more doors are closed.

**[0017]** Moreover, in some embodiments, the dispenser recess portion is slidably mounted within the cabinet. Some embodiments may further include an externally-accessible water dispenser coupled to a water supply and positioned to dispense water from the water supply through an outlet and into a container positioned below the outlet when the one or more doors are closed. Also, in some embodiments, the outlet of the externally-accessible water dispenser is fixedly mounted to the cabinet such that the outlet of the externally-accessible water dispenser remains in a fixed location on the cabinet when the dispenser recess portion is removed from the cabinet.

**[0018]** Further, in some embodiments, the externally-accessible water dispenser includes a user control configured to actuate the externally-accessible water dispenser. In some embodiments, the user control of the externally-accessible water dispenser is removably mounted within the cabinet. Also, in some embodiments, the externally-accessible ice dispenser includes a user control configured to actuate the externally-accessible ice dispenser. In some embodiments, the user control of the externally-accessible ice dispenser is mounted to the dispenser recess portion and is removable from the cabinet with the dispenser recess portion. Further, in some embodiments, the user control includes a paddle.

**[0019]** Some embodiments may also include a dispenser shut off circuit configured to deactivate the externally-accessible ice dispenser in response to removal of the dispenser recess portion from the cabinet. Some embodiments may further include a controller, where the dispenser shut off circuit includes at least one contact switch that disconnects the user control from the controller when the dispenser recess portion is removed from the cabinet.

**[0020]** In addition, some embodiments may further include a storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, where the dispenser recess portion is coupled to the storage bin such that removal of the dispenser recess portion from the cabinet additionally removes the storage bin from the cabinet. In addition, in some embodiments, the storage bin is a second storage bin, and the refrigerator further includes a first storage bin disposed above the second storage bin and below the icemaker to receive ice produced by the icemaker, an ice chute disposed above the dispenser recess portion, and an ice mover disposed within the first storage bin and operable to move ice in the first storage bin to the ice chute when dispensing ice.

**[0021]** In some embodiments, the ice mover is reversible and operable to move ice in first and second directions within the first storage bin, where movement of the ice mover in the first direction moves ice to the ice chute and movement of the ice mover in the second direction drops ice from the first storage bin and into the second storage bin. In addition, in some embodiments, the first storage bin is slidably mounted within the cabinet for withdrawal from the cabinet when the one or more doors are closed.

**[0022]** Also, in some embodiments, the one or more food compartments includes a freezer compartment and a fresh

food compartment, where the fresh food compartment is disposed in the cabinet above the freezer compartment and has a top wall, a bottom wall, and first and second side walls, where the bottom wall separates the fresh food compartment from the freezer compartment, where the refrigerator further includes an icemaking console extending upwardly from the bottom wall of the fresh food compartment only a portion of a height of the fresh food compartment and spaced apart from each of the top wall, the first side wall, and the second side wall, where the icemaking console includes one or more walls that insulate an interior compartment of the icemaking console from the fresh food compartment, and where the icemaker, the externally-accessible ice dispenser, and the dispenser recess portion are disposed within the icemaking console.

**[0023]** In some embodiments, a refrigerator may include a cabinet and an icemaker disposed within the cabinet. In various embodiments, the refrigerator may include a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes a plurality of apertures within one or more side walls. In some embodiments, the refrigerator may include a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin. Moreover, in various embodiments, the refrigerator may include an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover. In various embodiments, the refrigerator may include a second storage bin disposed below the first storage bin and configured to receive ice transferred by the plurality of apertures within one or more side walls of the first storage bin and moved in the second direction by the reversible ice mover.

**[0024]** In addition, in various embodiments, one side wall may include the plurality of apertures spaced along a longitudinal axis of the first storage bin. In some embodiments, each opposing side wall of the first storage bin may include at least one of the plurality of apertures. In various embodiments, a depth of two or more of the plurality of apertures from a top edge may be different. In some embodiments, the refrigerator may include a deflecting plate disposed between at least one of the plurality of apertures and the second storage bin. Moreover, in some embodiments, the refrigerator may include one or more raking structures extending inwardly from one or more side walls allowing ice to bypass at least one of the plurality of apertures in the first direction by the reversible ice mover and remove ice from the at least one of the apertures of the first storage bin when ice is moved in the second direction by the reversible ice mover. In some embodiments, the raking structure may include a cam surface facing towards the ice dispenser. Moreover, in various embodiments, the cam surface may have a free end spaced inwardly towards a longitudinal axis of the first storage bin and towards the ice dispenser more than a distal end of the cam surface.

**[0025]** In various embodiments, a refrigerator may include a cabinet. In some embodiments, the refrigerator may include an icemaker disposed within the cabinet. Moreover, in some embodiments, the refrigerator may include a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes two or more apertures spaced along a longitudinal axis of the first storage bin to distribute ice more

evenly towards a lower second storage bin. In various embodiments, the refrigerator may include a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin. In some embodiments, the refrigerator may include an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover. In addition, in some embodiments, the second storage bin disposed below the first storage bin and configured to receive ice transferred by the two or more in the first storage bin and moved in the second direction by the reversible ice mover.

**[0026]** In addition, in various embodiments, at least two of the apertures may be on one side of the longitudinal axis. In some embodiments, at least two of the apertures may be on opposing sides of the longitudinal axis. In various embodiments, the two or more apertures of the first storage bin are positioned in at least one of an end wall, a side wall, and a bottom wall. In some embodiments, the refrigerator may include one or more raking structures adjacent the two or more apertures. Moreover, in some embodiments, the one or more raking structures may include a cam surface facing the ice dispenser removing ice through at least one of the two or more apertures of the first storage bin when ice is moved in the second direction by the reversible ice mover. In various embodiments, the refrigerator may include one or more deflecting plates positioned below at least one of the two or more apertures of the first storage bin scattering falling ice into the second storage bin.

**[0027]** In addition, in some embodiments, a refrigerator may include a cabinet and an icemaker disposed within the cabinet. In various embodiments, the refrigerator may include a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes one or more apertures. In some embodiments, the refrigerator may include a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin. Moreover, in some embodiments, the refrigerator may include an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover. In various embodiments, the refrigerator may include a second storage bin disposed below the first storage bin and configured to receive ice transferred by the one or more apertures in the first storage bin and moved in the second direction by the reversible ice mover and bypassing the one or more apertures when ice is moved in the first direction by the reversible ice mover.

**[0028]** Also, in some embodiments, the refrigerator may include raking structure adjacent the one or more apertures. In various embodiments, the raking structure may include the one or more apertures spaced outwardly and away from the raking structure. In some embodiments, the raking structure may include a cam surface diverting ice outwardly and away from the reversible ice mover towards the one or more apertures when the ice is moved in the second direction. Moreover, in some embodiments, the raking structure may include another cam surface allowing ice to bypass the one or more apertures when ice is moved in the first direction by the reversible ice mover. In various embodiments, the raking structure may include a free end spaced from an outer periphery of the first storage bin and define a

raking inlet facing the first direction for receiving ice moved in the second direction. In addition, in some embodiments, two or more of the apertures may be spaced from each other along a longitudinal axis of the first storage bin.

[0029] These and other advantages and features, which characterize the invention, are set forth in the claims annexed hereto and forming a further part hereof. However, for a better understanding of the invention, and of the advantages and objectives attained through its use, reference should be made to the Drawings, and to the accompanying descriptive matter, in which there is described example embodiments of the invention. This summary is merely provided to introduce a selection of concepts that are further described below in the detailed description, and is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0030] FIG. 1 is a perspective view of a refrigerator consistent with some embodiments of the invention.

[0031] FIG. 2 is a block diagram of an example control system for the refrigerator of FIG. 1.

[0032] FIG. 3 is a front elevational view of the refrigerator of FIG. 1 with the fresh food compartment doors open.

