US010689240B1

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

(10) **Patent No.: US 10,689,240 B1**
(45) **Date of Patent: Jun. 23, 2020**

(54) **AUTOMATED BEVERAGE DISPENSING MACHINES**

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(73) Assignee: **CORNELIUS, INC.**, Osseo, MN (US)

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

(21) Appl. No.: **16/002,491**

(22) Filed: **Jun. 7, 2018**

Related U.S. Application Data

(60) Provisional application No. 62/516,356, filed on Jun. 7, 2017.

(51) **Int. Cl.**
B67D 1/00 (2006.01)
B67D 1/08 (2006.01)
B67D 1/12 (2006.01)

(52) **U.S. Cl.**
CPC ***B67D 1/0041*** (2013.01); ***B67D 1/0892*** (2013.01); ***B67D 1/1234*** (2013.01); *B67D 2210/00076* (2013.01); *B67D 2210/00078* (2013.01)

(58) **Field of Classification Search**
CPC A47J 37/1228; B67D 2210/00076; B67D 2210/00078
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,364,959	A *	1/1968	Hamilton	B67D 1/06 141/155
4,807,780	A *	2/1989	Parsons	B65G 59/108 141/173
4,949,526	A	8/1990	Brogna et al.	
4,951,719	A *	8/1990	Wiley	B67D 1/0041 141/1
5,000,345	A	3/1991	Brogna et al.	
5,044,517	A *	9/1991	U Park	G07F 11/54 221/104
5,799,932	A	9/1998	Blatt	
6,053,359	A *	4/2000	Goulet	B67D 1/00 221/221
6,102,246	A *	8/2000	Goulet	B67D 1/00 221/11
6,321,904	B1 *	11/2001	Mitchell	B65G 15/42 198/690.2
6,409,411	B1	6/2002	Crorey	
RE41,223	E	4/2010	Dellach	

(Continued)

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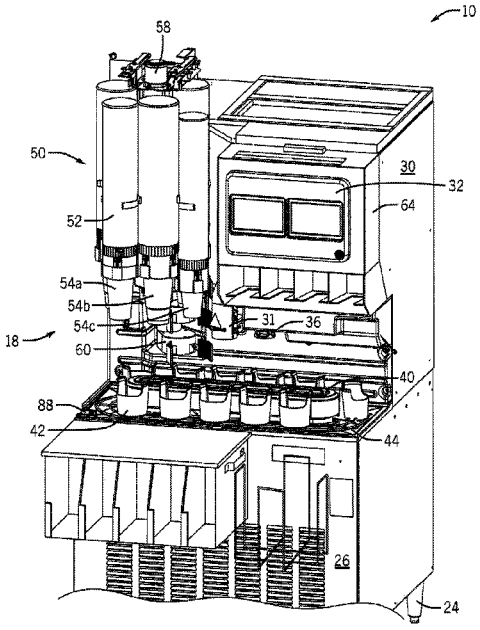
Assistant Examiner — Kelvin L Randall, Jr.
(74) *Attorney, Agent, or Firm* — Andrus Intellectual Property Law, LLP

(57) **ABSTRACT**

A beverage dispensing machine includes a countertop for a conveyor that carries a plurality of cup holders around a track. A front side of the beverage dispenser machine is accessible by an operator to remove cups from the plurality of cup holders. A cup tower has a plurality of cup dispenser tubes that are each configured to hold a respective stack of cups. A cup grabber is movable up and down into and between a raised position in which the cup grabber is positioned to grab a cup from one of the stacks of cups and place a cup into one of the plurality of cup holders.

13 Claims, 31 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

8,104,810	B2	1/2012	Holcomb et al.	
8,162,176	B2	4/2012	Rudick	
8,167,346	B2	5/2012	Filipiak	
8,251,258	B2 *	8/2012	Rudick	B67D 1/0034 222/1
8,297,673	B2	10/2012	Waldorf et al.	
8,340,815	B2	12/2012	Peters et al.	
8,434,642	B2	5/2013	Rudick	
8,454,069	B2	6/2013	Jenkins et al.	
8,565,916	B2	10/2013	Zhang et al.	
8,678,239	B2 *	3/2014	Abdelmoteleb	B08B 9/032 222/1
8,739,840	B2	6/2014	Mattos, Jr. et al.	
8,744,618	B2	6/2014	Peters et al.	
8,751,037	B2	6/2014	Peters et al.	
8,755,932	B2	6/2014	Peters et al.	
8,757,222	B2	6/2014	Rudick et al.	
8,814,000	B2	8/2014	Rudick	
8,851,329	B2	10/2014	Rudick et al.	
8,919,844	B1	12/2014	Mascorro et al.	
9,017,485	B2 *	4/2015	Murthy	B67D 1/07 134/18
9,045,323	B2	6/2015	Crane et al.	
9,051,162	B2	6/2015	Peters et al.	
9,067,775	B2	6/2015	Mattos, Jr. et al.	
9,141,562	B2 *	9/2015	Pickett	G07F 13/10
9,150,366	B2 *	10/2015	Rudick	B65G 54/025
9,204,734	B2	12/2015	Jablonski et al.	
9,227,830	B2	1/2016	Angus et al.	
9,327,958	B2	5/2016	Angus et al.	
10,239,742	B2 *	3/2019	Dresser	A47F 1/085
2009/0014464	A1 *	1/2009	Adbelmoteleb	B08B 9/032 222/1
2013/0079926	A1	3/2013	Peters et al.	
2013/0220480	A1 *	8/2013	Angus	B67D 7/302 141/9
2013/0282164	A1 *	10/2013	Veloo	B67D 1/00 700/216
2014/0001195	A1 *	1/2014	Patterson	G07F 13/10 221/1
2014/0041748	A1	2/2014	Angus et al.	
2014/0130891	A1 *	5/2014	Abdelmoteleb	B08B 9/032 137/15.05
2014/0142749	A1	5/2014	Peters et al.	
2014/0263447	A1	9/2014	Peters, Jr. et al.	
2014/0288700	A1	9/2014	Peters, Jr. et al.	
2014/0297026	A1	10/2014	Peters, Jr. et al.	
2014/0361035	A1	12/2014	Rudick	
2015/0251891	A1	9/2015	Peters et al.	
2015/0298956	A1 *	10/2015	Rudick	B67D 1/07 222/1
2016/0083123	A1	3/2016	Angus et al.	