[0033] FIG. 4 is an exploded perspective view of the icemaking console for the refrigerator of FIG. 1.

[0034] FIG. 5 is a perspective view of the refrigerator of FIG. 1, with the fresh food compartment doors removed, and with a storage bin in a fully extended position.

[0035] FIG. 6 is a perspective view of the refrigerator of FIG. 1, with the fresh food compartment doors removed, and with a full width shelf in a fully extended position.

[0036] FIG. 7 is a functional top plan view of an alternate full width shelf support to that illustrated in FIG. 6.

[0037] FIG. 8 is a functional top plan view of another alternate full width shelf support to that illustrated in FIG. 6.

[0038] FIG. 9 is a functional front elevational view illustrating a top mount refrigerator utilizing an icemaking console consistent with some embodiments of the invention.

[0039] FIG. 10 is a functional front elevational view illustrating a bottom mount refrigerator utilizing an icemaking console covered by the fresh food compartment doors consistent with some embodiments of the invention.

[0040] FIG. 11 is a functional front elevational view illustrating a bottom mount refrigerator utilizing an icemaking console that additionally extends into a freezer compartment consistent with some embodiments of the invention.

[0041] FIG. 12 is a side cross-sectional view of the icemaking console in the refrigerator of FIG. 1.

[0042] FIG. 13 is a perspective cross-sectional view of the icemaking console in the refrigerator of FIG. 1.

[0043] FIG. 14 is a perspective cross-sectional view of the icemaking console in the refrigerator of FIG. 1, with the upper and lower ice storage bins pulled to open positions.

[0044] FIG. 15 is a perspective view of an alternate lower ice storage bin to that illustrated in FIG. 4.

[0045] FIG. 16 is a flowchart illustrating a sequence of operations for making ice in the refrigerator of FIG. 1.

[0046] FIG. 17 is a perspective cross-sectional view of an alternate icemaking console in the refrigerator to that illustrated in FIG. 1.

[0047] FIG. 18 is a partial perspective view of the upper ice storage bin in the refrigerator of FIG. 17.

[0048] FIG. 19 is a partial perspective view of an alternate upper ice storage bin to that illustrated in FIG. 18.

#### DETAILED DESCRIPTION

[0049] Turning now to the drawings, wherein like numbers denote like parts throughout the several views, FIG. 1 illustrates an example refrigerator 10 in which the various technologies and techniques described herein may be implemented. Refrigerator 10 is a residential-type refrigerator, and as such includes a cabinet or case 12, a fresh food compartment 14, a freezer compartment 16, one or more fresh food compartment doors 18, 20 and one or more freezer compartment doors 22, 24.

[0050] Fresh food compartment 14 is generally maintained at a temperature above freezing for storing fresh food such as produce, drinks, eggs, condiments, lunchmeat, cheese, etc. Various shelves, drawers, and/or sub-compartments may be provided within fresh food compartment 14 for organizing foods, and it will be appreciated that some refrigerator designs may incorporate multiple fresh food compartments and/or zones that are maintained at different temperatures and/or at different humidity levels to optimize environmental conditions for different types of foods. Freezer compartment 16 is generally maintained at a temperature below freezing for longer-term storage of frozen foods, and may also include various shelves, drawers, and/or sub-compartments for organizing foods therein.

[0051] Refrigerator 10 as illustrated in FIG. 1 is a type of bottom mount refrigerator commonly referred to as a French door refrigerator, and includes a pair of side-by-side fresh food compartment doors 18, 20 that are hinged along the left and right sides of the refrigerator to provide a wide opening for accessing the fresh food compartment, as well as a pair of sliding freezer compartment doors 22, 24 that are similar to drawers and that pull out to provide access to items in the freezer compartment. Both the fresh food compartment and the freezer compartment may be considered to be full width as they extend substantially across the full width of the cabinet 12. It will be appreciated, however, that other door designs may be used in other embodiments, including various combinations and numbers of hinged and/or sliding doors for each of the fresh food and freezer compartments (e.g., a pair of French freezer doors, a single sliding freezer door, or one hinged fresh food and/or freezer door). Moreover, while refrigerator 10 is a bottom mount refrigerator with freezer compartment 16 disposed below fresh food compartment 14, the invention is not so limited, and as such, the principles and techniques may be used in connection with other types of refrigerators in other embodiments, e.g., top mount refrigerators, side-by-side refrigerators, etc.

[0052] Refrigerator 10 also includes a cabinet-mounted dispenser 26 for dispensing ice and/or water. In the illustrated embodiments, dispenser 26 is an ice and water dispenser capable of dispensing both ice and chilled water, while in other embodiments, dispenser 26 may be an ice only dispenser for dispensing only cubed and/or crushed ice. In still other embodiments, dispenser 26 may additionally dispense hot water, coffee, beverages, or other liquids, and may have variable and/or fast dispense capabilities. In some instances, ice and water may be dispensed from the same location, while in other instances separate locations may be provided in the dispenser for dispensing ice and water.

[0053] A refrigerator consistent with the invention also generally includes one or more controllers configured to



control a refrigeration system as well as manage interaction with a user. FIG. 2, for example, illustrates an example embodiment of a refrigerator 10 including a controller 40 that receives inputs from a number of components and drives a number of components in response thereto. Controller 40 may, for example, include one or more processors 42 and a memory 44 within which may be stored program code for execution by the one or more processors. The memory may be embedded in controller 40, but may also be considered to include volatile and/or non-volatile memories, cache memories, flash memories, programmable read-only memories, read-only memories, etc., as well as memory storage physically located elsewhere from controller 40, e.g., in a mass storage device or on a remote computer interfaced with controller 40.

[0054] As shown in FIG. 2, controller 40 may be interfaced with various components, including a cooling or refrigeration system 46, an ice and water system 48, one or more user controls 50 for receiving user input (e.g., various combinations of switches, knobs, buttons, sliders, touchscreens or touch-sensitive displays, microphones or audio input devices, image capture devices, etc.), and one or more user displays 52 (including various indicators, graphical displays, textual displays, speakers, etc.), as well as various additional components suitable for use in a refrigerator, e.g., interior and/or exterior lighting 54, among others. User controls and/or user displays 50, 52 may be disposed, for example, on one or more control panels disposed in the interior and/or on doors and/or other external surfaces of the refrigerator. Further, in some embodiments audio feedback may be provided to a user via one or more speakers, and in some embodiments, user input may be received via a spoken or gesture-based interface. Additional user controls may also be provided elsewhere on refrigerator 10, e.g., within fresh food and/or freezer compartments 14, 16. In addition, refrigerator 10 may be controllable remotely, e.g., via a smartphone, tablet, personal digital assistant or other networked computing device, e.g., using a web interface or a dedicated app.

[0055] Controller 40 may also be interfaced with various sensors 56 located to sense environmental conditions inside of and/or external to refrigerator 10, e.g., one or more temperature sensors, humidity sensors, etc. Such sensors may be internal or external to refrigerator 10, and may be coupled wirelessly to controller 40 in some embodiments. Sensors 56 may also include additional types of sensors such as door switches, switches that sense when a portion of an ice dispenser has been removed, and other status sensors, as will become more apparent below.

[0056] In some embodiments, controller 40 may also be coupled to one or more network interfaces 58, e.g., for interfacing with external devices via wired and/or wireless networks such as Ethernet, Wi-Fi, Bluetooth, NFC, cellular and other suitable networks, collectively represented in FIG. 2 at 60. Network 60 may incorporate in some embodiments a home automation network, and various communication protocols may be supported, including various types of home automation communication protocols. In other embodiments, other wireless protocols, e.g., Wi-Fi or Bluetooth, may be used.