* cited by examiner

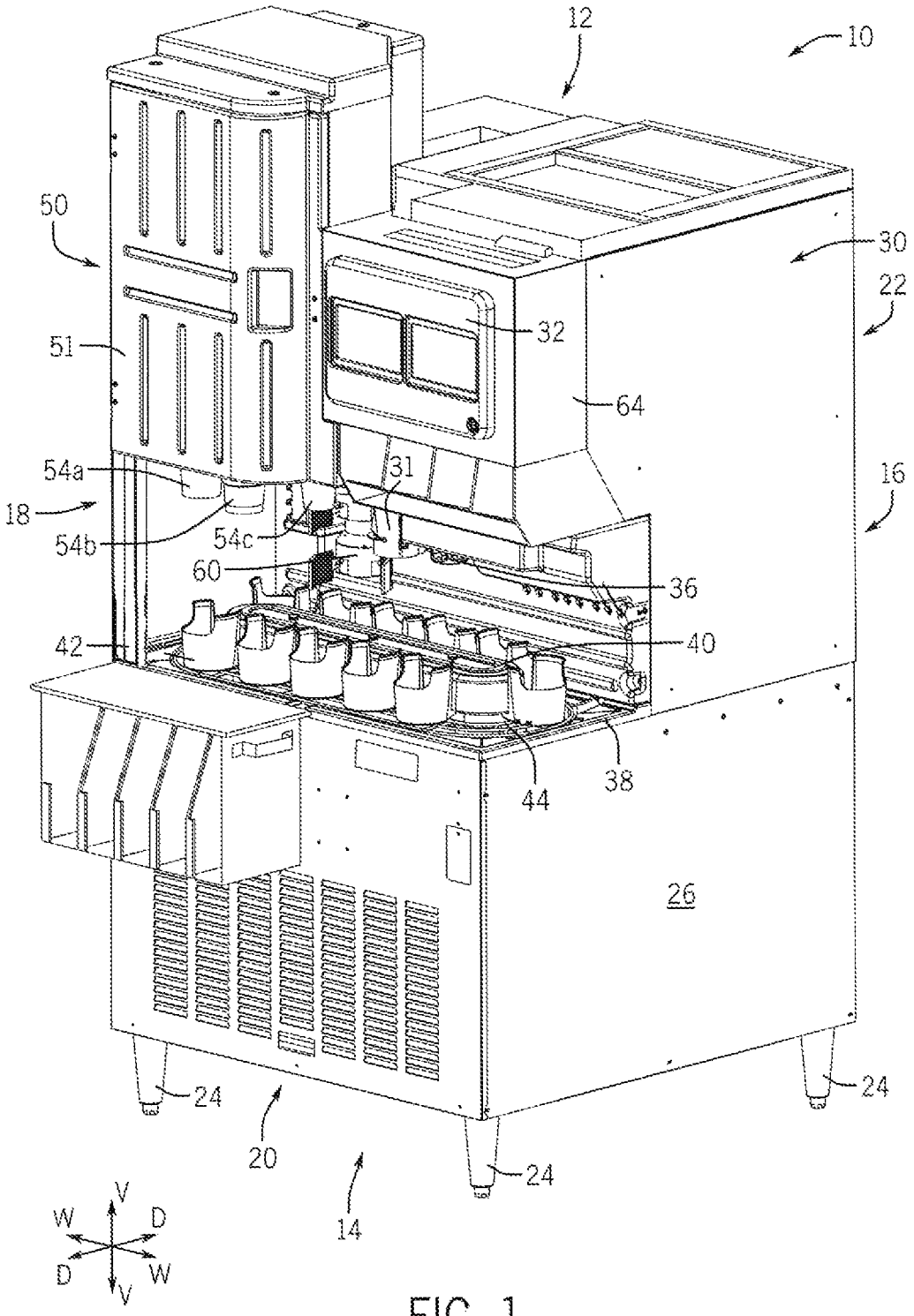

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FIG. 1

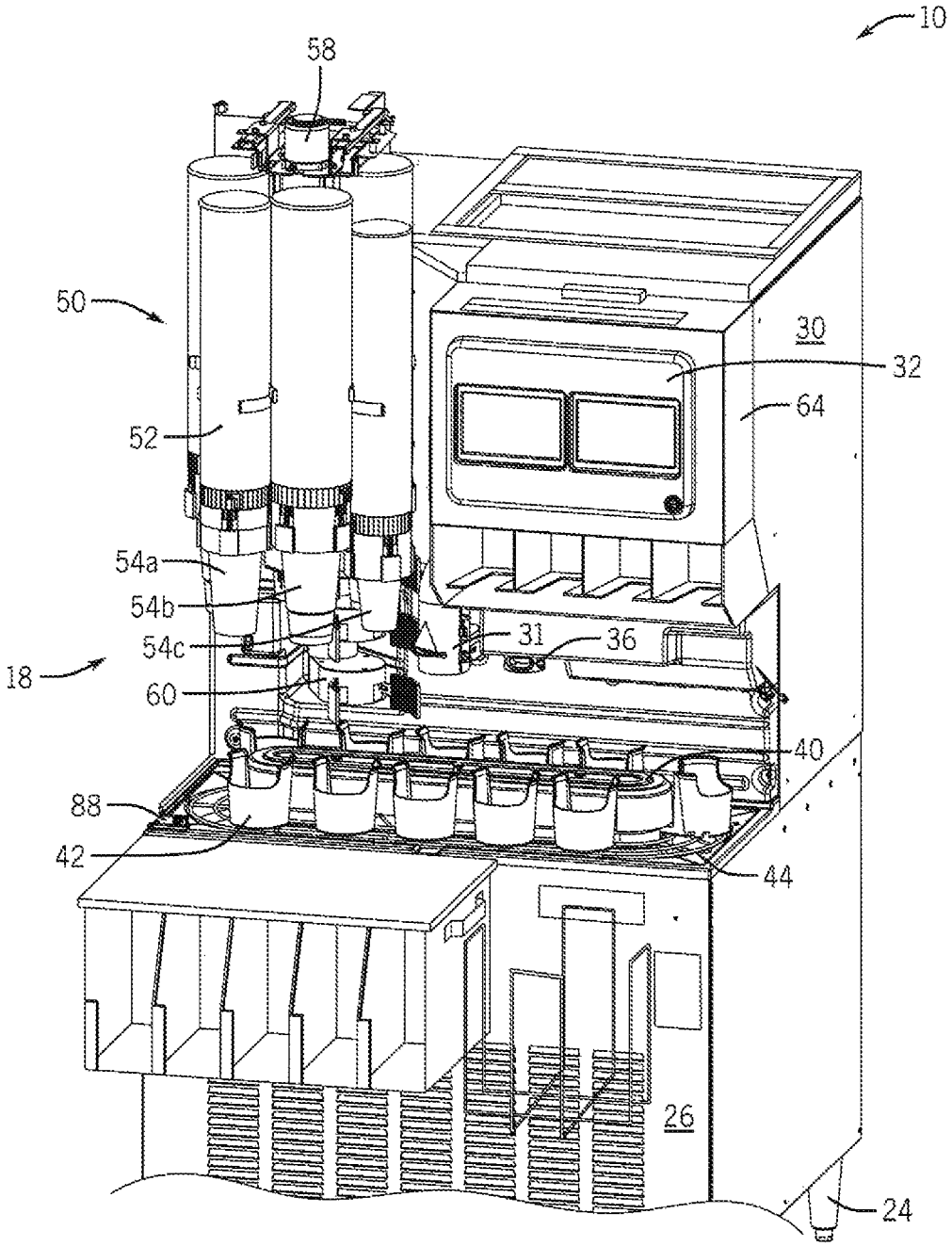

FIG. 2

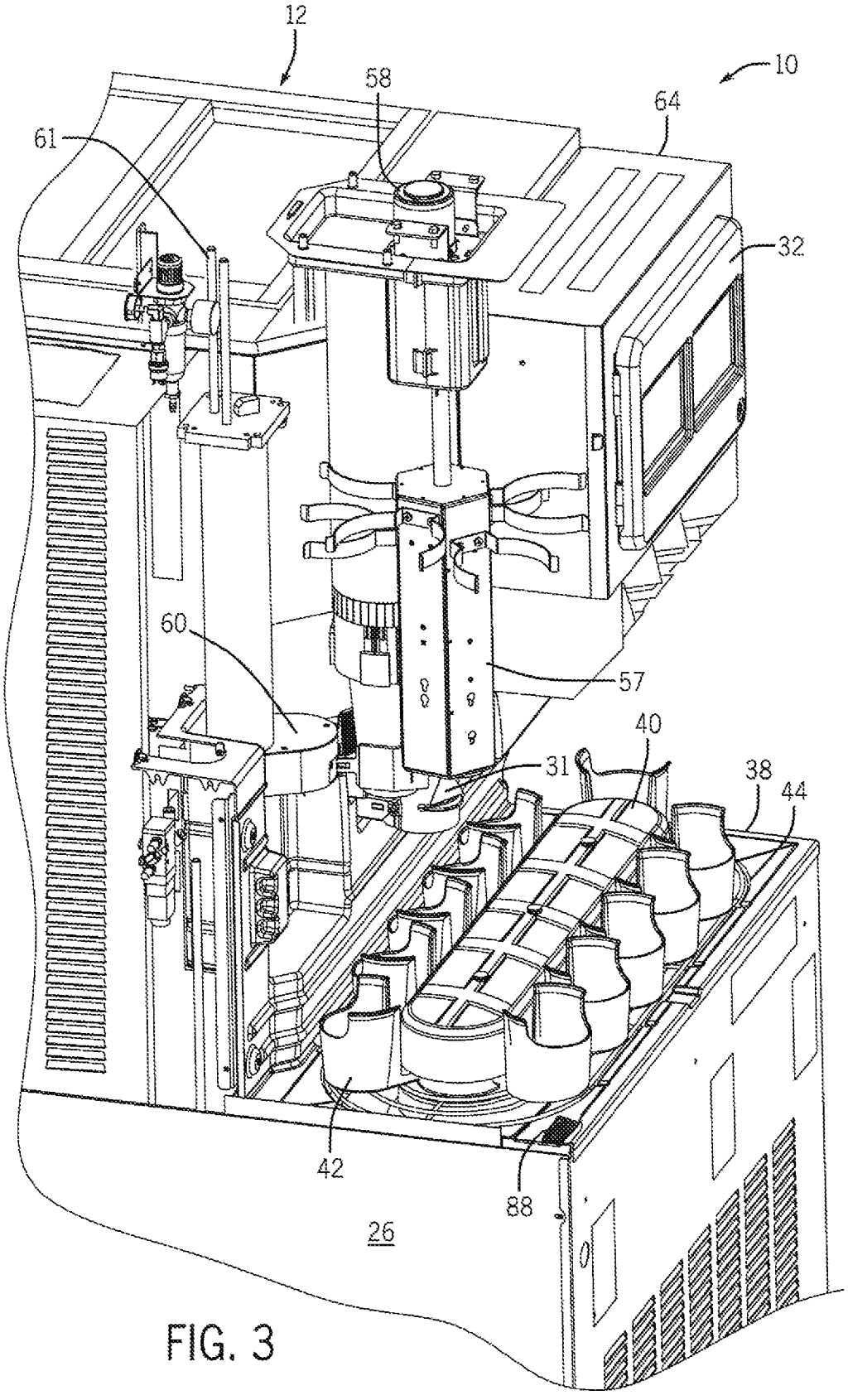

FIG. 3

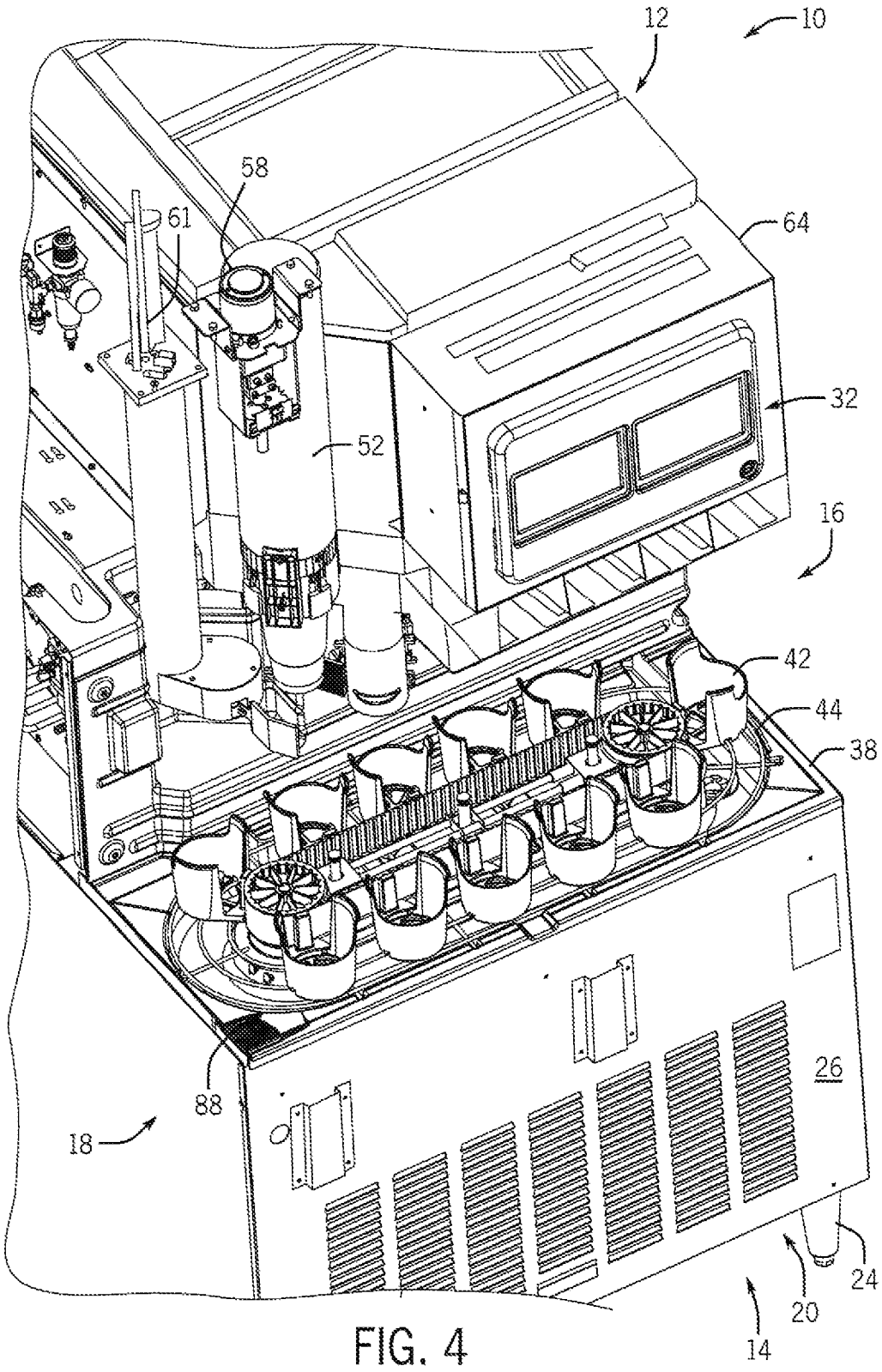

FIG. 4

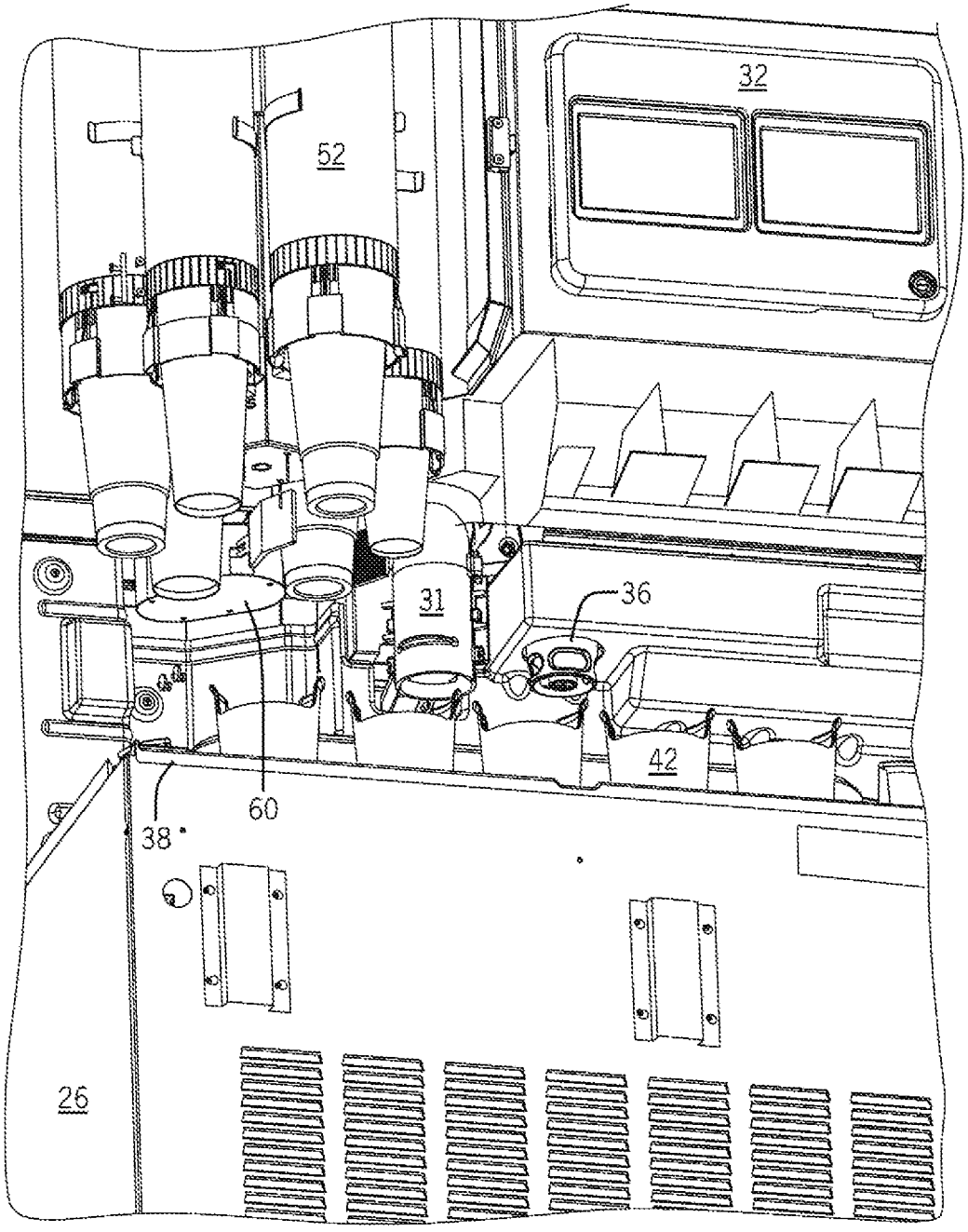

FIG. 5

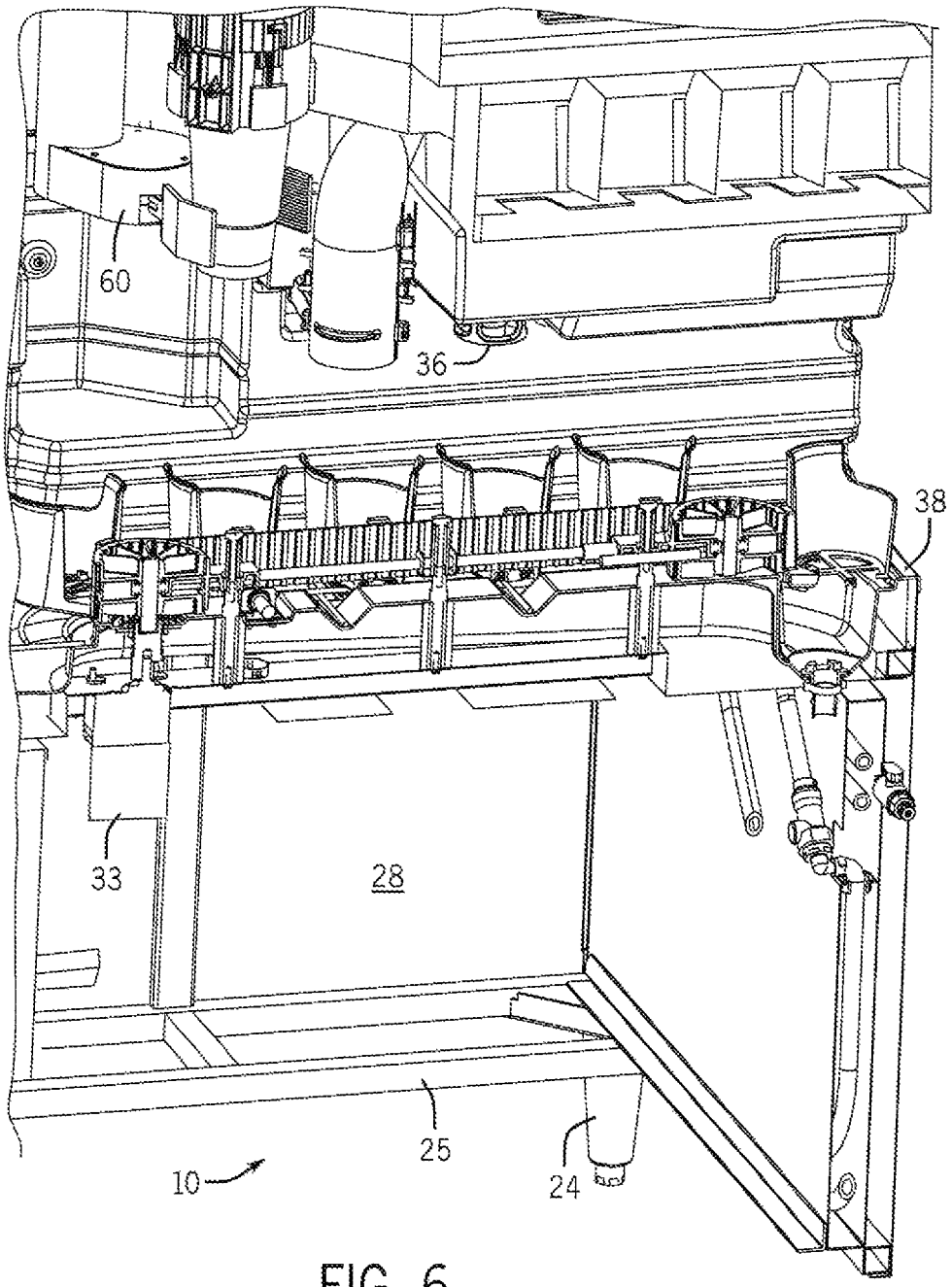

FIG. 6

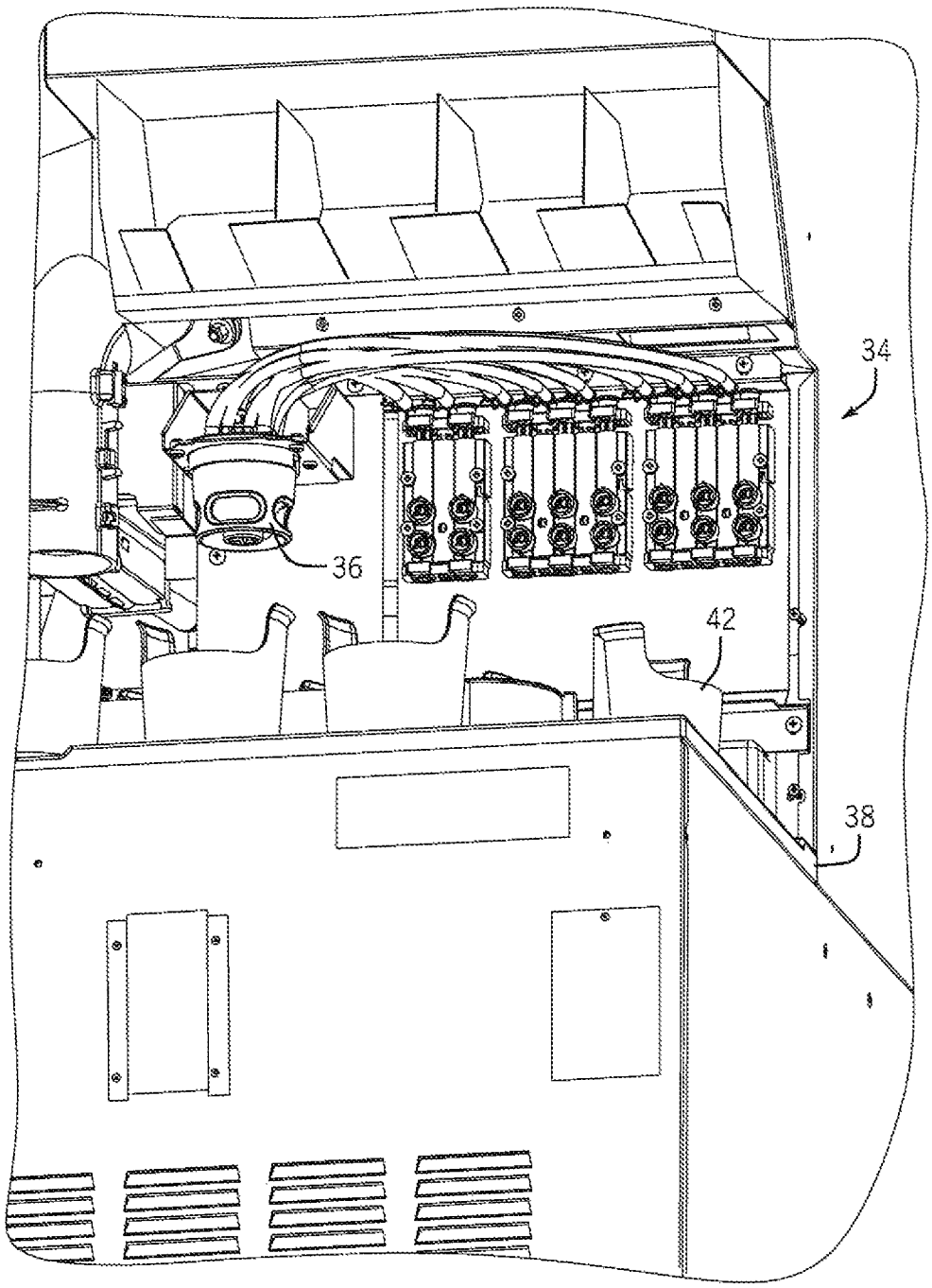

FIG. 7

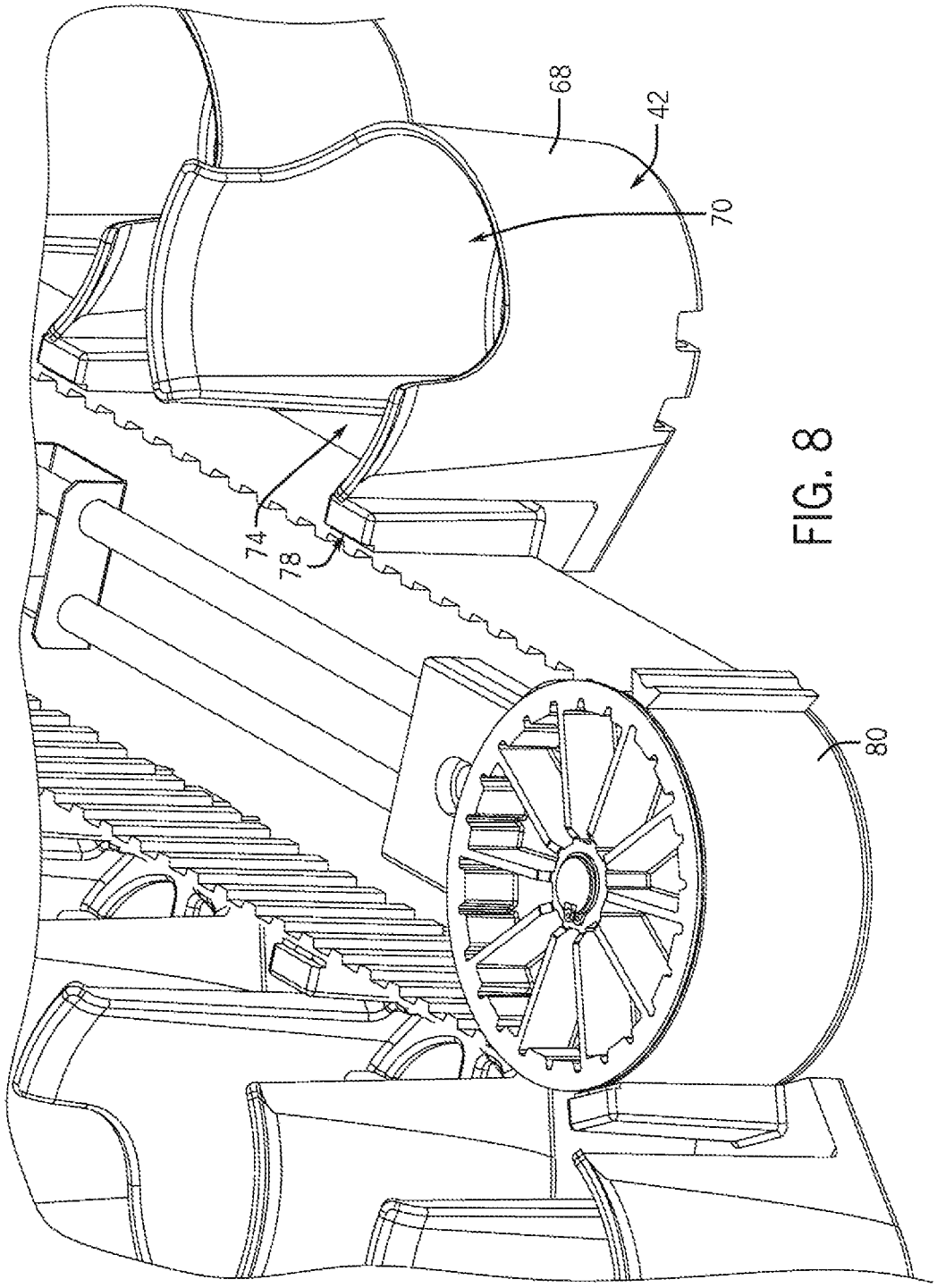

FIG. 8

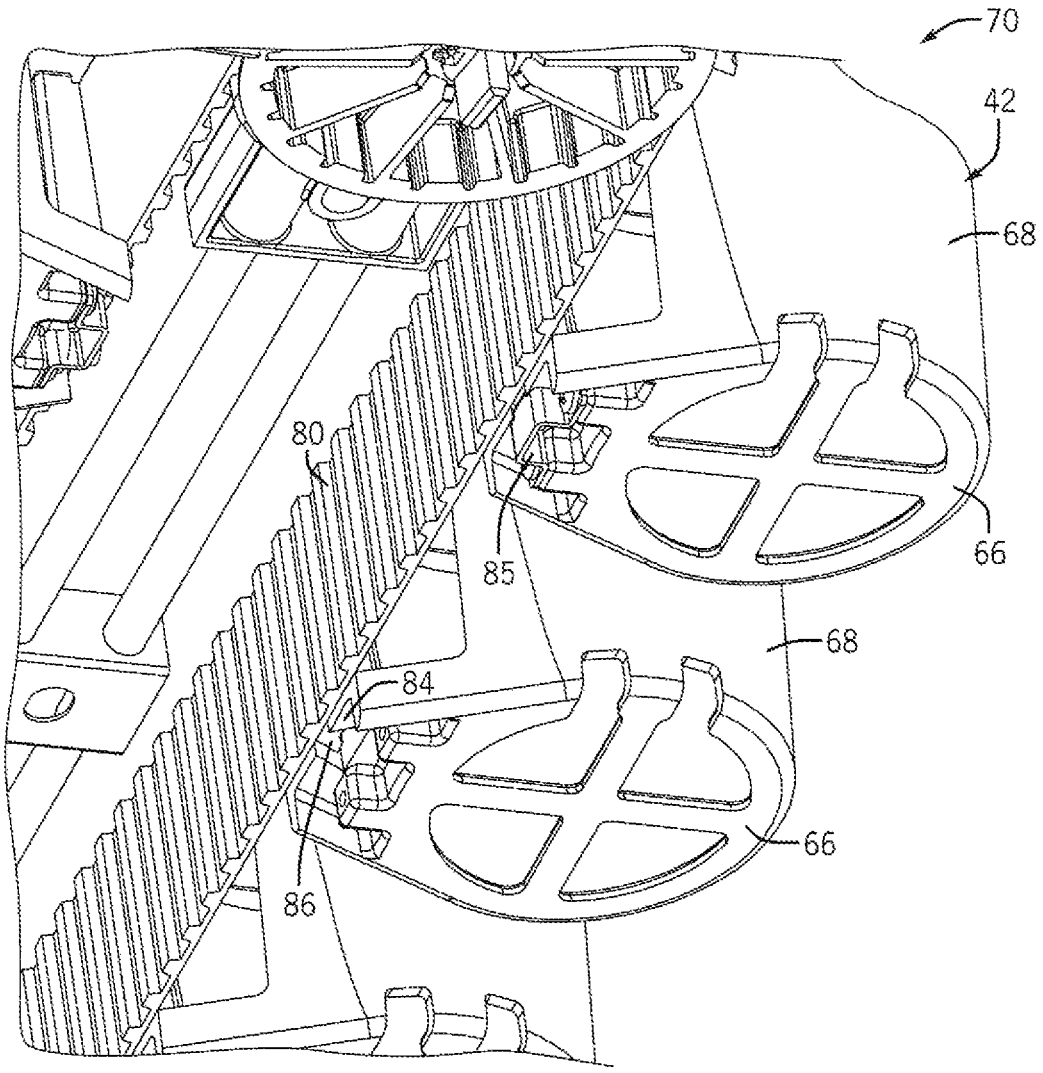

FIG. 9

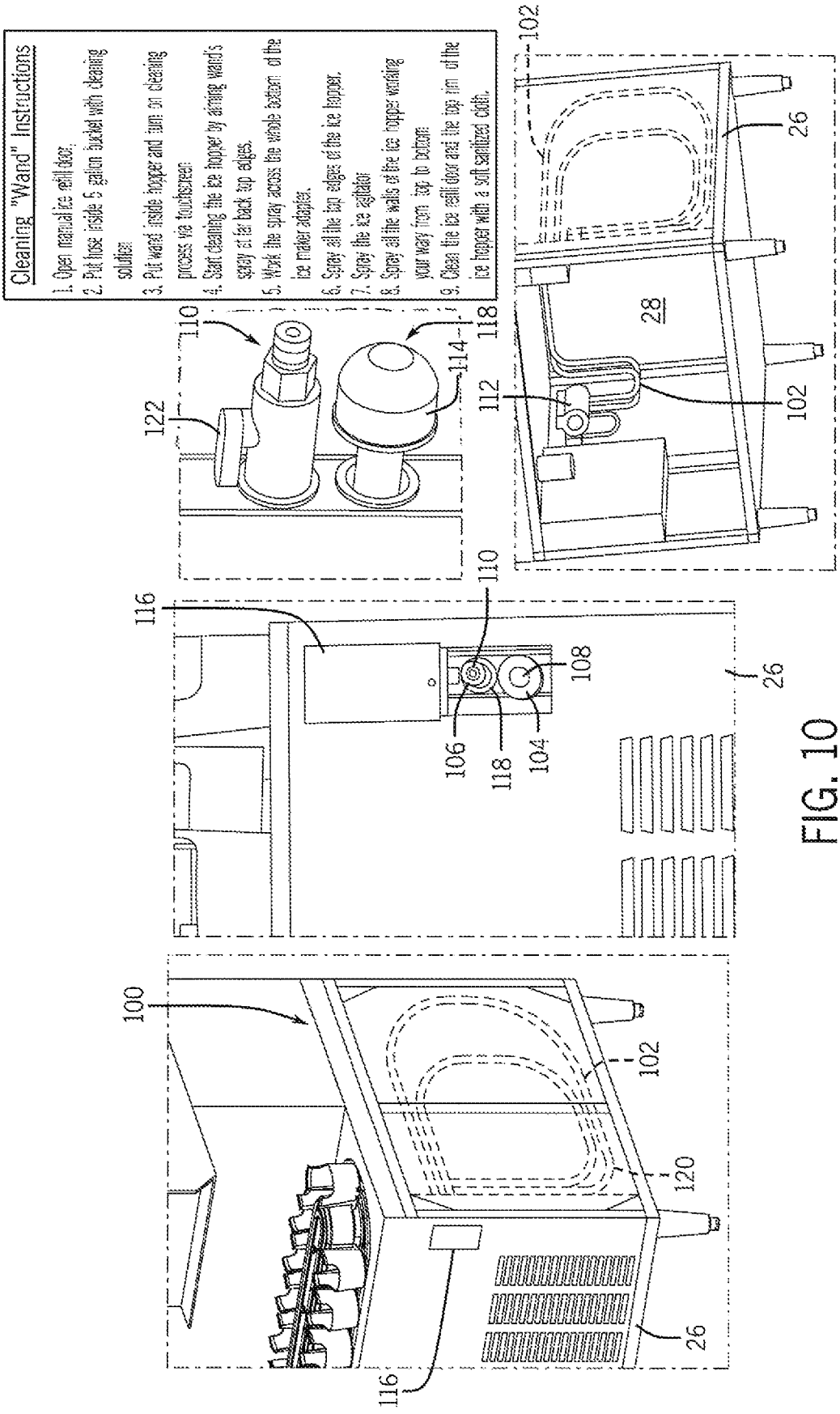
Cleaning "Wand" Instructions
1. Open manual ice refill door.
2. Put hose inside 5 gallon bucket with cleaning solution
3. Put wand inside hopper and turn on cleaning process via touchscreen
4. Start cleaning the ice hopper by aiming wand's spray at far back top edges.
5. Work the spray across the whole bottom of the ice maker adapter.
6. Spray all the top edges of the ice hopper.
7. Spray the ice agitator
8. Spray all the walls of the ice hopper working your way from top to bottom
9. Clean the ice refill door and the top rim of the ice hopper with a soft sanitized cloth.
100
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FIG. 10