[0057] In some embodiments, refrigerator 10 may be interfaced with one or more user devices 62 over network 60, e.g., computers, tablets, smart phones, wearable devices,

etc., and through which refrigerator 10 may be controlled and/or refrigerator 10 may provide user feedback.

[0058] In some embodiments, controller 40 may operate under the control of an operating system and may execute or otherwise rely upon various computer software applications, components, programs, objects, modules, data structures, etc. In addition, controller 40 may also incorporate hardware logic to implement some or all of the functionality disclosed herein. Further, in some embodiments, the sequences of operations performed by controller 40 to implement the embodiments disclosed herein may be implemented using program code including one or more instructions that are resident at various times in various memory and storage devices, and that, when read and executed by one or more hardware-based processors, perform the operations embodying desired functionality. Moreover, in some embodiments, such program code may be distributed as a program product in a variety of forms, and that the invention applies equally regardless of the particular type of computer readable media used to actually carry out the distribution, including, for example, non-transitory computer readable storage media. In addition, it will be appreciated that the various operations described herein may be combined, split, reordered, reversed, varied, omitted, parallelized and/or supplemented with other techniques known in the art, and therefore, the invention is not limited to the particular sequences of operations described herein.

[0059] Numerous variations and modifications to the refrigerator illustrated in FIGS. 1-2 will be apparent to one of ordinary skill in the art, as will become apparent from the description below. Therefore, the invention is not limited to the specific implementations discussed herein.

#### Icemaking Console

[0060] Now turning to FIGS. 3 and 4, some embodiments consistent with the invention, as mentioned above, are directed in part to the use of an icemaking console disposed at least partially within a fresh food compartment and extending only a portion of the height of the fresh food compartment. In particular, an icemaking console 70 may be disposed in fresh food compartment 14 and may extend upwardly from a bottom wall 72 of the fresh food compartment 14 only a portion of a height H of the fresh food compartment and spaced apart from each of a top wall 74, right side wall 76, and left side wall 78 of the fresh food compartment. Console 70 may include a front wall 82, top wall 84, right side wall 86 and left side wall 88, and in some instances, at least portions of front wall 82 may be externally-accessible when doors 18, 20 are closed. In some instances, for example, front wall 82 may include a sealing surface 90 against which gaskets 92, 94 on doors 18, 20 may form a seal when doors 18, 20 are closed.

[0061] Console 70 may extend in some instances to a back wall 96 of fresh food compartment 14, while in other instances, and as shown in FIG. 4, a separate housing 98 may project from back wall 96 (e.g., formed integrally with back wall 96, or formed as a separate component that is fastened or otherwise attached to back wall 96). Housing 98 may be used, for example, to provide space for an evaporator and/or other cooling system component, for control electronics, for air ducts, or for other suitable purposes.

[0062] Moreover, the walls 82, 84, 86 and 88 of console 70 may be insulated (e.g., via foam or another suitable insulator) such that console 70 is an insulated console and such

that an interior compartment of console 70 is maintained at a below-freezing temperature for the purposes of making and storing ice. In the illustrated embodiment, console 70 is in fluid communication with freezer compartment 16 through an opening 100 formed in bottom wall 72 of fresh food compartment 14, such that while console 70 is physically disposed within the boundary of fresh food compartment 14, the interior of console 70 is insulated from the fresh food compartment and in fluid communication with freezer compartment 16, thus effectively operating as an extension of freezer compartment 16. In other embodiments, console 70 may be separate from freezer compartment 16, e.g., insulated from freezer compartment 16 and including a separate cooling system, e.g., a thermoelectric cooling system, or separated from freezer compartment 16 but fluidly coupled via ducts or vents to receive cool air circulated by the freezer compartment cooling system.

[0063] Further, it will be appreciated that console 70 is formed separate from the shell or liner used to form the fresh food and/or freezer compartments. In other embodiments, however, console 70 may be formed integrally with the shell or liner of a fresh food and/or freezer compartment.

[0064] Console 70 in some embodiments may also provide a convenient location for a control panel 102 suitable for controlling various functions of refrigerator 10. For example, control panel 102 may include displays, buttons, sliders, switches, etc., and may be used to perform various control operations such as setting temperature setpoints, controlling ice and/or water functions, displaying alarms or alerts, etc. As shown in the illustrated embodiment, top wall 84 of console 70 may be bi-level to accommodate control panel 102, although in other embodiments, no control panel may be used, and top wall 84 may be at a substantially consistent elevation along its depth.

[0065] Console 70 in some instances may be an icemaking console insofar as the console is used to make, dispense and/or store ice. As will become more apparent below, however, console 70 may not be an icemaking console in some embodiments. In some embodiments, however, console 70 may be configured to receive one or more drawers or storage bins, e.g., upper and lower ice storage bins 104, 106. Upper ice storage bin 104 includes a front face 108 that insulates console 70 from the external environment when the bin is pushed into the console and forms a front surface of the upper ice storage bin, while lower ice storage bin 106 includes a front face 110 that similarly insulates console 70 from the external environment when the bin is pushed into the console and forms a front surface of the lower ice storage bin. Front faces 108, 110 also house at least a portion of an externally-accessible ice and water dispenser, discussed in greater detail below. In some embodiments, a single front face may be used, whereby the upper and lower ice storage bins may be coupled to the same front face.

[0066] Beyond ice-related functions, however, console 70 also provides a number of structural features associated with the storage of food items within fresh food compartment 14. For example, as illustrated in FIG. 5, side walls 86, 88 of console 70 respectively face side walls 76, 78 of fresh food compartment 14, and may provide structural support for one or more sliding storage elements (e.g., storage elements 112, 114, 116, 118, 120, 122) within fresh food compartment 14. A storage element within the context of the disclosure may include any structural member capable of storing or otherwise supporting a food item, e.g., a shelf, a basket, a storage

bin, a drawer, a rack, etc., and a sliding storage element may be considered to be a storage element capable of sliding within a horizontal plane, e.g., along a generally horizontal axis extending from the rear to the front of refrigerator 10.

[0067] Storage elements 112 and 118, for example, are sliding shelves, while storage elements 114, 116, 120 and 122 are sliding storage bins or drawers. It will also be appreciated that storage bins or drawers may be configured with customizable environmental conditions (e.g., different temperatures, humidity levels, etc.) suitable for storing food items such as meats, cheeses, vegetables, fruits, etc. Further, not all of storage elements 114-122 need be configured as sliding storage elements, and moreover, different numbers and types of storage elements may be used for any of the storage elements illustrated in FIG. 5, so the invention is not limited to the particular combination of storage elements illustrated herein.

[0068] Moreover, despite the fact that storage elements 112-122 are disposed within a full width fresh food compartment 14, console 70 provides greater support for these storage elements, so much so that in some embodiments it may be desirable to utilize full extension slide rails (e.g., slide rails 124, 126 for storage element 120) to support a sliding storage element, permitting the sliding storage element to be fully extended outwardly from the fresh food compartment, thereby providing greater access to the rear portion of the interior of a storage bin, drawer or basket, or to the rear portion of a shelf or rack. A full extension slide rail, in this regard, is configured to extend at least substantially the full depth of a sliding storage element, including overextension beyond the full depth of the sliding storage element in some embodiments.

[0069] Likewise, and with further reference to FIG. 6, console 70 may also provide structural support for storage elements located above the console, e.g., full width shelf 128, which is disposed underneath a pair of non-sliding shelves 130, 132 (which could also be sliding shelves in some embodiments as well). It will be appreciated that in conventional full width fresh food compartments, a full width shelf, extending substantially between the side walls of the fresh food compartment, would be exceptionally prone to sagging given the typical dimensions of such refrigerators. Moreover, configuring such a shelf to slide would generally strain any slide rails mounted to the side walls of the fresh food compartment, and adding full extension capability would provide even greater challenges.

[0070] In the illustrated embodiment, in contrast, top wall 84 of console 70 may provide adequate support for full width shelf 128 to enable a full width shelf to substantially span the entire width of fresh food compartment 14. In one embodiment illustrated in FIG. 6, for example, a pair of undermount slide rails 134, 136 (i.e., substantially horizontally oriented slide rails) support full width shelf 128 and extend along an underside thereof and generally parallel to one another. Further, in some embodiments, slide rails 134, 136 may be full extension slide rails to permit substantially full extension of full width shelf 128. Moreover, slide rails 134, 136 may provide sufficient support for full width shelf 128 to eliminate the need to support the shelf from side walls 76, 78, such that while the shelf extends substantially between the side walls of the fresh food compartment, the ends of the shelf do not necessarily contact or couple with the side walls themselves. Moreover, even if any additional storage elements are disposed underneath shelf 128 (e.g.,

storage elements **112** and **118**), console **70** generally provides sufficient support such that shelf **128** need not be supported by any storage elements or other components disposed proximate the sides of the shelf.

[0071] Other manners of supporting full width shelf **128** may be used in other embodiments, including various combinations of undermount, top mount or side mount slide rails, glides (i.e., low friction tracks or surfaces), etc. FIG. 7, for example, illustrates a top view of an alternate full width shelf **140** supported by a console **142** using a single full extension undermount slide rail **144** and a pair of undermount glides **146**, **148** extending generally parallel thereto. FIG. 8, as another example, illustrates a top view of an alternate full width shelf **150** supported by a console **152** using a pair of side wall mounted full extension slide rails **154**, **156** and a pair of undermount glides **158**, **159**. Other combinations of components may be used to slidably support a full width shelf in other embodiments, as will be appreciated by those of ordinary skill in the art having the benefit of the instant disclosure.

[0072] As noted above, in the illustrated embodiment of FIGS. 1 and 3-6, console **70** extends upwardly from a bottom wall of a fresh food compartment of a bottom mount refrigerator only a portion of the height of the fresh food compartment, and further supports an externally-accessible ice and water dispenser that may be accessed without opening any door to the fresh food or freezer compartment. However, in other embodiments, various modifications may be used.

[0073] As shown in FIG. 9, for example, an icemaking console may extend downwardly rather than upwardly in some embodiments. The figure illustrates a top mount refrigerator **160** including a top mount freezer compartment **162** covered by a single freezer door **164** and disposed at a higher elevation from a fresh food compartment **166** covered by a pair of French doors **168**, **170**. In this design, an icemaking console **172** may extend downwardly from a dividing wall **174** that functions as a top wall for the fresh food compartment and separates fresh food compartment **166** from freezer compartment **162**. However, the icemaking console **172** extends only a portion of the height of fresh food compartment **166**, and is thus separated from an end wall **176** and side walls **178**, **180** of the fresh food compartment. French doors **168**, **170** also have cut-outs such that console **172** is externally-accessible without opening any of doors **164**, **168** and **170**.

[0074] As shown in FIG. 10, an icemaking console may not be externally-accessible in some embodiments, and may be covered by one or more of the fresh food and/or freezer doors. The figure illustrates a bottom mount refrigerator **182** that includes a fresh food compartment **184** at a higher elevation than a freezer compartment **186**, with each compartment **184**, **186** covered by a pair of French doors **188**, **190** and **192**, **194**. An icemaking console **196** extends upwardly from a dividing wall **198** separating the fresh food and freezer compartments; however, no cut-outs are provided on any of the doors such that console **196** is only accessible by opening one or more of doors **188-194**.

[0075] As shown in FIG. 11, an icemaking console may not only extend into a fresh food compartment, but also into a freezer compartment. Doing so, for example, may assist in positioning an ice and water dispenser at a more convenient height. Thus, as shown in FIG. 11, a bottom mount refrigerator **200** may include a fresh food compartment **202** at a

higher elevation than a freezer compartment **204**, with each compartment **202**, **204** covered by a pair of French doors **206**, **208** and **210**, **212**. An icemaking console **214** extends upwardly from a dividing wall **216** separating the fresh food and freezer compartments. Dividing wall **216** functions as both a bottom wall for fresh food compartment **202** and a top wall for freezer compartment **204**, and in this embodiment, console **214** not only extends upwardly but also extends downwardly from dividing wall **216** a portion of the height of the freezer compartment. Moreover, at least a portion of the console (and if included, an ice and/or water dispenser) is disposed below the bottom edges of the fresh food doors **206**, **208**. Furthermore, in this embodiment, cut-outs are provided on each of doors **206**, **208**, **210**, **212**.

[0076] Other variations will be appreciated by those of ordinary skill in the art having the benefit of the instant disclosure. Therefore, the invention is not limited to the particular console designs described herein.

#### Icemaking System

[0077] Now turning to FIGS. 12-14, some embodiments of the invention may include an icemaking system incorporating a pair of tandem ice storage bins as well as a removable dispenser recess portion consistent with this invention. The icemaking system may include an icemaker **220** disposed within cabinet **12**, and in particular, within icemaking console **70**, e.g., proximate a top of the icemaking console. Produced ice is ejected out of a front end **222** of icemaker **220** and drops into an intermediate area of upper ice storage bin **104**, which is disposed below icemaker **220** and configured to receive ice produced by the icemaker. It will be appreciated that various icemaker designs may be used in the alternative, including icemakers capable of producing different shapes and/or quantities of ice, icemakers that rotate to dump ice into a storage bin, etc. Further, while icemaker **220** extends generally from front to back within console **70**, in other embodiments icemaker **220** may extend transversely (i.e., from side to side). Therefore, the invention is not limited to the particular icemaker design illustrated herein.

[0078] Upper ice storage bin **104** also includes a reversible ice mover **224**. Ice mover **224** may be driven by a motor **226** or other drive, which in the illustrated embodiment is external to upper ice storage bin **104** and removably and mechanically coupled to ice mover **224** to drive ice mover **224** in two opposing directions when upper ice storage bin **104** is in an operating position, but to separate from the upper ice storage bin when the upper ice storage bin is slid outwardly from console **70**. In other embodiments, an ice mover drive may be incorporated into upper ice storage bin **104** itself, and may be removable from refrigerator **10** along with the upper ice storage bin.

[0079] Ice mover **224** in the illustrated embodiment may be configured as an auger. In other embodiments, however, ice mover **224** may be configured as a conveyor, a paddle, or other suitable component. Moreover, while no ice crusher is specifically illustrated in the figures, it will be appreciated that various types of ice crusher configurations may be used, and may provide selective crushing of ice dispensed by the icemaking system.

[0080] As noted above, ice mover **224** is reversible, and in this regard, may be actuated to push ice disposed in upper ice storage bin **104** in two opposing directions. In a first, forward direction, ice mover **224** pushes ice towards an ice

dispenser 228, which in the illustrated embodiment includes portions disposed on each of the front faces 108, 110 of upper and lower ice storage bins 104, 106. Specifically, ice mover 224 may be configured to push ice towards the front of refrigerator 10, and towards an ice chute 230 disposed in front face 108 of the upper ice storage bin. Doing so causes ice (cubed or crushed) to fall through the ice chute and into a container positioned within a dispenser recess portion 232 defined on front face 110 of lower ice storage bin 106. In some embodiments, a flap 234 or other closure may also be provided proximate ice chute 230 to provide some insulation for the ice chute and reduce heat loss from icemaking console 70.