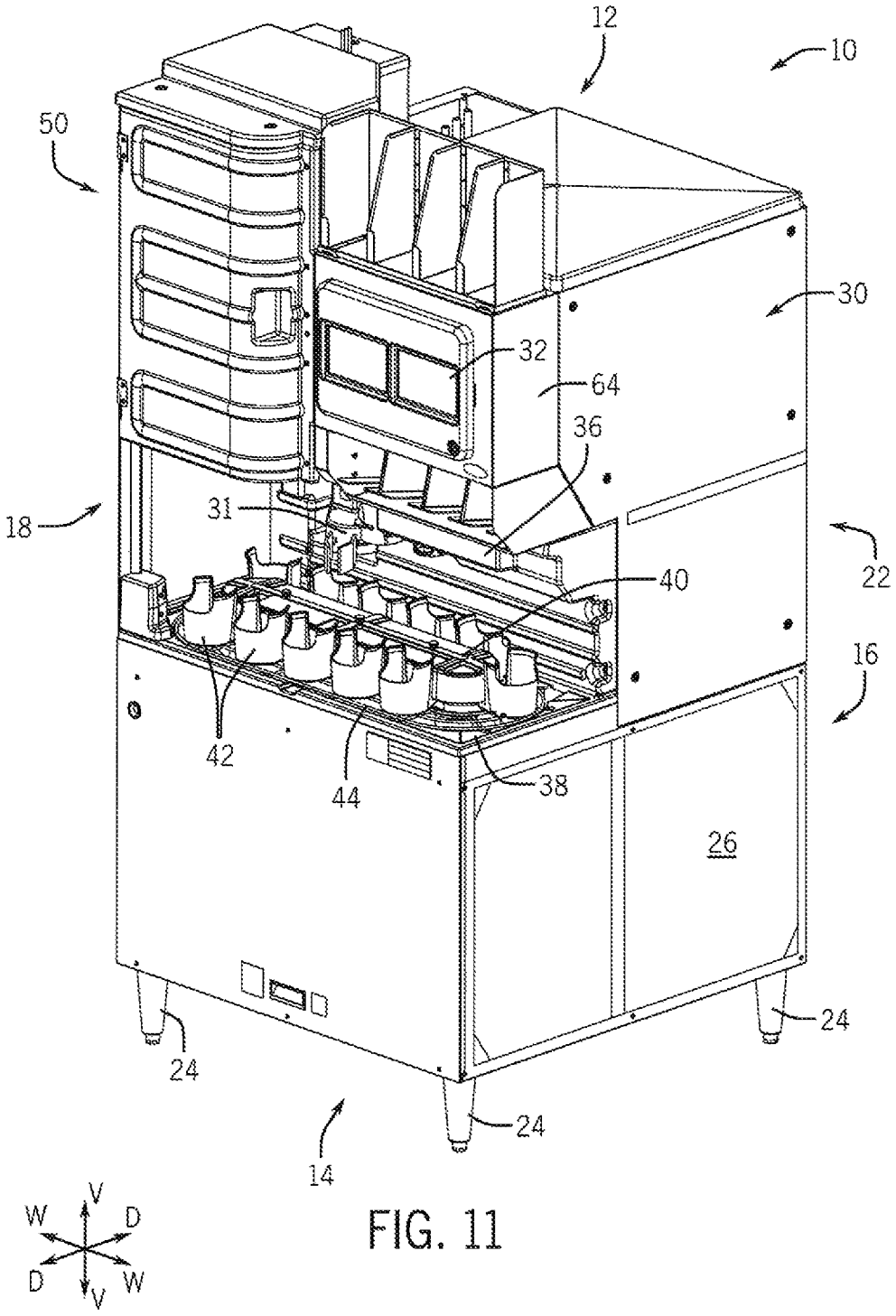


FIG. 11

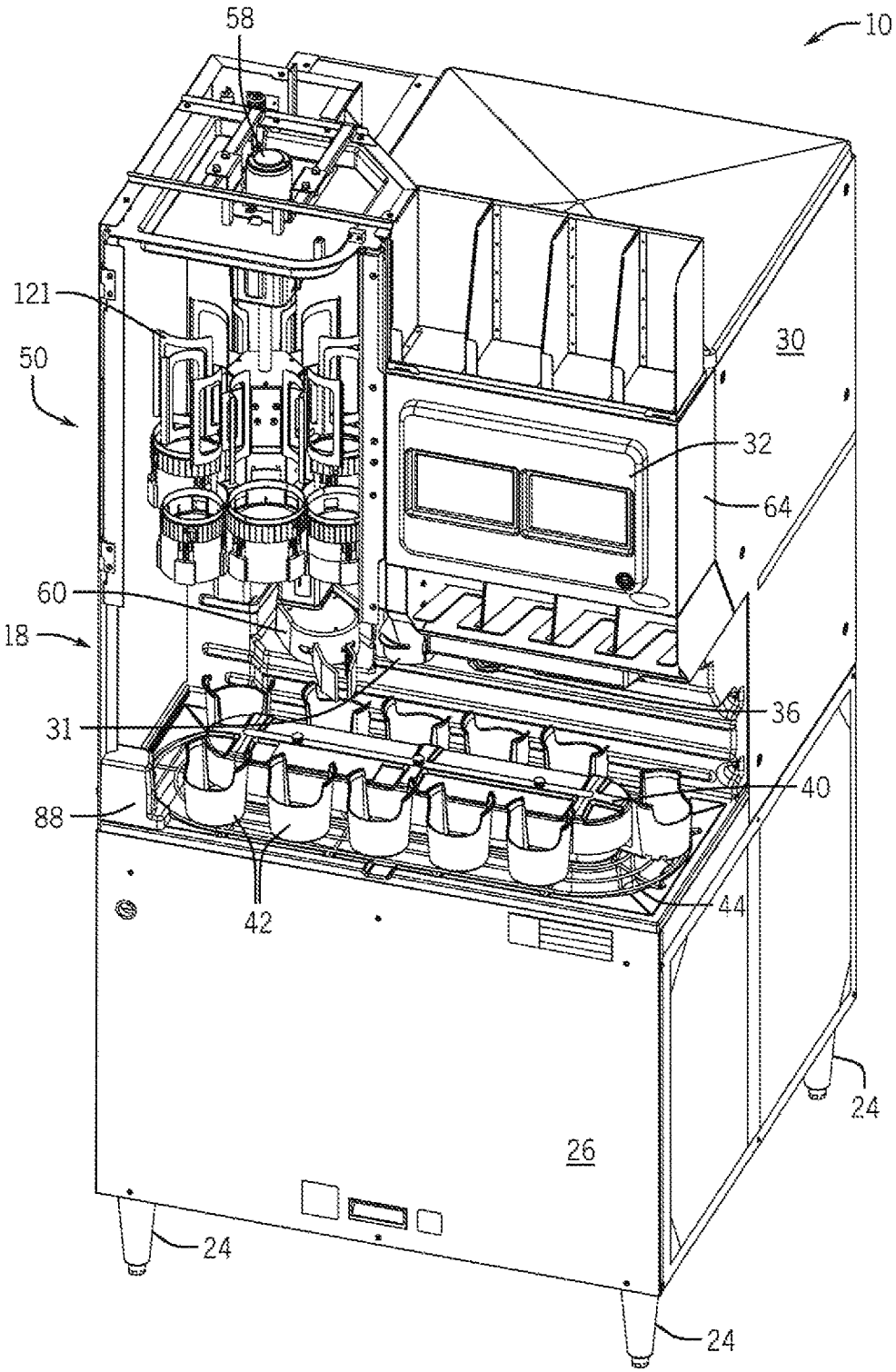


FIG. 12

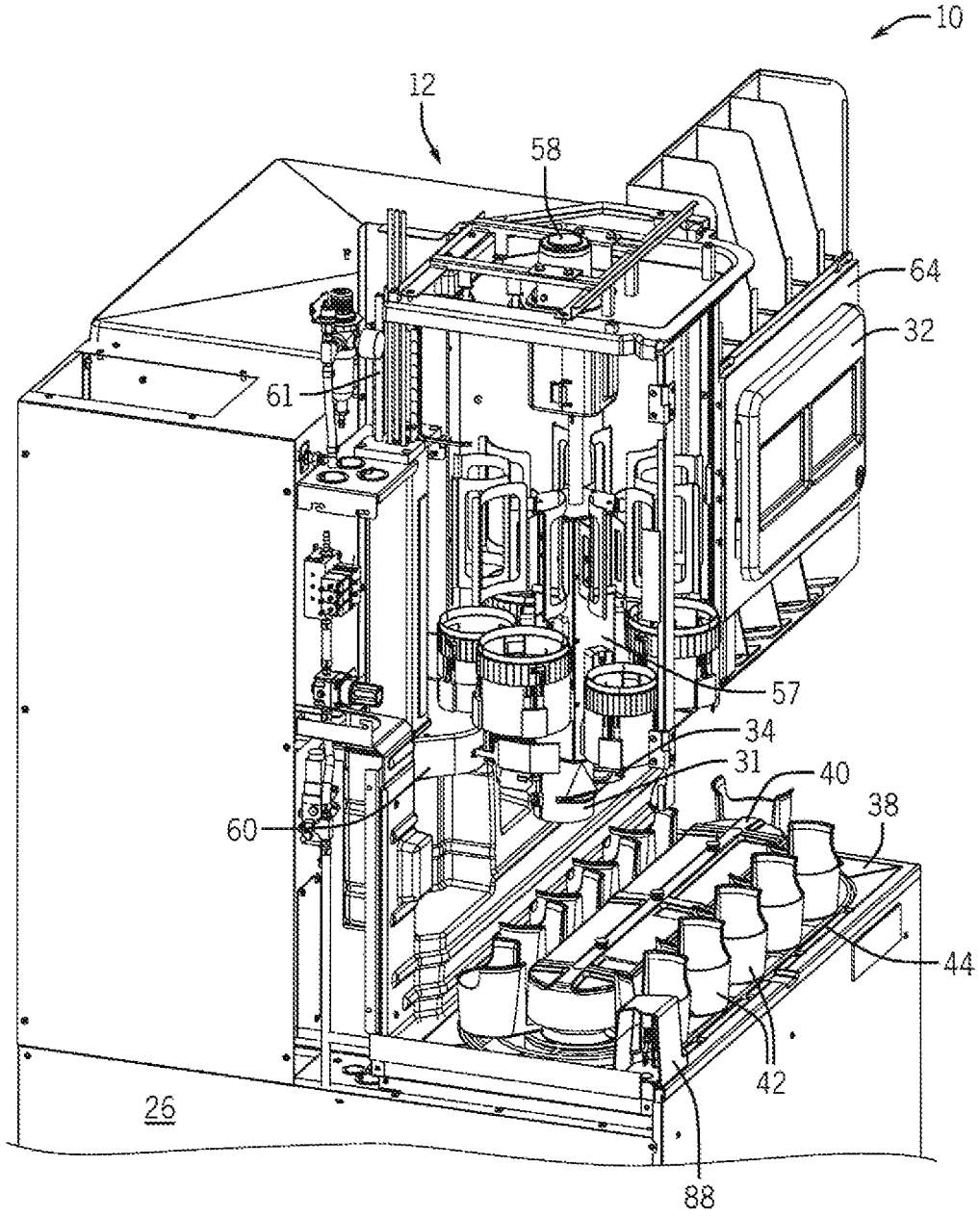


FIG. 13

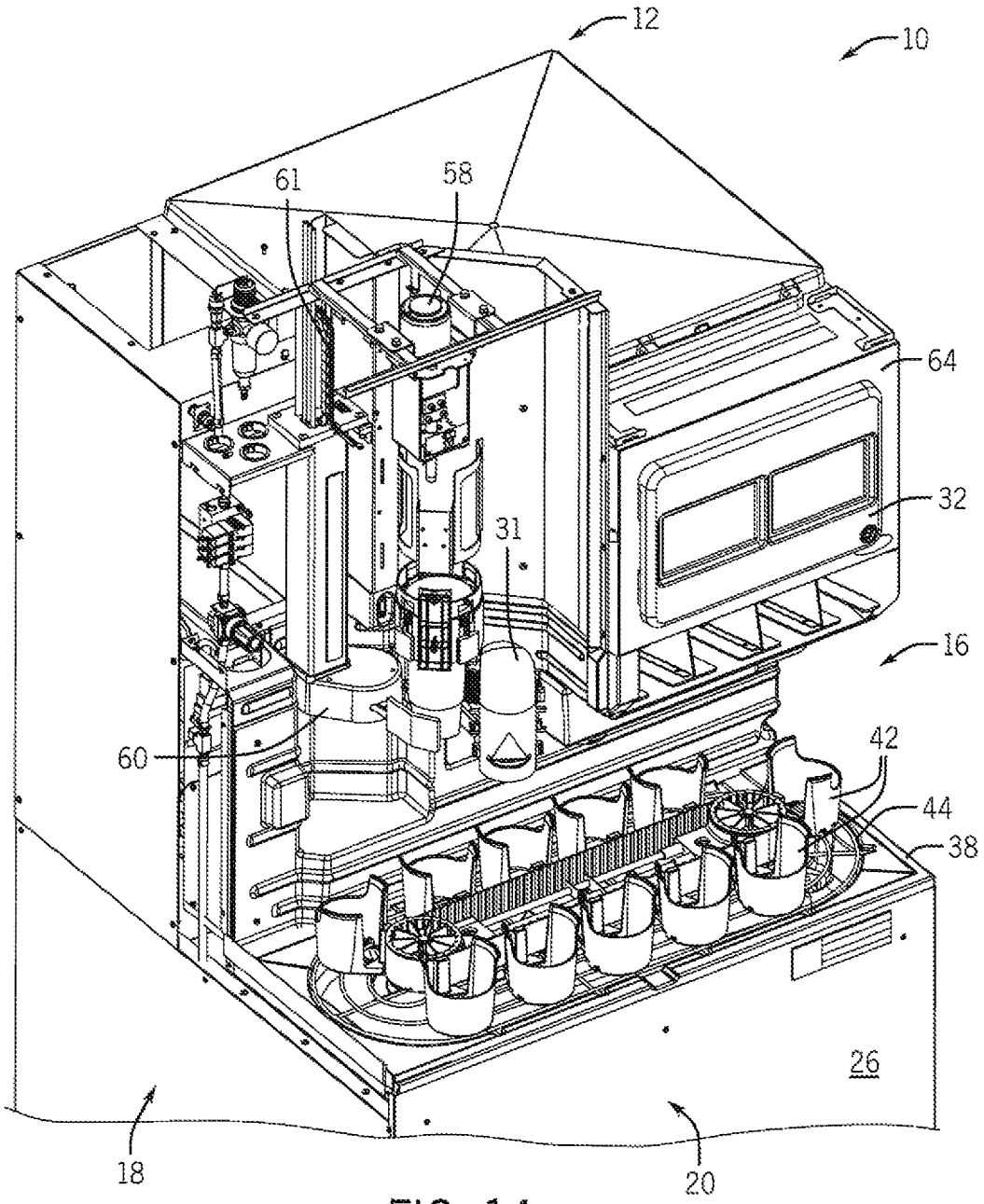


FIG. 14

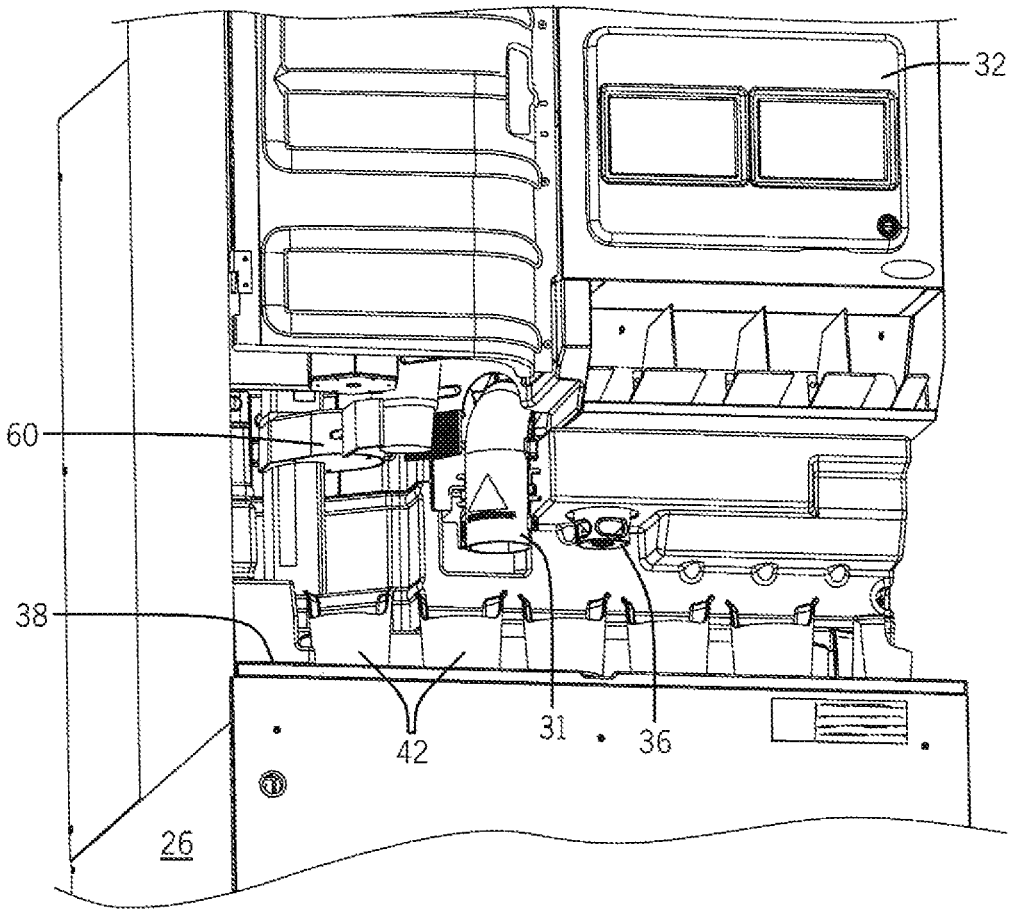


FIG. 15

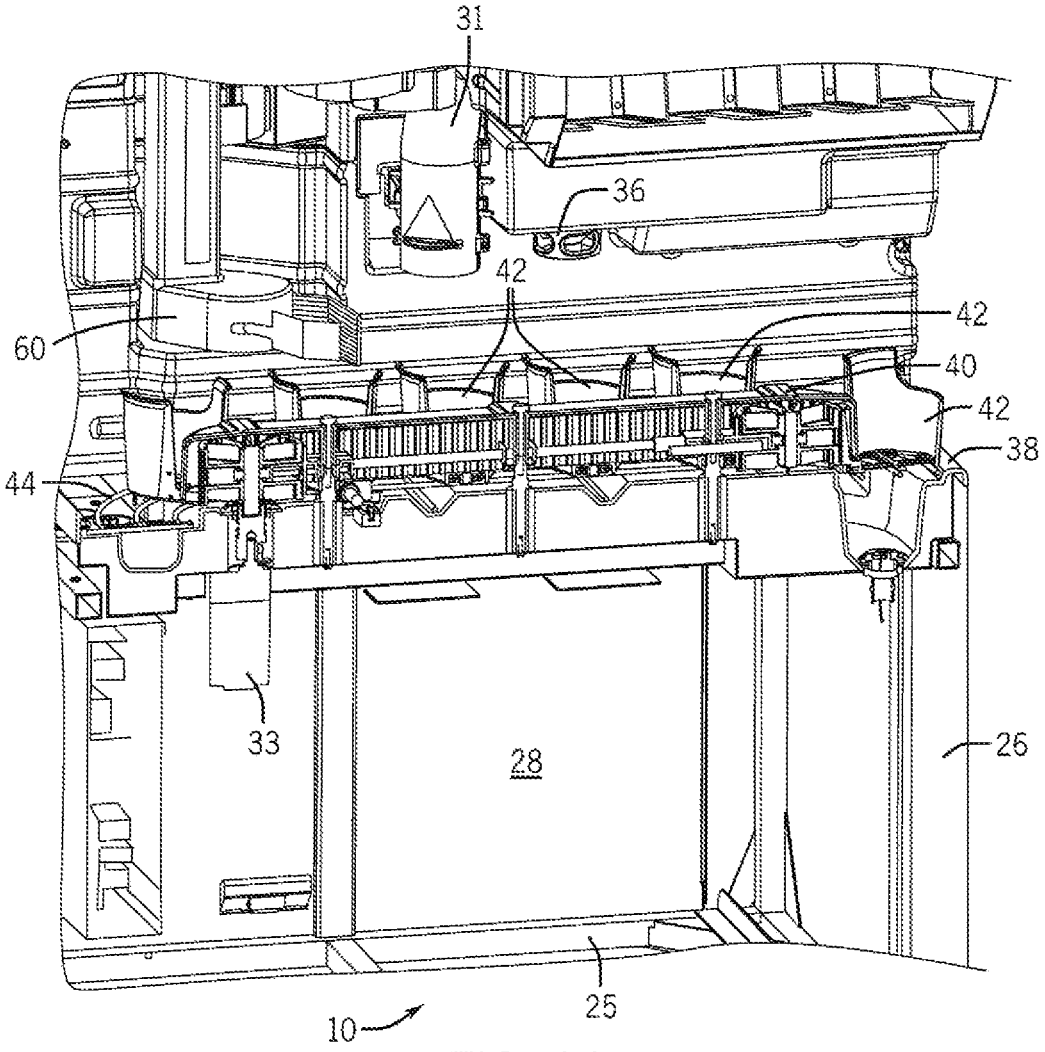


FIG. 16

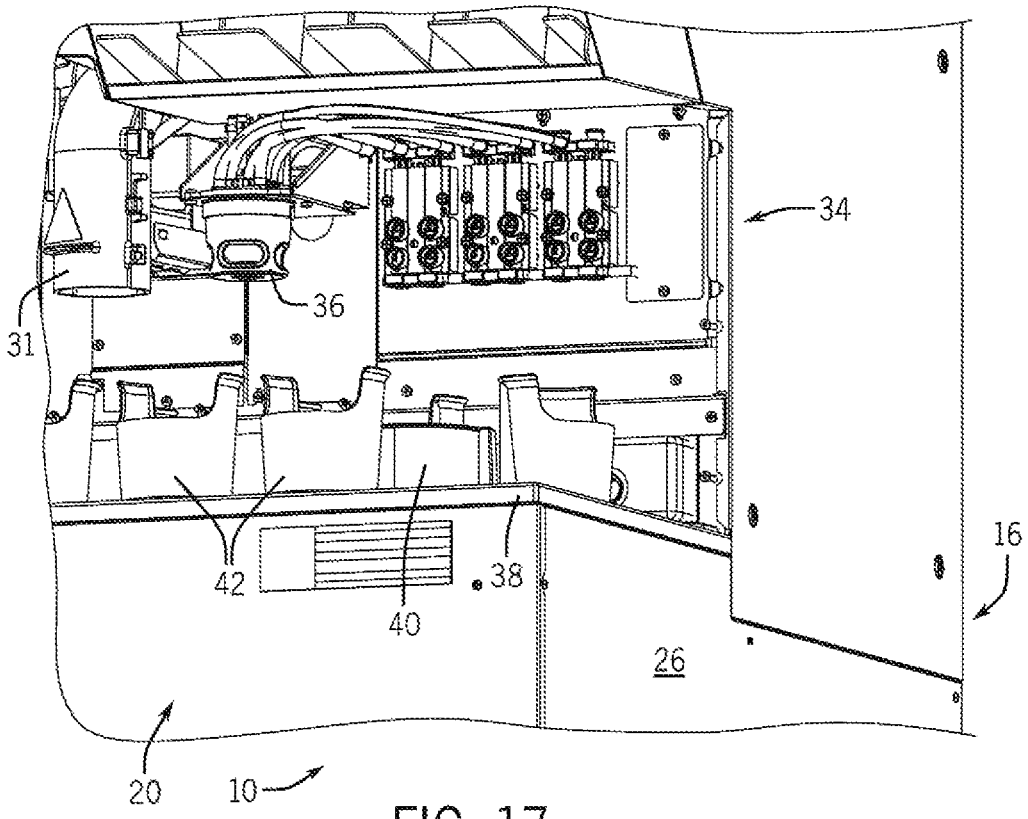


FIG. 17

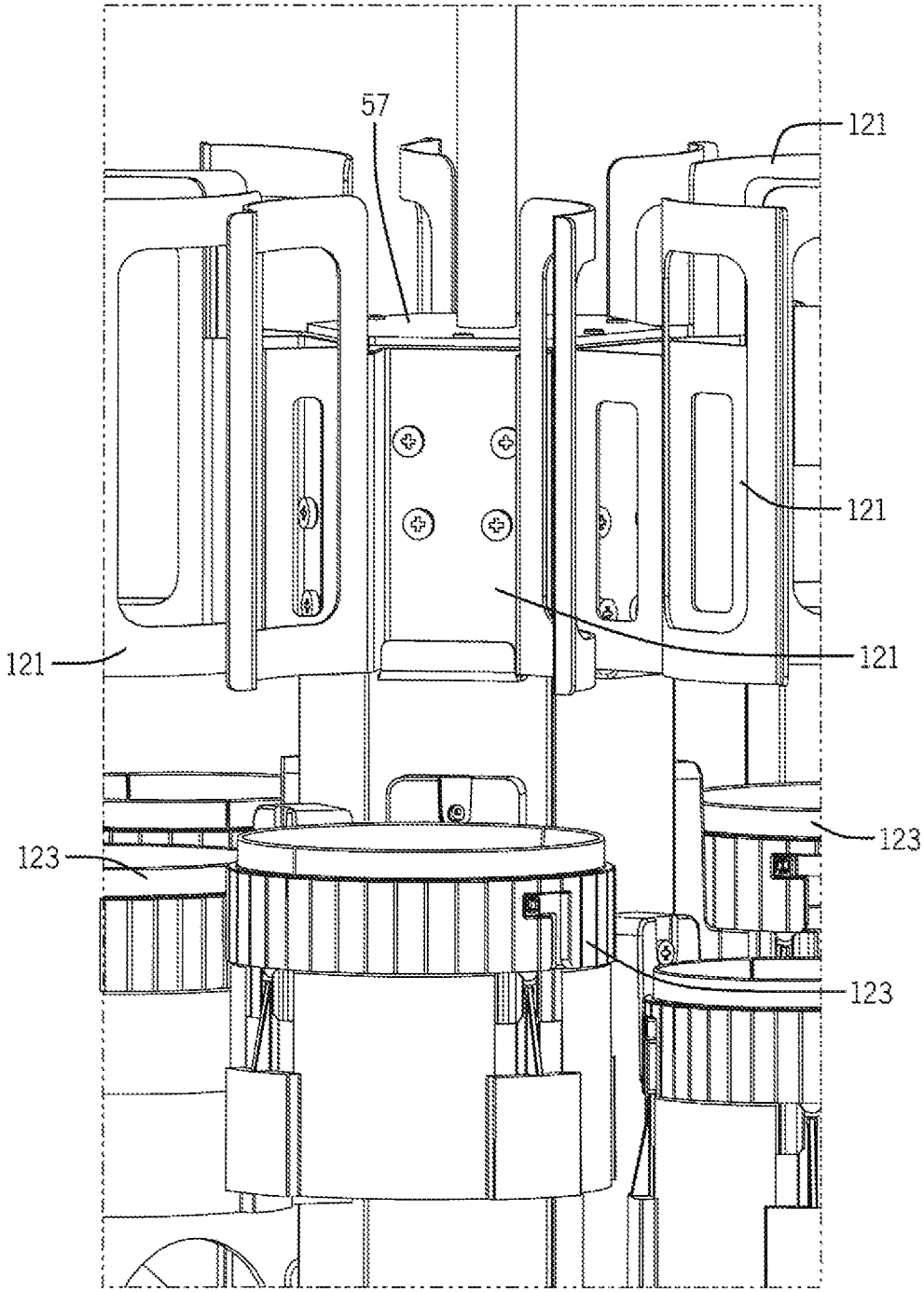


FIG. 18

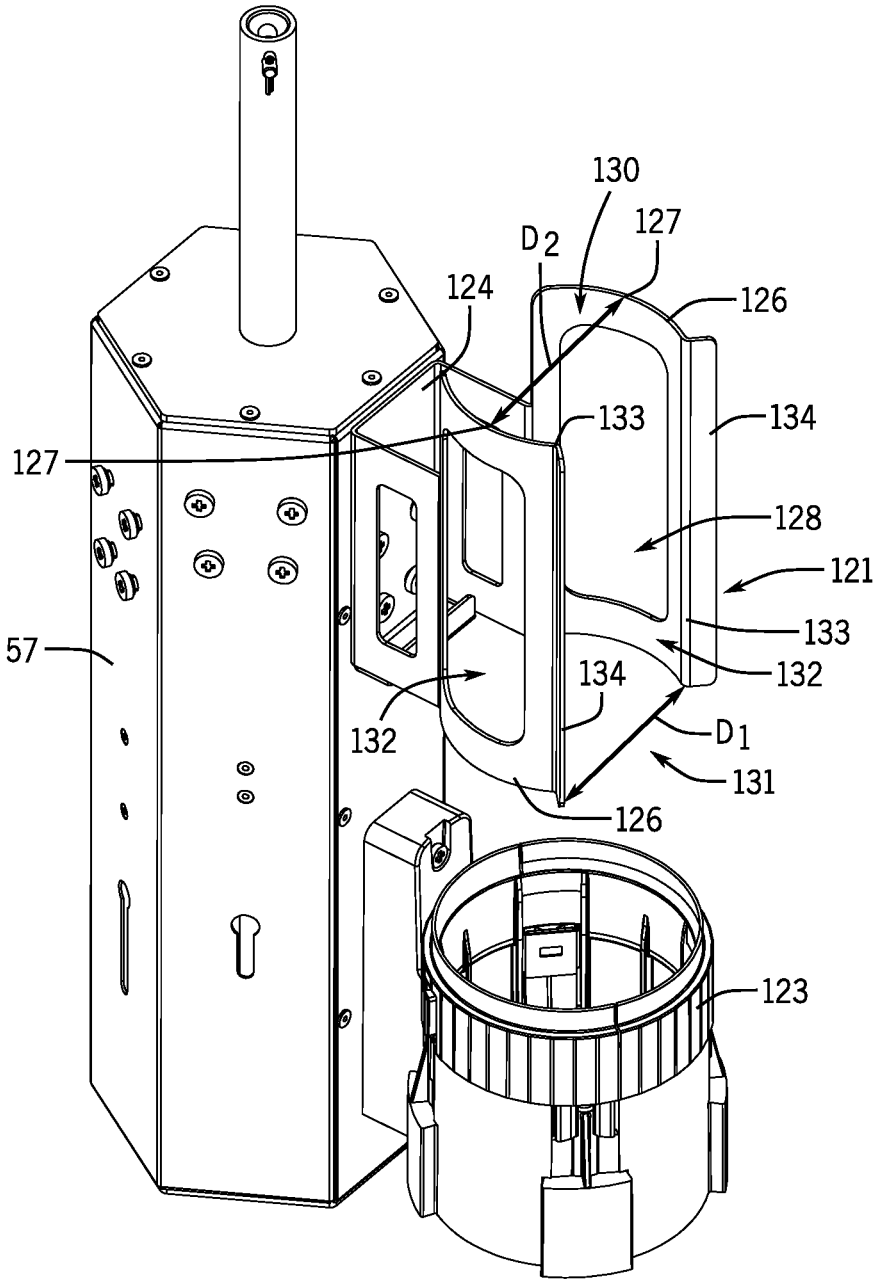

130
127
D2
124
126
133
134
127
128
121
133
57
134
132
132
D1
131
126
123

FIG. 19

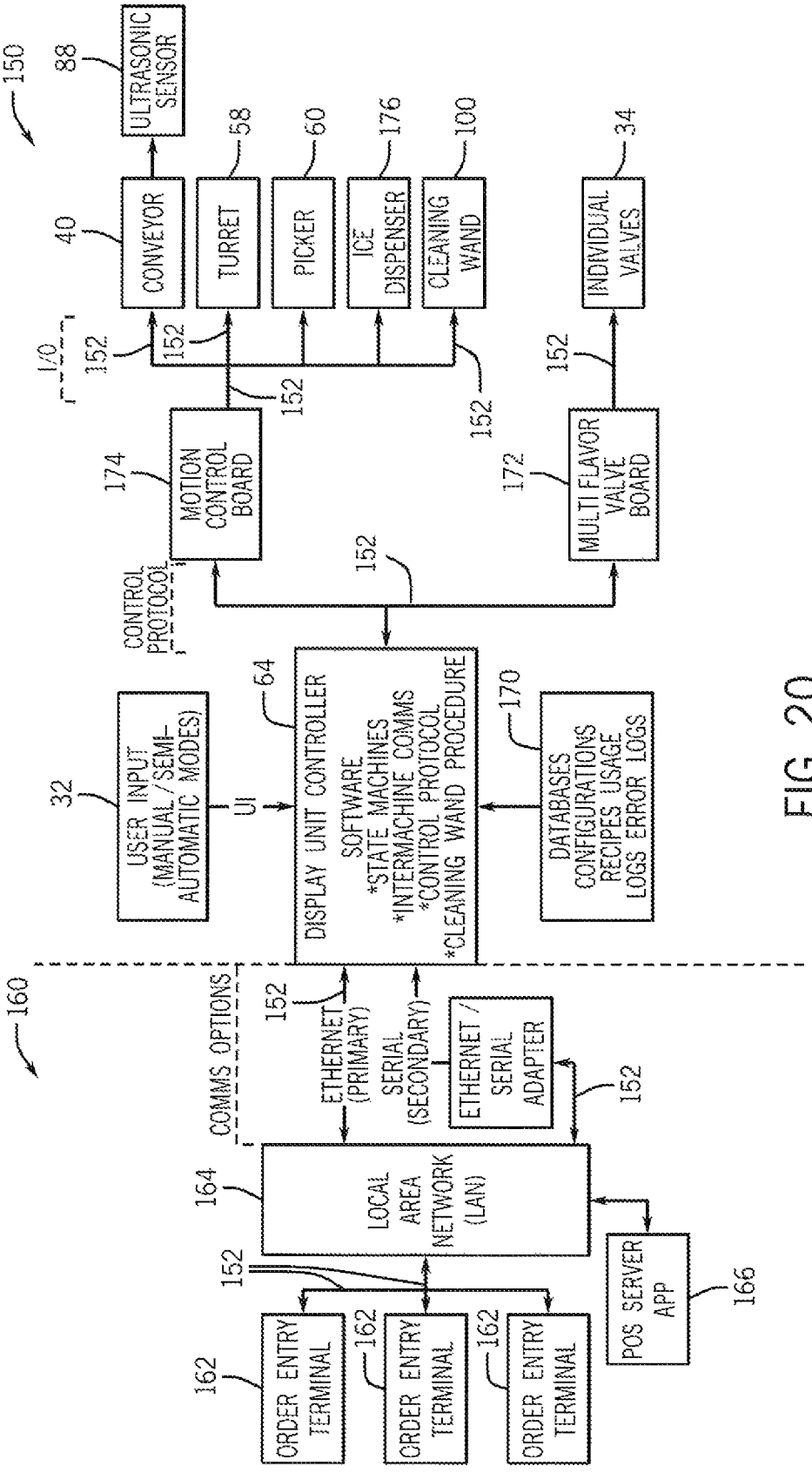

150
88
ULTRASONIC SENSOR
40
CONVEYOR
58
TURRET
60
PICKER
176
ICE DISPENSER
100
CLEANING WAND
34
INDIVIDUAL VALVES
I/O
152
174
MOTION CONTROL BOARD
172
MULTI FLAVOR VALVE BOARD
CONTROL PROTOCOL
64
DISPLAY UNIT CONTROLLER
SOFTWARE
*STATE MACHINES
*INTERMACHINE COMMS
*CONTROL PROTOCOL
*CLEANING WAND PROCEDURE
32
USER INPUT (MANUAL/SEMI-AUTOMATIC MODES)
UI
170
DATABASES
CONFIGURATIONS
RECIPES
USAGE
LOGS
ERROR LOGS
160
COMMS OPTIONS
ETHERNET (PRIMARY)
SERIAL (SECONDARY)
ETHERNET / SERIAL ADAPTER
164
LOCAL AREA NETWORK (LAN)
162
ORDER ENTRY TERMINAL
166
POS SERVER APP