[0081] In a second, rearward direction, ice mover 224 pushes ice away from ice dispenser 228, and towards a rearwardly-disposed aperture 236 formed in upper ice storage bin at an opposite end from ice dispenser 228 such that ice pushed into aperture 236 drops into lower ice storage bin 106 positioned below upper ice storage bin 104. While aperture 236 is illustrated as being formed in a bottom wall of upper ice storage bin 104, aperture 236 may alternatively be disposed elsewhere, e.g., on an end or side wall of upper ice storage bin 104. Moreover, while aperture 236 is illustrated as being always open, in other embodiments a movable closure element such as a hinged or sliding trap door may be used, e.g., so that aperture 236 is closed when upper ice storage bin 104 is removed from icemaking console 70. For example, in some embodiments aperture may be normally closed but opened when ice mover 224 is pushing ice in the second, rearward direction.

[0082] Lower ice storage bin 106 in the embodiment illustrated in FIGS. 12-14 includes an ice bucket 238 that is fastened or otherwise secured to front face 110. In other embodiments, however, and as illustrated in FIG. 15, a lower ice storage bin (e.g., lower ice storage bin 106') may include a removable ice bucket 238' that rests on a base 240 that is fastened or otherwise secured to a front face 110'. In some embodiments, an ice bucket may also include one or more handles, e.g., handles 242 of ice bucket 238', that facilitate carrying the ice bucket when loaded down with ice. Ice bucket 238' may be removed, for example, by first sliding lower ice storage bin 106' out of icemaking console 70 and then lifting the ice bucket out of the lower ice storage bin.

[0083] Returning to FIGS. 12-14, and with particular reference to FIG. 14, in the illustrated embodiment both of upper and lower ice storage bins 104, 106 are removable from icemaking console 70. In some embodiments upper and lower ice storage bins 104, 106 are both fully removable, while in other embodiments one or both of upper and lower ice storage bins 104, 106 may be only partially removable, e.g., to provide access to the ice stored therein, but without fully disengaging from icemaking console 70. Also, as noted above both ice storage bins may share the same front face, and may be removable together. Further, in some embodiments, a stop, tab or latch (e.g., stop 244 for upper ice storage bin 104) may be provided on either or both of upper and lower ice storage bins 104, 106 to enable upper and lower ice storage bins 104, 106 to be withdrawn at most a predetermined amount from icemaking console 70, but thereafter allow the upper and lower ice storage bins 104, 106 to be fully withdrawn after actuation of the stop.

[0084] In one example embodiment, for example, lower ice storage bin 106 may be used as a primary ice storage bin from which a user may obtain ice when a large quantity of

ice is needed by the user. The lower ice storage bin 106 may lack a stop and thus may be easily removed from icemaking console 70, even when doors 18, 20, 22 and 24 are all closed. Upper ice storage bin 104, in contrast, may be primarily used to hold ice for dispensing purposes, and thus may not be frequently removed from icemaking console 70 by a user. The upper ice storage bin, however, also provides access to ice mover 224 and icemaker 220, and thus in the event of an obstruction or other issue that may inhibit the production, dispensing and/or storage of ice, the upper ice storage bin may be removed to enable a user to clear any obstructions. In this regard, upper ice storage bin 104 may include stop 244 such that it is not fully removed by a user in most circumstances, yet is still fully removable through actuation of stop 244, e.g., for use by service personnel or when wider access to the upper area of the icemaking console is needed or desired.

[0085] Each of upper and lower ice storage bins 104, 106 may be configured to be slidably removed from icemaking console 70, either with or without the use of slide rails or other tracking guides. In the embodiment of FIGS. 12-14, for example, upper ice storage bin 104 lacks any tracking guides, while lower ice storage bin 106 slides along slide rails 246, 248. In other embodiments, other configurations may be used, and moreover, ice storage bins may be mounted for other movement relative to icemaking console 70 in other embodiments, e.g., through rotation or some combination of linear and rotational movement, and through openings in other walls of the icemaking console.

[0086] In addition, as discussed above, housing 98 in some embodiments provides additional space within fresh food compartment, e.g., for a fresh food, freezer, or other evaporator, a fan, a compressor, or other cooling system component, for control electronics, or for other purposes. The interior of housing 98 may be insulated from fresh food compartment in some embodiments, or may be in fluid communication with the fresh food compartment via vents. In other embodiments, housing 98 may be omitted, and console 70 may extend all of the way to back wall 96. In some embodiments, and as shown in dashed lines in FIG. 12, an evaporator 250 for fresh food compartment 14 may be disposed within housing 98. Further, it may be desirable in some embodiments to route one or more cooling tubes 252 to icemaker 220 to provide direct cooling of the icemaker using the fresh food evaporator. The cooling tubes 252 may extend through an interior wall 254 of console 70 that insulates console 70 from housing 98. In embodiments where housing 98 is omitted, an evaporator may be disposed within console 70, rather than behind console 70 as is the case in FIG. 12. It will be appreciated that by placing fresh food evaporator 250 either within or behind console 70, additional space on the back wall of the fresh food compartment is available, thereby enabling the fresh food compartment to be deeper than would otherwise be possible with the evaporator spread across the back of the cabinet, and thereby increasing the capacity of refrigerator 10.

[0087] Turning now with particular reference to FIG. 13, refrigerator 10 includes ice and water dispensing functionality. In this regard, at least portions of ice dispenser 228 are formed by front faces 108, 110 of upper and lower ice storage bins 104, 106, with front face 108 housing ice chute 230 and flap 234, and front face 110 housing a dispenser recess portion 232. Dispenser recess portion 232 is recessed relative to ice chute 230 such that a container (e.g., a cup,

glass, bowl, bucket, cooler, etc.) placed into dispenser recess portion 232 will be aligned with ice chute 230 to receive ice dispensed by ice dispenser 228. Moreover, dispenser recess portion may also include one or more ice dispenser controls 256 for actuating ice dispenser 228. In the embodiment shown in FIG. 13, for example, a single ice dispenser control 256 configured as a paddle may be used in dispenser recess portion 232, and may be actuated by a user's finger or by pressing a container against the paddle. In some instances, a separate control or setting may be used to select from between cubed and crushed ice, or in some instances, two paddles or other controls may be used to separately dispense cubed and crushed ice.

[0088] In addition to ice dispenser 228, refrigerator 10 also includes a water dispenser 258 disposed on icemaking console 70. Water dispenser 258, as with ice dispenser 228, is externally-accessible when doors 18, 20, 22, and 24 are closed. Unlike ice dispenser 228, however, water dispenser 258 is disposed at a fixed location in icemaking console 70, e.g., on a cantilevered extension 260 having a profile that conforms with front face 108 of upper ice storage bin 104. Water dispenser 258 includes an outlet 262 coupled to a supply line 264, and further includes a valve (not shown) that controls the supply of water to outlet 262. A water dispenser control 266, e.g., a paddle or button, may be disposed underneath outlet 262, e.g., on front face 108 of upper ice storage bin 104, may be used to selectively actuate water dispenser 258 either through pressing by a user's finger or by pressing the edge of a container against the control.

[0089] By providing at least the water supply and outlet of water dispenser 258 on a fixed component of refrigerator 10, no detachable couplings or flexible hoses are needed in order to support movement of the water dispenser relative to icemaking console 70. In addition, since at least outlet 262 of water dispenser 258 is separate from ice dispenser 228, ice storage bins 104, 106 are readily removable without concern for the water supply to water dispenser 258.

[0090] It will be appreciated, however, that other dispenser configurations may be used in other embodiments. In some embodiments, for example, ice and water may be dispensed from the same dispenser recess portion, and in some instances using the same control (e.g., where a separate dispenser mode switch is used to select between ice, water, and in some instances, crushed ice). Further, different dispenser controls may be used in other embodiments, e.g., various combinations of buttons, paddles, proximity sensors, mode switches, etc. In addition, in other embodiments the various components of the ice and/or water dispensers may be disposed on removable or fixed components in refrigerator 10. Therefore, the invention is not limited to the particular configuration disclosed herein.

[0091] In addition, given that controls 256, 266 are disposed on removable components (upper and lower ice storage bins 104, 106), it may be desirable in some embodiments to include a dispenser shut off circuit for one or both of the ice dispenser 228 and water dispenser 258 in response to movement of either of upper and lower ice storage bins 104, 106 away from an operating position. In some embodiments, for example, a dispenser shut off circuit may include one or more switches (e.g., contact switches, magnetic switches, etc.) that disconnect controls 256, 266 from controller 40 when an upper and/or lower ice storage bin 104, 106 is moved away from the operating position.

[0092] As shown in FIGS. 12 and 14, for example, a contact switch 270 may be disposed on a front face of icemaking console 70 to contact a contact pad 272 disposed on a rearwardly-facing surface of front face 108 of upper ice storage bin 104 when upper ice storage bin 104 is pushed back into an operating position. Likewise, a second contact switch 274 may be disposed on a front face of icemaking console 70 to contact a contact pad 276 disposed on a rearwardly-facing surface of front face 110 of lower ice storage bin 106 when lower ice storage bin 106 is pushed back into an operating position.

[0093] Controller 40 may be configured to deactivate ice and/or water dispenser 228, 258 whenever one or both of upper and lower ice storage bins 104, 106 have been pulled away from icemaking console 70. For example, it may be desirable in some instances to disable both dispensers in response to either ice storage bin 104, 106 being out of an operating position.

[0094] In some embodiments, control signals generated by controls 256, 266 may be passed through contact switches 270, 274 and contact pads 272, 276. In other embodiments, separate electrical contacts or wiring may be used to communicate control signals. In addition, while contact switches are illustrated as being located on surfaces that are generally transverse to the sliding axes of ice storage bins 104, 106, in other embodiments the contact switches may be disposed on surfaces that are generally parallel to the sliding axes, or in other locations suitable for detecting the presence of an ice storage bin in an operating position. Moreover, while electrical contact switches are illustrated in FIGS. 12 and 14, in other embodiments other types of switches may be used, e.g., magnetic switches, mechanical switches, optical switches, etc. Further, while in the illustrated embodiment controls 256, 266 include electrical switches that close upon actuation, in other embodiments electrical switches may be disposed in icemaking console and mechanical linkages may be coupled to each control 256, 266 to depress the electrical switches only when ice storage bins 104, 106 are in an operating position. Other manners of coupling controls 256, 266 to controller 40 and/or of disabling the ice and/or water dispensers 228, 258 upon removal of one or both of upper and lower ice storage bins 104, 106 will be apparent to those of ordinary skill having the benefit of the instant disclosure.

[0095] Control of ice production with icemaker 220 may be based in part on the sensed level of ice in each of upper and lower ice storage bins 104, 106. In some embodiments, for example, an upper level sensor 280 and a lower level sensor 282 may be configured to sense the level of ice within each of upper and lower ice storage bins 104, 106. Level sensors 280, 282 may be configured as optical or photoelectric sensors, although other sensors may be used in other embodiments, e.g., weight sensors, or sensor arrays capable of sensing ice level at multiple locations in each ice storage bin.

[0096] As shown in FIG. 16, controller 40 may implement a sequence of operations 300 for producing ice and storing the ice in the upper and lower ice storage bins 104, 106. Starting in block 302, an ice production operation, using any of various known icemaking techniques, may be initiated. Block 304 may then determine whether the icemaker is ready to release the ice, and if not, passes control to block 306 to wait for a next interval before returning control to block 304 to again check if the icemaker is ready to release the ice.

[0097] Once the ice production process is complete and the icemaker is ready to release the ice, block 304 passes control to block 308 to determine (e.g., from sensor 280) whether the upper storage bin is full. If not, control passes to block 310 to operate ice mover 224 in the forward direction a predetermined amount to push ice forward towards dispenser 228. By pushing ice forward, the ice may be positioned proximate dispenser 228 to reduce the amount of time ice mover 224 needs to be actuated before ice is dispensed to a user. Control then passes to block 312 to release the ice, thereby dropping the ice into the upper ice storage bin 104. Control then returns to block 302 to initiate another ice production operation.

[0098] Returning to block 308, if the upper storage bin is determined to be full, block 308 instead passes control to block 314 to determine (e.g., using sensor 282) whether the lower ice storage bin is full. If so, control returns to block 304 to wait until the upper storage bin is no longer full (e.g., after a user has dispensed some ice using the ice dispenser), such that the produced ice is retained in the icemaker, and no additional ice is produced, until sufficient room exists in the upper ice storage bin.

[0099] Returning to block 314, if the lower storage bin is determined to not be full, block 314 passes control to block 316 to operate ice mover 224 in the opposite, rearward direction a predetermined amount to push ice rearward so that at least some of the ice will drop into lower ice storage bin 106. Block 318 then determines if the upper storage bin is still full, and if so, returns control to block 316 to continue pushing ice rearward and thus from the upper ice storage bin to the lower ice storage bin. Once the upper ice storage bin is no longer full, block 318 then passes control to block 312 to release the ice, and then to block 302 to initiate another ice production operation.

[0100] As shown in the Figures, the refrigerator may include configurations to distribute ice from the upper ice storage bin to reduce the buildup of ice in a pile or mound. In some implementations, the ice dispensing system may be configured to evenly distribute ice from the upper ice storage bin to the lower ice storage bin. The lower storage bin may be a variety of sizes, shapes, quantities, constructions, and positions relative to the upper ice storage bin. In one implementation as shown in FIG. 17, the lower ice storage bin 106 may be positioned below the upper ice storage bin 404. For example, ice may gravity feed to the lower ice storage bin 106. The lower ice storage bin 106 may not extend above the lower extent of the upper ice storage bin 404 as shown in the one embodiment.

[0101] As shown in the embodiment in FIGS. 17 and 18, the upper ice storage bin 404 may include a plurality of apertures 436 spaced along a longitudinal axis A to evenly distribute ice away therefrom. The two or more apertures 436 (e.g. 436a-c) transfer the ice from the upper ice storage bin 404 to the receiving lower ice storage bin 106. The apertures 436 may be positioned along a variety of lengths/distances and/or positions of the upper ice storage bin within one or more of the end walls 410, side walls 411, and/or bottom walls 412 of the upper ice storage bin 404.

[0102] The apertures may be positioned along the longitudinal axis A in a variety of quantities, sizes, shapes, and positions within the upper ice storage bin. As shown in FIG. 12, one embodiment may have at least an aperture 236 in the bottom wall. As shown in FIGS. 17 and 18, apertures 436 may be positioned along one or more side walls 411 alone

or in combination with apertures within the end wall and/or bottom wall (e.g. FIG. 12). For example, as shown in FIG. 18, a plurality of apertures 436 (e.g. 436a and 436c) may be positioned along at least one side wall 411 of the upper ice storage bin 404, laterally, or on one side of the longitudinal axis A. In another example, one or more apertures 436 (e.g. 436b) may be positioned along the other side wall 411. As shown in FIGS. 18 and 19, the apertures 436 (e.g. 436a-d) may extend along both side walls 411 or along opposing sides of the longitudinal axis A. Although the apertures 436a-436c within each side wall may be offset from the adjacent aperture within the other side wall as shown in the one embodiment of FIG. 18, it should be understood that the apertures may be substantially opposite from each other (e.g. same spacing/distance along the length) within the side walls, end walls, or bottom walls. For example, two apertures 436d of upper ice storage bin 504 shown in FIG. 19 may be positioned at the same or substantially similar distance from one or both ends of the bin along opposing side walls 511. The apertures 436 may also be connected to each other or adjacent to each other within the end wall, bottom wall, and/or side wall. The quantity of apertures 436 within each side wall may be the same or different (see FIGS. 18 and 19) from each other. The upper ice storage bin may include apertures 436d that may be mirror images along the length of the axis in some embodiments (e.g. see FIG. 19). Moreover, varying the size, shape, quantities, spacing between apertures, construction, and position within the upper ice storage bin (e.g. side walls, etc.) may adjust the percentage of ice transferred through the apertures along the length of the bin(s) with or without the ice mover operating in one or more directions.