FIG. 20

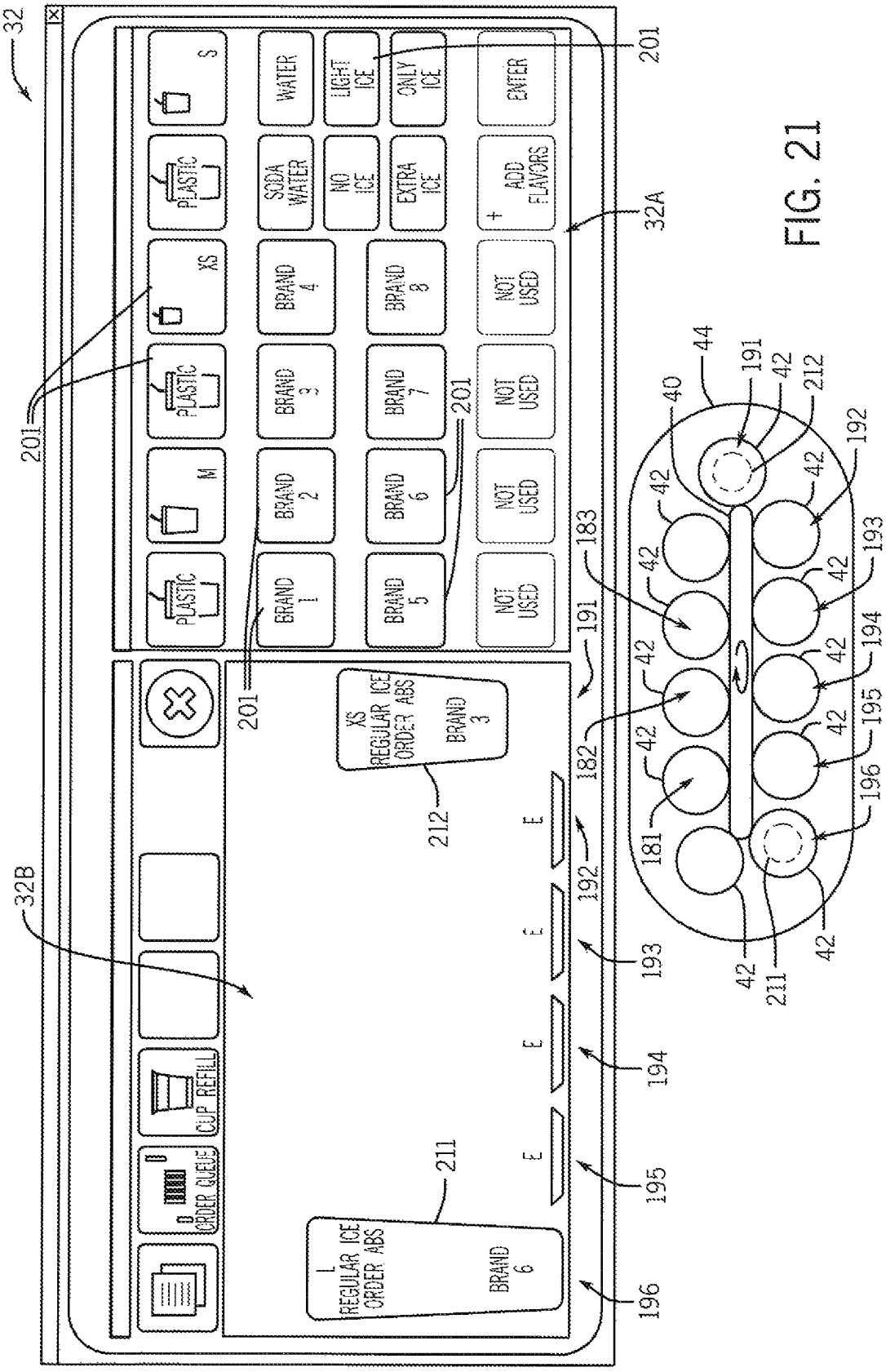
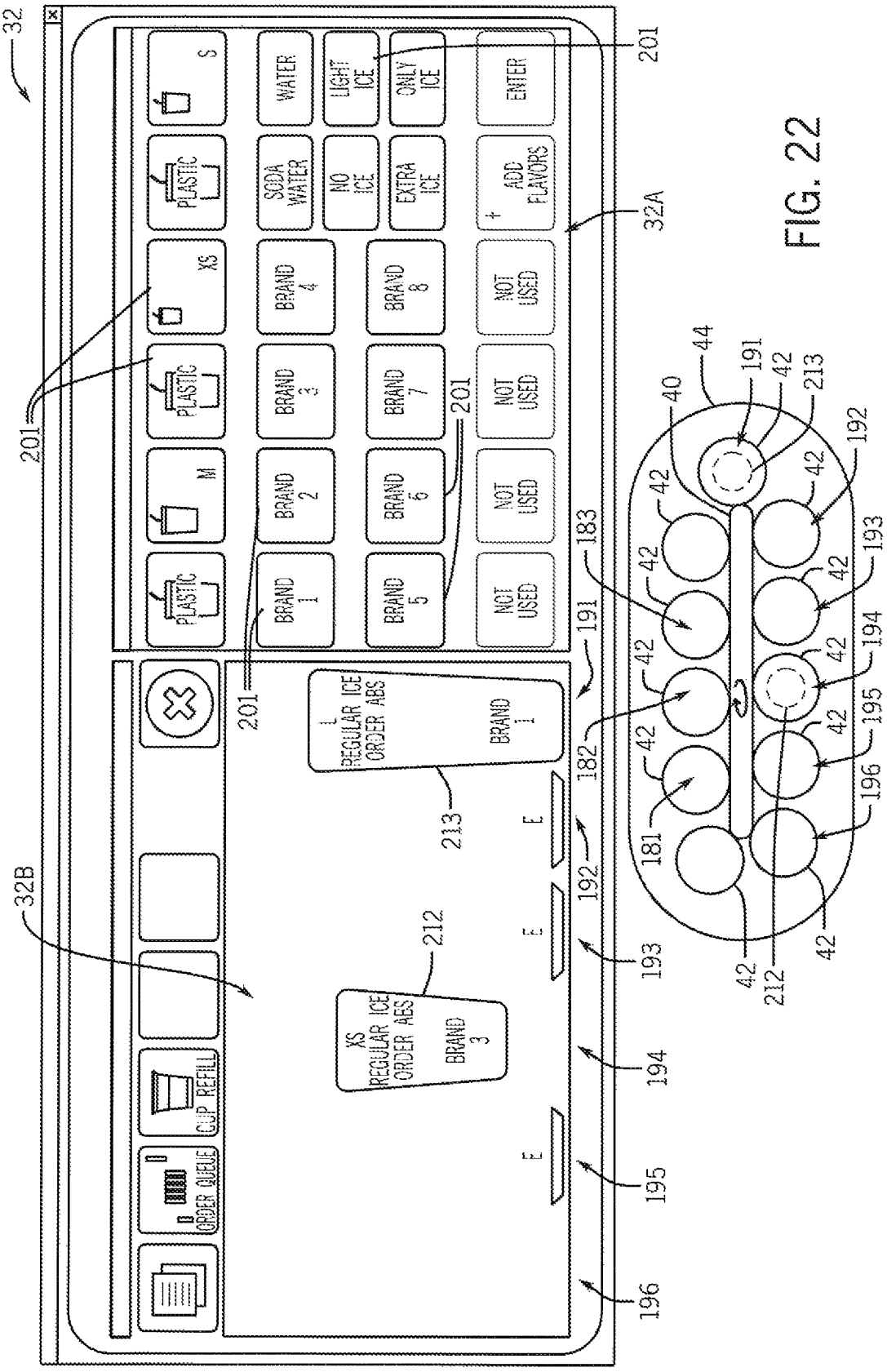

32
201
32A
32B
PLASTIC
M
XS
PLASTIC
S
BRAND 1
BRAND 2
BRAND 3
BRAND 4
BRAND 5
BRAND 6
BRAND 7
BRAND 8
NOT USED
SODA WATER
NO ICE
EXTRA ICE
+ ADD FLAVORS
WATER
LIGHT ICE
ONLY ICE
ENTER
ORDER QUEUE
CUP REFILL
L REGULAR ICE ORDER ABS BRAND 6
XS REGULAR ICE ORDER ABS BRAND 3
211
212
181
182
183
191
192
193
194
195
196
40
42
44

FIG. 21


32
201
32A
32B
PLASTIC
M
XS
PLASTIC
S
BRAND 1
BRAND 2
BRAND 3
BRAND 4
BRAND 5
BRAND 6
BRAND 7
BRAND 8
NOT USED
WATER
SODA WATER
NO ICE
EXTRA ICE
LIGHT ICE
ONLY ICE
ADD FLAVORS
ENTER
ORDER QUEUE
CUP REFILL
L REGULAR ICE ORDER ABS
BRAND 1
XS REGULAR ICE ORDER ABS
BRAND 3
183
191
182
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181
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FIG. 22

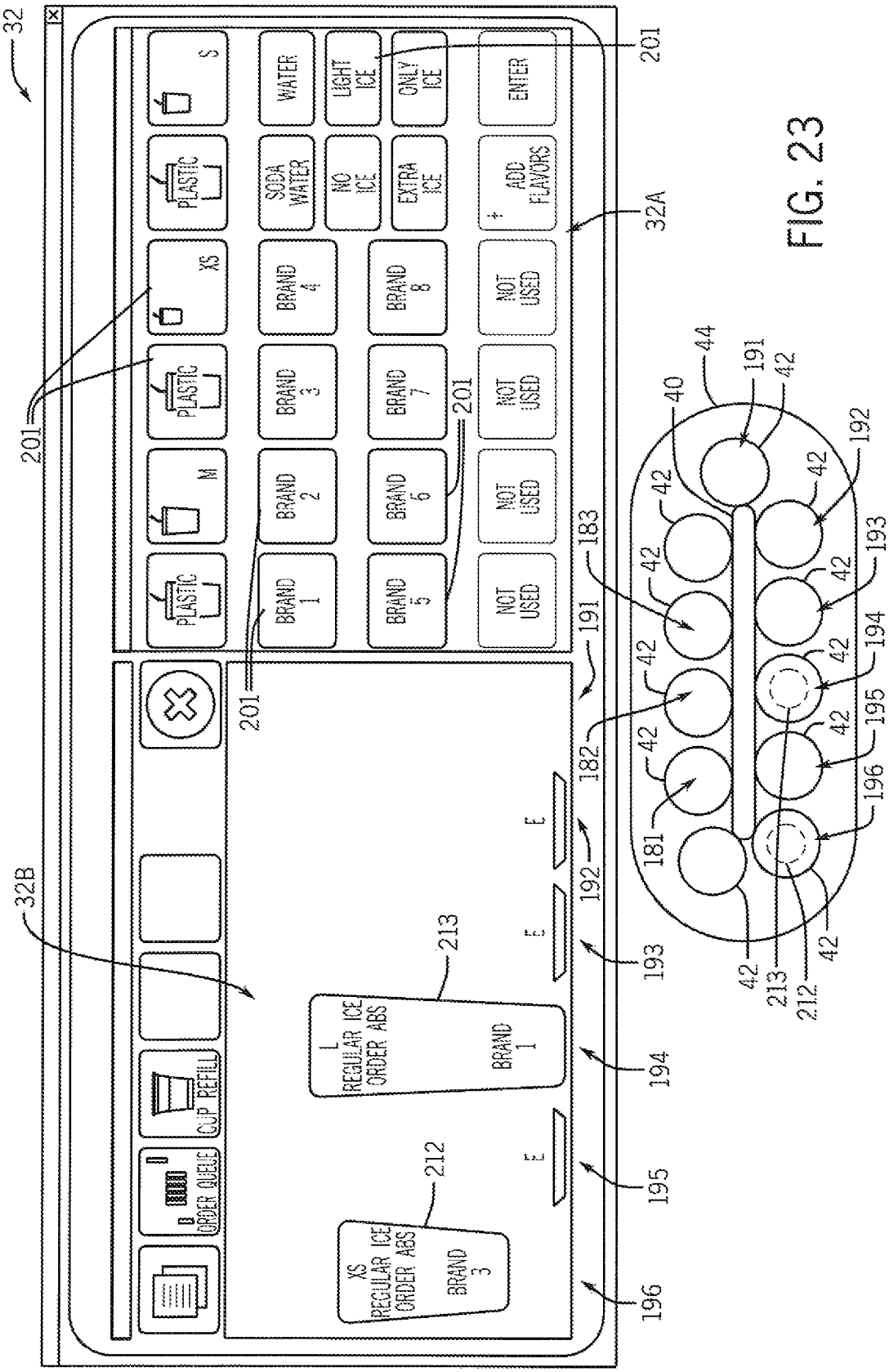
32
32A
32B
201
PLASTIC
S
XS
M
WATER
LIGHT ICE
ONLY ICE
SODA WATER
NO ICE
EXTRA ICE
ADD FLAVORS
ENTER
BRAND 1
BRAND 2
BRAND 3
BRAND 4
BRAND 5
BRAND 6
BRAND 7
BRAND 8
NOT USED
183
191
182
192
193
194
195
196
181
213
212
ORDER QUEUE
CUP REFILL
L REGULAR ICE ORDER ABS
XS REGULAR ICE ORDER ABS
E
40
42
44