[0103] The one or more apertures may be positioned at a variety of lengths along the upper ice storage bin or longitudinal axis A. The spacing between each aperture 436, on one or both sides/periphery of the bin, may be a variety of distances D1, D2 therebetween. In some implementations, distance D1 may be larger than distance D2 as shown in FIG. 18. In other embodiments, the distance D1 may be the same as distance D2. The spacing for example may increase or decrease in the direction towards dispensing. The spacing between apertures 436, on one or more sides (e.g. side walls) or periphery of the ice storage bin, may be similar and/or different between the end wall and the ice dispenser. In some implementations as shown in FIG. 17, when the upper ice storage bin is in the stowed position one or more apertures 436 may be positioned along the longitudinal axis A other than beneath the ice maker 220. For example, at least one aperture 436a may be adjacent the end wall 410 and beneath the ice maker 220 and/or at least one aperture 436c may be adjacent the ice dispenser 228 away from or not beneath the ice maker. Moreover, for example, at least one aperture 436b may be positioned beneath the ice maker in combination with other apertures or alone.

[0104] The size and shape of one or more apertures 436 may be a variety of constructions along the length of the upper ice storage bin. Although the size and/or shape of the apertures 436 may be similar in some embodiments, the apertures may be different in size and/or shape along the length of the upper ice storage bin to evenly distribute the ice below. As shown in the one embodiment in FIG. 19, the aperture 436d may include a continuous periphery defined by one or more portions of the upper ice storage bin 504. Alternatively, the aperture 436a may include a discontinu-

ous periphery defined by one or portions of the upper ice storage bin **504**. As shown in the one embodiment in FIG. **18**, the apertures **436** (e.g. **436a**, **436b**, and/or **436c**) may be different in size (e.g. smaller in size towards or away from the ice dispenser). The apertures **436** progressively decrease in size towards the ice dispenser. For example, the aperture **436c** adjacent the ice dispenser **228** includes a smaller depth from a top edge **413** of the upper ice storage bin **404** than aperture **436a**. As shown in FIG. **19**, the aperture **436d** may not extend through the top edge **513** in some embodiments. In the embodiments as shown in FIGS. **18** and **19**, the one or more apertures **436** may always be opened to dispense ice therefrom. Alternatively, the apertures **436** may be opened and/or closed when desired or be predetermined to open and/or close.

[**0105**] The ice dispensing system may include one or more slides, guides, or deflecting plates **500** to funnel ice between the upper ice storage bin **404** to the lower ice storage bin **106**. The plates **500** may disperse or scatter the ice falling in one or more directions from the upper ice storage bin **404** to one or more directions towards the lower ice storage bin **106**. Although not shown, a series of plates **500** may be used to direct the ice from one or more apertures. As shown in FIG. **17**, the plates **500** may redirect falling ice from an outward position to an inward position towards the lower ice storage bin **106**. Although the plates are shown attached to the interior walls (e.g. left side wall **86**) of the console **70**, it should be understood that the interior walls of one or more compartments (e.g. freezer, etc.), lower ice storage bin and/or upper ice storage bin may include the plates attached thereto. For example, the one or more plates may travel with the upper/lower ice storage bins between the stowed position and the deployed positions.

[**0106**] In some implementations, the deflecting plate **500** may be positioned adjacent one or more apertures **436** of the upper ice storage bin. The deflecting plate **500** may be positioned below at least one aperture **436** or between the aperture and the lower ice storage bin. As shown in FIG. **17**, the deflecting plate may have an upper edge **501** attached to the compartment wall (e.g. left side wall **86**) and extends inwardly and downwardly therefrom towards a free end or lower edge **502**. The lower edge **502** may extend over or within the outer periphery of the lower ice storage bin **106**. In some embodiments as is shown, the plate **500** may be arcuate in shape. Moreover, in some embodiments, the plate may narrow from the lower edge **502** towards the upper edge **501**. The plate **500** may be a variety of sizes, shapes, quantities, constructions, and positions within the ice dispensing system and still be within the scope of the invention.

[**0107**] In some implementations, the ice dispensing system may include one or more raking structures or baffles **600** to guide ice one or more apertures of the upper ice storage bin **504**. The raking structure **600** may be used to guide ice into or through an adjacent or downstream aperture **436**, or more specifically shown in FIG. **19** as **436d** (e.g. in the direction of moving ice via the ice mover). The raking structure or rakes **600** will grab a portion or percentage of the ice moving in a direction and drop the ice into the lower ice storage bin. As shown in FIG. **19**, the apertures **436d** are downstream (e.g. in the second direction away from the ice dispenser) or spaced outwardly away from the raking structure **600**. The raking structure **600** of the upper ice storage bin **504** may allow ice to bypass at least one of the apertures in the first direction towards the ice dispenser **228** and

removes ice from the upper ice storage bin when ice travels in the opposing second direction (e.g. towards the end wall **510**) via the ice mover **224**. Although the bin, includes raking structure removing ice in one direction, it should be understood that raking structure may be used in both directions in some embodiments. For example, if raking structure is used in both directions, the portion of ice removed may be the same or different depending on the direction of ice movement by the ice mover.

[**0108**] In the one embodiment shown of the raking structure, the raking structure **600** may include one or more cam surfaces. One cam surface **620** of one or more walls **610** may be inwardly and angled towards the longitudinal axis A or ice mover **224**, such that the cam surface faces the ice dispenser **228**. In some embodiments, the cam surface **620** may be positioned at an angle B (e.g. acute) relative to the side wall **511** adjacent or more proximal to the ice dispenser **228**. The acute angle B may be in the direction opposite of the ice removal direction. The angle B may be a variety of angles and still be within the scope of the invention. When the ice is moved in the second direction (e.g. towards the end wall **510**), the ice is guided or diverted along the cam surface **620** outwardly and away to the aperture **436d** from the ice mover **224**. The cam surface may alternatively guide ice in a variety of directions towards the aperture (e.g. inwardly) for example. The raking structure **600** may also include a second or another one or more cam surfaces **622** in some embodiments. As shown in FIG. **19**, the second cam surface **622** may be angled and face away from the ice dispenser **228** in the second direction. Such that when the ice is moved in the first direction, the ice is guided along the cam surface **622** and bypasses the aperture **436d** and is forced inwardly and away from the side walls **511** towards the longitudinal axis A or ice mover **224**.

[**0109**] In some implementations, the raking structure may include one or more walls or members arranged to guide the ice from the upper ice storage bin (e.g. through one or more apertures **436**) when the ice mover is moving in a direction and/or pass over in the other opposing direction. As shown in the one embodiment of FIG. **19**, the wall **610** may include the one or more cam surfaces **620**, **622**. The wall **610** and/or cam surfaces may include a free edge/end or proximal edge **611** spaced inwardly towards the ice mover **224**. The free end **611** of the raking structure **600** may be spaced from the outer periphery of the upper ice storage bin and define a raking or receiving inlet **602**. The receiving inlet **602** may face towards the first direction or ice dispenser **228**. The other or distal end **612** may be attached to or adjacent the side wall **511** and may be spaced further away from the ice dispenser than the free end **611**. The distal end may be adjacent the aperture or outer periphery of the bin. At least the free end **611** of the raking structure may define a portion of the receiving inlet **602** for the raking structure **600**. The receiving inlet **602** may coincide with the aperture **436** in some embodiments. In the embodiment shown in FIG. **19**, the distal end **612** is attached downstream of the aperture **436d** or in the second direction away from the ice dispenser **228**. In some embodiments a top wall **613** and bottom wall **614** (e.g. bottom wall **512**), if used, may extend from the free end **611** of the raking structure and may define the receiving inlet **602** or passageway to the aperture **436** with the wall or outer periphery. The top wall **613** and the bottom wall **614** may connect with the distal end **612** and/or side wall **511**. In some implementations, the wall **610** may be angled and

substantially planar. However, the one or more walls may not be planar and may have different shaped one or more cam surfaces **620**, **622**. The wall **610** may extend from the bottom wall **512** to the top edge **513** of the upper ice storage bin **504**, however other heights of the wall or spacing from the bottom wall **512** are within the scope of the invention. For example, the wall or raking structure **600** may be spaced from the bottom wall **512** and/or side wall and still be adjacent the aperture (e.g. adjacent the top edge **513** of the upper ice storage bin). Thereby, the raking structure may rake ice at a range of elevations unlike raking from the bottom wall **512** for a distance to an elevation as shown in FIG. **19** (e.g. to the top edge **513** or top wall **613**).

**[0110]** It should be understood that the raking structure may include a variety of sizes, shapes, quantities, constructions, and positions relative to the apertures, ice mover, and/or top edge (e.g. side wall, end walls, and/or bottom walls) and still be within the scope of the invention. For example, the raking structure may be several members in series to guide the ice in one or more directions. In some implementations, the ice may be raked within an aperture within the bin's bottom wall. In various embodiments, the raking structure may be spaced from the aperture and/or side wall. In some embodiments, the rear facing and/or front facing angled cam surfaces, if used, may be parallel to each other as shown however may not be parallel to each other in some embodiments. Moreover, varying the size, shape, quantities, construction, angles relative to the direction of ice motion, and position within the upper ice storage bin may adjust the percentage of ice grabbed/transferred through the apertures/receiving inlet along the length of the bin(s).

**[0111]** In some implementations, the two or more apertures spaced along the length of upper ice storage bin may allow for the overflow of ice to dispense evenly to the lower ice storage bin without the ice mover moving ice in one or more directions. For example, two or more apertures may be spaced along the longitudinal axis (e.g. within one or both side walls, or in combination with a bottom wall and/or end wall aperture, etc.). The overflow may occur with or without the ice mover moving in one or more directions. For example, in some implementations, the upper ice storage bin may overflow until the lower ice bucket bin level sensor **282** and/or other sensors signal the shut off of the ice ejection or supply.

**[0112]** Other manners of managing ice production will be apparent to those of ordinary skill having the benefit of the instant disclosure, so the invention is not limited to the particular ice production management disclosed herein.

**[0113]** It will be appreciated that various additional modifications may be made to the embodiments discussed herein, and that a number of the concepts disclosed herein may be used in combination with one another or may be used separately. For example, an icemaking console consistent with the invention may be used in connection with other icemaking systems in other embodiments, and conversely, an icemaking system consistent with the invention may be used in other refrigerator designs, including those without an icemaking console and/or those in which an icemaking system is at least partially disposed elsewhere in a fresh food compartment, a freezer compartment, or door of a refrigerator. Furthermore, an icemaking system consistent with the invention may incorporate tandem ice storage bins without a removable dispenser recess portion in some embodiments, or alternatively, a removable dispenser recess

portion without tandem ice storage bins. Therefore, the invention lies in the claims hereinafter appended.

What is claimed is:

1. A refrigerator, comprising:
  - a cabinet;
  - an icemaker disposed within the cabinet;
  - a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes a plurality of apertures within one or more side walls;
  - a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin;
  - an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover; and
  - a second storage bin disposed below the first storage bin and configured to receive ice transferred by the plurality of apertures within one or more side walls of the first storage bin and moved in the second direction by the reversible ice mover.
2. The refrigerator of claim **1** wherein one side wall includes the plurality of apertures spaced along a longitudinal axis of the first storage bin.
3. The refrigerator of claim **1** wherein each opposing side wall of the first storage bin includes at least one of the plurality of apertures.
4. The refrigerator of claim **1** wherein a depth of two or more of the plurality of apertures from a top edge are different.
5. The refrigerator of claim **1** further comprising a deflecting plate disposed between at least one of the plurality of apertures and the second storage bin.
6. The refrigerator of claim **1** further comprising one or more raking structures extending inwardly from one or more side walls allowing ice to bypass at least one of the plurality of apertures in the first direction by the reversible ice mover and remove ice from the at least one of the apertures of the first storage bin when ice is moved in the second direction by the reversible ice mover.
7. The refrigerator of claim **6** wherein the raking structure includes a cam surface facing towards the ice dispenser, the cam surface having a free end spaced inwardly towards a longitudinal axis of the first storage bin and towards the ice dispenser more than a distal end of the cam surface.
8. A refrigerator, comprising:
  - a cabinet;
  - an icemaker disposed within the cabinet;
  - a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes two or more apertures spaced along a longitudinal axis of the first storage bin to distribute ice more evenly towards a lower second storage bin;
  - a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin;
  - an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover; and
  - the second storage bin disposed below the first storage bin and configured to receive ice transferred by the two or



- more in the first storage bin and moved in the second direction by the reversible ice mover.
- 9.** The refrigerator of claim **8** wherein at least two of the apertures are on one side of the longitudinal axis.
- 10.** The refrigerator of claim **8** wherein at least two of the apertures are on opposing sides of the longitudinal axis.
- 11.** The refrigerator of claim **8** wherein the two or more apertures of the first storage bin are positioned in at least one of an end wall, a side wall, and a bottom wall.
- 12.** The refrigerator of claim **8** further comprising one or more raking structures adjacent the two or more apertures.
- 13.** The refrigerator of claim **12** wherein the one or more raking structures includes a cam surface facing the ice dispenser removing ice through at least one of the two or more apertures of the first storage bin when ice is moved in the second direction by the reversible ice mover.
- 14.** The refrigerator of claim **8** further comprising one or more deflecting plates positioned below at least one of the two or more apertures of the first storage bin scattering falling ice into the second storage bin.
- 15.** A refrigerator, comprising:
- a cabinet;
  - an icemaker disposed within the cabinet;
  - a first storage bin disposed below the icemaker and configured to receive ice produced by the icemaker, wherein the first storage bin includes one or more apertures;
  - a reversible ice mover disposed within the first storage bin and operable to move ice in first and second directions within the first storage bin;
- an ice dispenser configured to dispense ice disposed in the first storage bin, the ice dispenser configured to receive ice moved in the first direction by the reversible ice mover; and
- a second storage bin disposed below the first storage bin and configured to receive ice transferred by the one or more apertures in the first storage bin and moved in the second direction by the reversible ice mover and bypassing the one or more apertures when ice is moved in the first direction by the reversible ice mover.
- 16.** The refrigerator of claim **15** further comprising a raking structure adjacent the one or more apertures.
- 17.** The refrigerator of claim **16** wherein the raking structure includes the one or more apertures spaced outwardly and away from the raking structure.
- 18.** The refrigerator of claim **16** wherein the raking structure includes a cam surface diverting ice outwardly and away from the reversible ice mover towards the one or more apertures when the ice is moved in the second direction.
- 19.** The refrigerator of claim **18** wherein the raking structure includes another cam surface allowing ice to bypass the one or more apertures when ice is moved in the first direction by the reversible ice mover.
- 20.** The refrigerator of claim **16** wherein the raking structure includes a free end spaced from an outer periphery of the first storage bin and defines a raking inlet facing the first direction for receiving ice moved in the second direction.
- 21.** The refrigerator of claim **15** wherein two or more of the apertures are spaced from each other along a longitudinal axis of the first storage bin.

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