FIG. 23

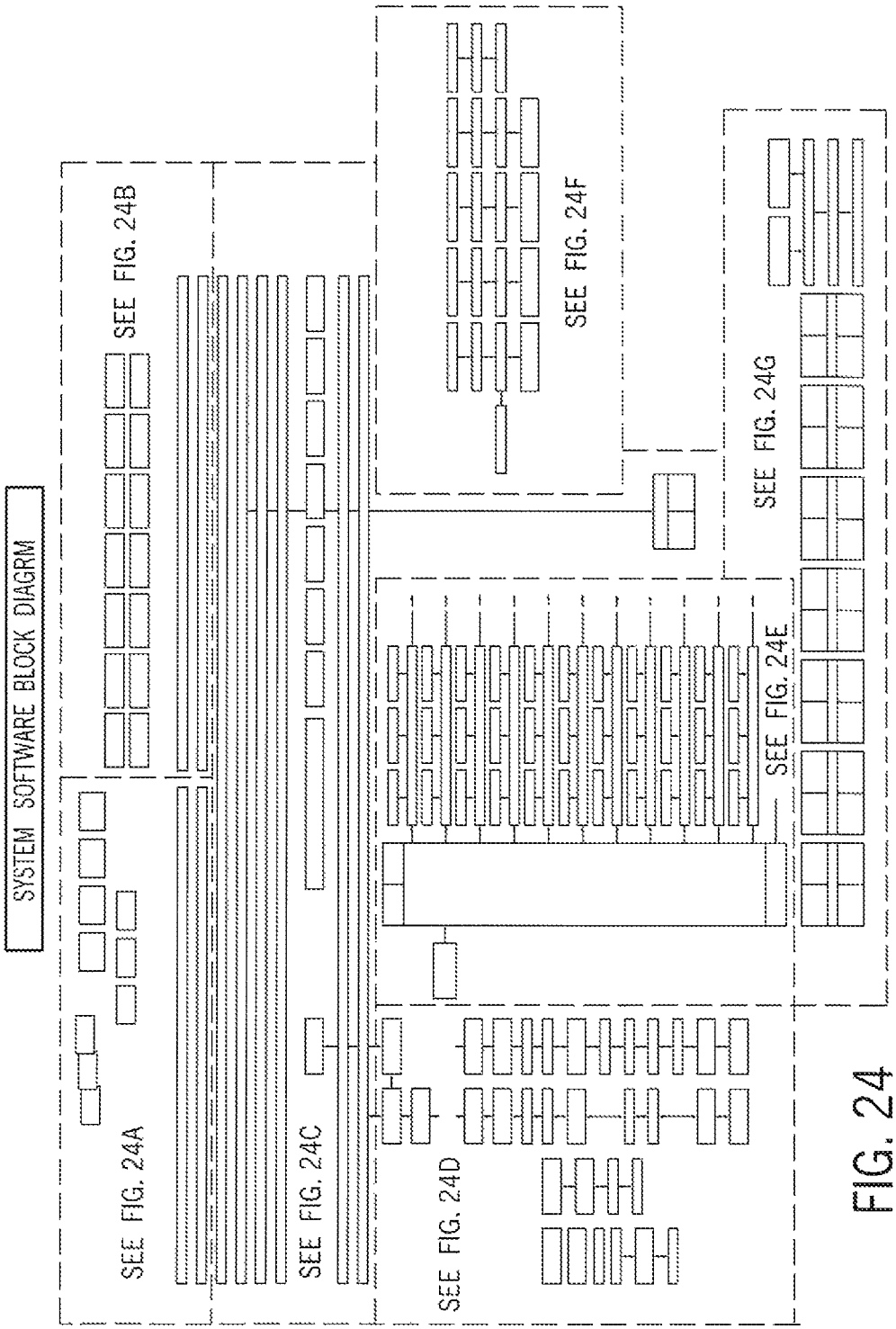
SYSTEM SOFTWARE BLOCK DIAGRM
SEE FIG. 24A
SEE FIG. 24B
SEE FIG. 24C
SEE FIG. 24D
SEE FIG. 24E
SEE FIG. 24F
SEE FIG. 24G

FIG. 24

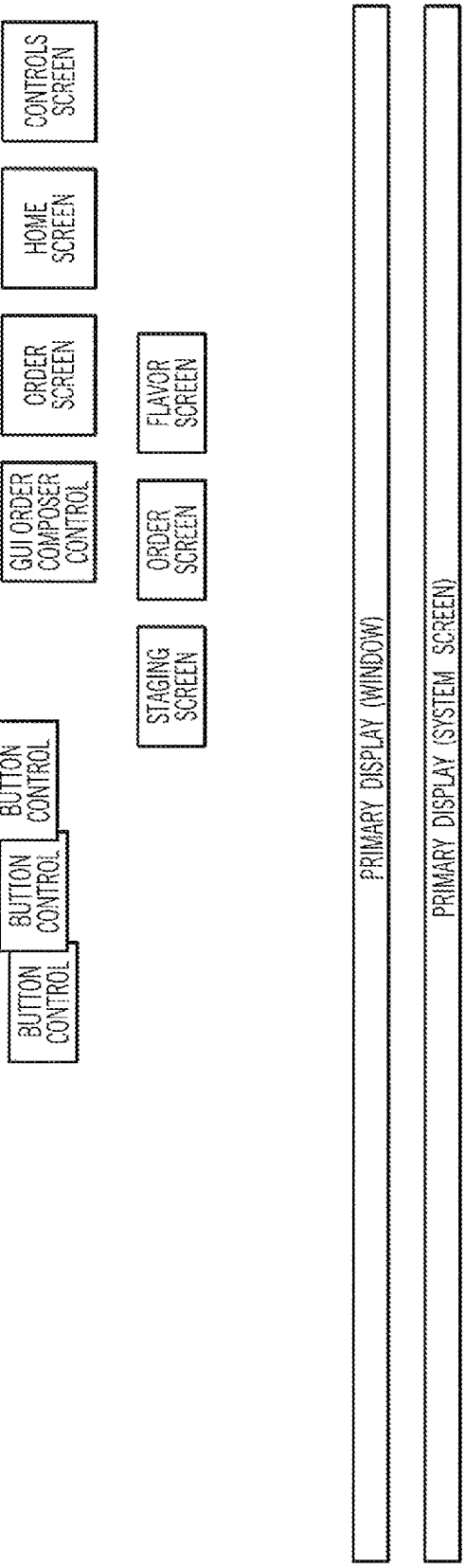
PRIMARY DISPLAY (WINDOW)
PRIMARY DISPLAY (SYSTEM SCREEN)
BUTTON CONTROL
BUTTON CONTROL
BUTTON CONTROL
STAGING SCREEN
ORDER SCREEN
FLAVOR SCREEN
GUI ORDER COMPOSER CONTROL
ORDER SCREEN
HOME SCREEN
CONTROLS SCREEN

FIG. 24A

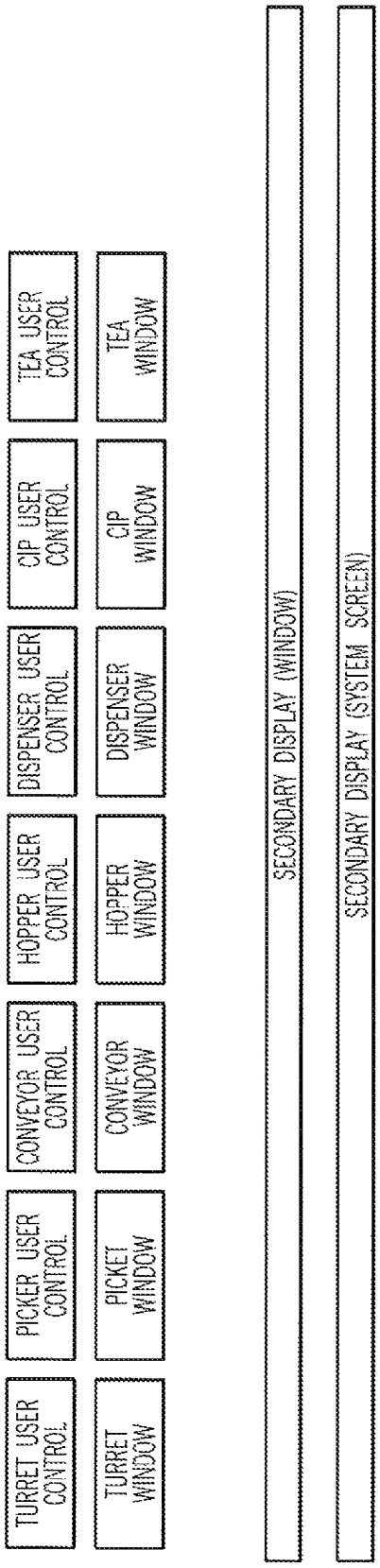
TURRET USER CONTROL
TURRET WINDOW
PICKER USER CONTROL
PICKET WINDOW
CONVEYOR USER CONTROL
CONVEYOR WINDOW
HOPPER USER CONTROL
HOPPER WINDOW
DISPENSER USER CONTROL
DISPENSER WINDOW
CIP USER CONTROL
CIP WINDOW
TEA USER CONTROL
TEA WINDOW
SECONDARY DISPLAY (WINDOW)
SECONDARY DISPLAY (SYSTEM SCREEN)

FIG. 24B

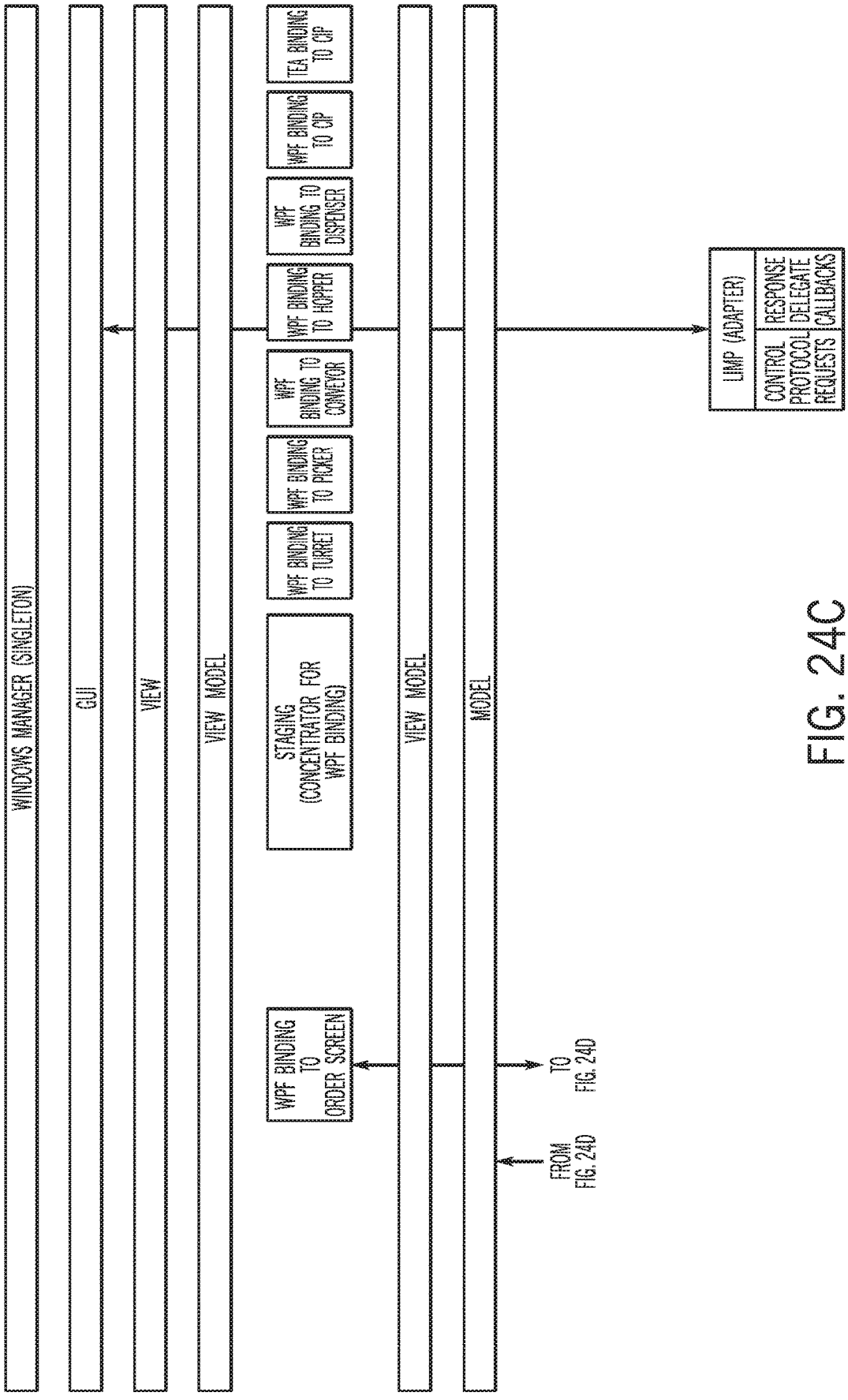
WINDOWS MANAGER (SINGLETON)
GUI
VIEW
VIEW MODEL
STAGING (CONCENTRATOR FOR WPF BINDING)
WPF BINDING TO TURRET
WPF BINDING TO PICKER
WPF BINDING TO CONVEYOR
WPF BINDING TO HOPPER
WPF BINDING TO DISPENSER
WPF BINDING TO CIP
TEA BINDING TO CIP
VIEW MODEL
MODEL
LIMP (ADAPTER)
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACKS
WPF BINDING TO ORDER SCREEN
FROM FIG. 24D
TO FIG. 24D

FIG. 24C

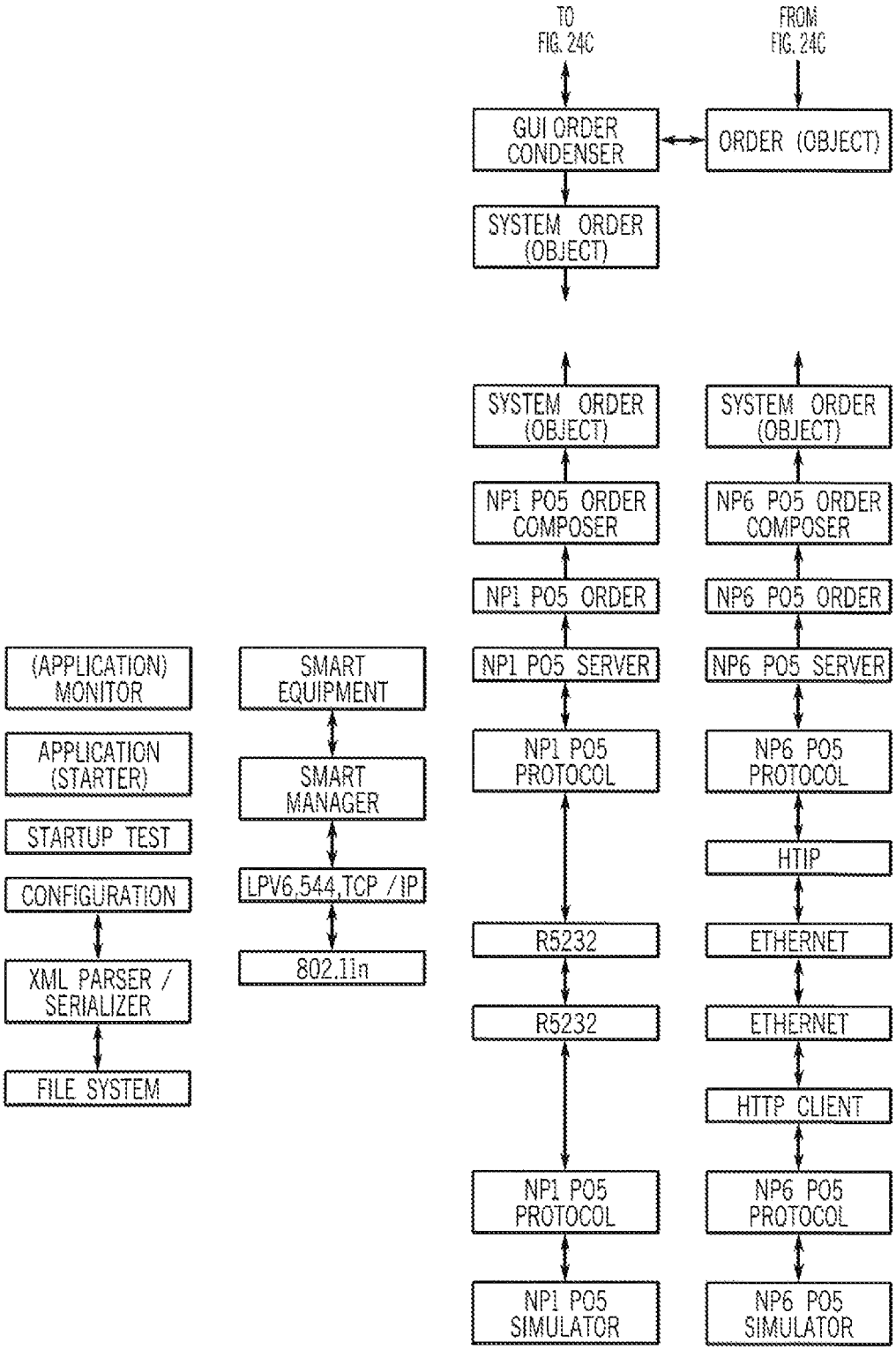
TO FIG. 24C
FROM FIG. 24C
GUI ORDER CONDENSER
ORDER (OBJECT)
SYSTEM ORDER (OBJECT)
SYSTEM ORDER (OBJECT)
SYSTEM ORDER (OBJECT)
NP1 P05 ORDER COMPOSER
NP6 P05 ORDER COMPOSER
NP1 P05 ORDER
NP6 P05 ORDER
NP1 P05 SERVER
NP6 P05 SERVER
NP1 P05 PROTOCOL
NP6 P05 PROTOCOL
HTIP
R5232
ETHERNET
R5232
ETHERNET
HTTP CLIENT
NP1 P05 PROTOCOL
NP6 P05 PROTOCOL
NP1 P05 SIMULATOR
NP6 P05 SIMULATOR
(APPLICATION) MONITOR
APPLICATION (STARTER)
STARTUP TEST
CONFIGURATION
XML PARSER / SERIALIZER
FILE SYSTEM
SMART EQUIPMENT
SMART MANAGER
LPV6,544,TCP /IP
802.11n

FIG. 24D

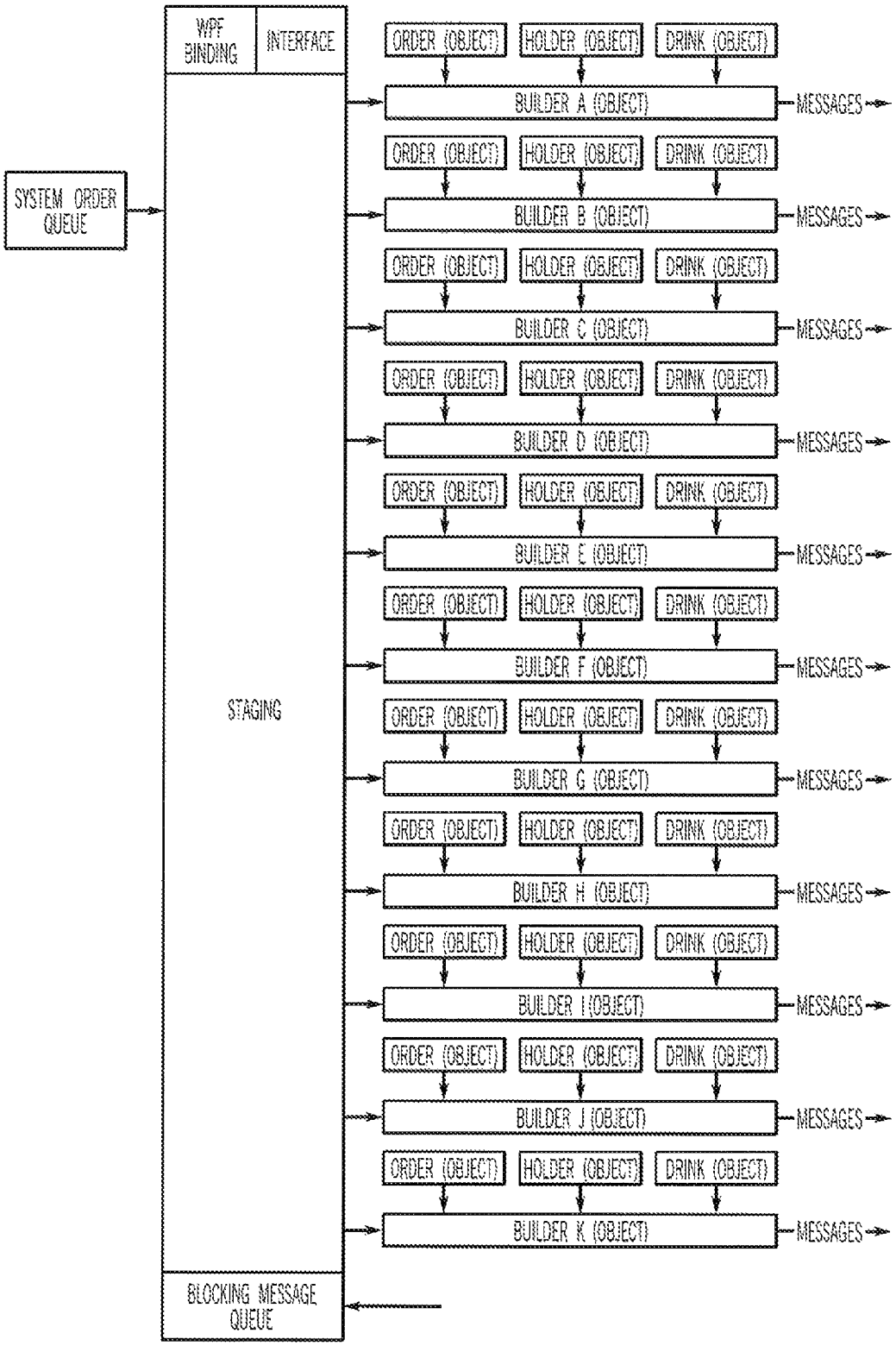
WPF BINDING
INTERFACE
SYSTEM ORDER QUEUE
STAGING
BLOCKING MESSAGE QUEUE
ORDER (OBJECT)
HOLDER (OBJECT)
DRINK (OBJECT)
BUILDER A (OBJECT)
BUILDER B (OBJECT)
BUILDER C (OBJECT)
BUILDER D (OBJECT)
BUILDER E (OBJECT)
BUILDER F (OBJECT)
BUILDER G (OBJECT)
BUILDER H (OBJECT)
BUILDER I (OBJECT)
BUILDER J (OBJECT)
BUILDER K (OBJECT)
MESSAGES

FIG. 24E

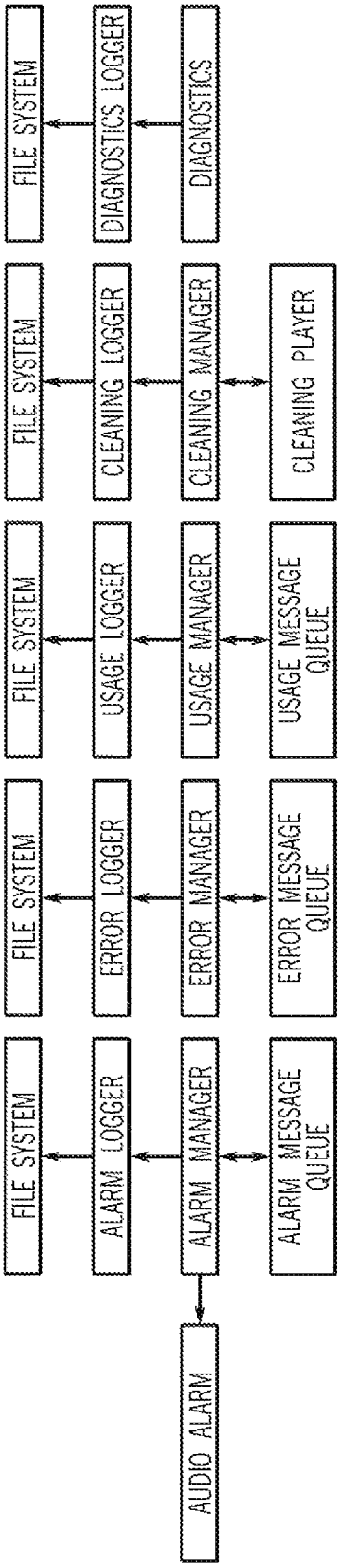
FILE SYSTEM
ALARM LOGGER
ALARM MANAGER
ALARM MESSAGE QUEUE
AUDIO ALARM
FILE SYSTEM
ERROR LOGGER
ERROR MANAGER
ERROR MESSAGE QUEUE
FILE SYSTEM
USAGE LOGGER
USAGE MANAGER
USAGE MESSAGE QUEUE
FILE SYSTEM
CLEANING LOGGER
CLEANING MANAGER
CLEANING PLAYER
FILE SYSTEM
DIAGNOSTICS LOGGER
DIAGNOSTICS

FIG. 24F

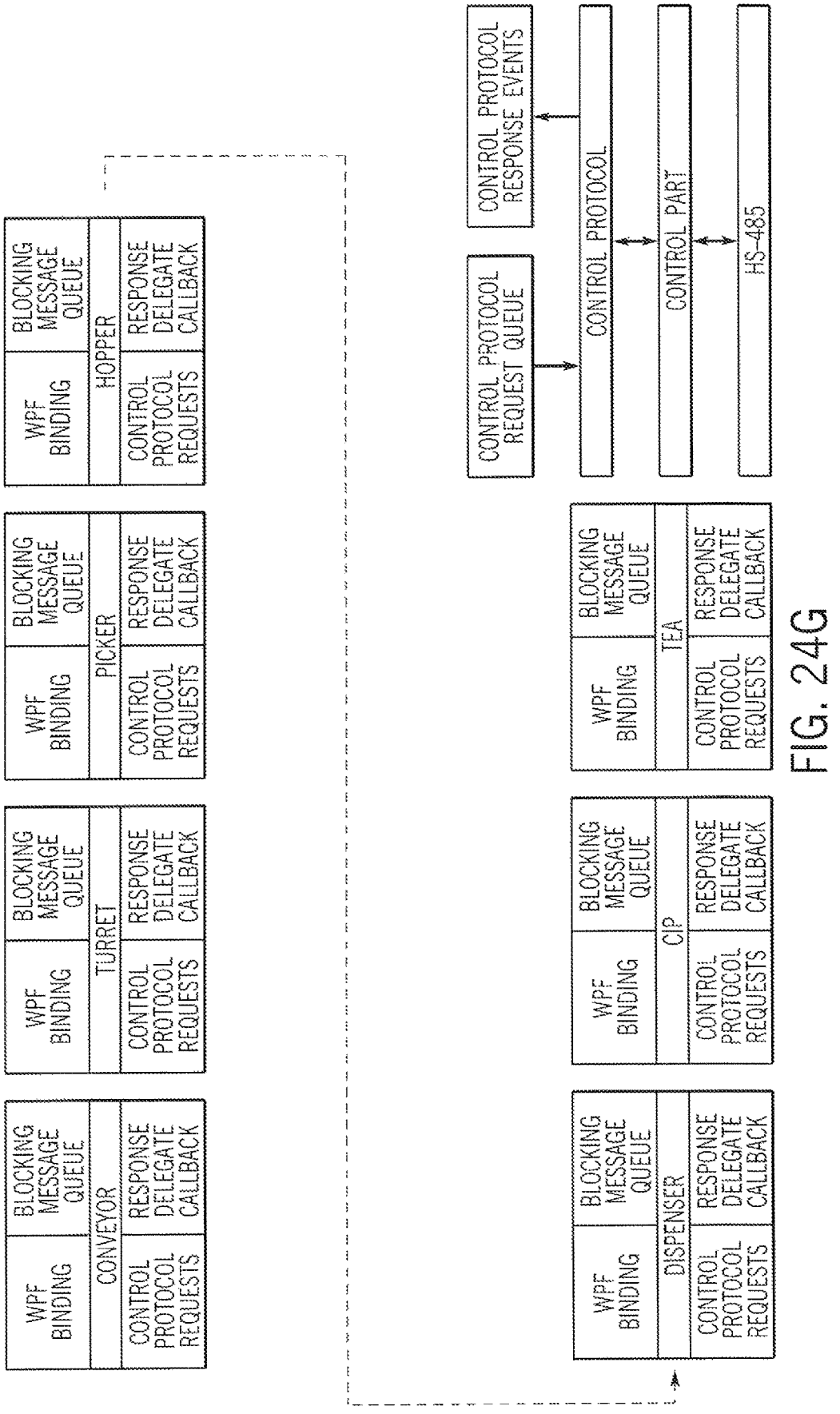
WPF BINDING
BLOCKING MESSAGE QUEUE
CONVEYOR
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
TURRET
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
PICKER
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
HOPPER
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
DISPENSER
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
CIP
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
WPF BINDING
BLOCKING MESSAGE QUEUE
TEA
CONTROL PROTOCOL REQUESTS
RESPONSE DELEGATE CALLBACK
CONTROL PROTOCOL REQUEST QUEUE
CONTROL PROTOCOL
CONTROL PART
HS-485
CONTROL PROTOCOL RESPONSE EVENTS

FIG. 24G

AUTOMATED BEVERAGE DISPENSING MACHINES

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on and claims priority to U.S. Provisional Patent Application Ser. No. 62/516,356 filed Jun. 7, 2017, the disclosure of which is incorporated herein by reference.

FIELD

The present disclosure relates to beverage dispensing machines, and particularly to automated beverage dispensing machines for automatically selecting, placing and dispensing a beverage to a cup.

BACKGROUND

The following U.S. Patents are incorporated herein by reference:

U.S. Pat. Nos. 6,102,246 and 6,053,359 disclose an automated system for preparing and delivering post-mix beverages in response to one or more drink orders being entered from a remote point of sale unit or a local keypad and including: a post-mix beverage preparation assembly for dispensing ice and a selected post-mix beverage into a cup; an oblong carousel type conveyor assembly including a plurality of upwardly open cup holders which are driven by a motor driven belt so as to pass beneath a cup dispensing station, an ice dispensing station, a beverage dispensing station, and a plurality of pick-up stations; a cup storage and dispenser assembly including a bi-directionally rotatable tower upon which is mounted a plurality of different sized cup supply tubes for holding a respective stack of beverage cups; and a pneumatic vertically driven cup gripper/extractor mechanism having a pair of pneumatically operated gripper arms which operate to remove a cup from a selected supply tube on the tower and place the extracted cup into an empty cup holder which is then transported past the dispensing stations and then to a pick-up station on the conveyor for manual removal by an attendant.

U.S. Pat. No. 9,045,323 discloses a process for dispensing a beverage into a cup comprising: providing a dispensing structure; providing a transportation mechanism linked with the dispensing structure; providing a staging structure linked with the transportation structure; providing a control system linked with the dispensing structure, staging structure and the transportation mechanism; providing a sensor mechanism linked with the control system, the sensor mechanism providing signals indicating the position of a cup; providing a cup identification system having an interactive display connected to the control system; picking a cup from a storage device and positioning it within a dispensing structure; dispensing ice and a beverage at separate locations within the dispensing structure; transporting the filled beverage to a staging structure; positioning the filled cup in the staging structure; and removing the filled cup from the staging structure for sale to a customer wherein the cup identification system and the display outputs visual characteristics indicating the position and characteristics of a cup at every stage of the process.

U.S. Pat. No. 9,204,734 discloses a cup storage device that includes a tube having opposing dispensing and terminal ends and inner and outer surfaces that define an inner volume. The inner volume receives cups stacked upon each other and stores them. The cup storage device includes a plurality of resilient cup restraining members disposed on the inner surface of the tube at the dispensing end. The cup restraining members extend from a mounting end proximate the inner surface of the tube to a contact end. A guide structure is positioned on the inner surface of the tube. The guide structure defines a recess. The contact ends of the plurality of cup restraining members are disposed within the recess.

U.S. Pat. No. 9,227,830 discloses an automated beverage dispenser for dispensing a beverage and ice into a cup. The automated beverage dispenser may include an ice dispensing station with an ice auger and a weight sensor, a beverage dispensing station, and a control device. The control device instructs the ice auger to fill the cup with a predetermined amount of ice and instructs the beverage dispensing station to fill the cup with a predetermined amount of the beverage in response to a weight of the cup as determined by the weight sensor.

U.S. Pat. No. 9,327,958 discloses an automated beverage dispenser for use with a number of cups. The automated beverage dispenser may include a carousel with a number of shelves, a first actuator configured to maneuver the shelves in a first direction, a second actuator positioned adjacent to the carousel, and a gripper positioned on the second actuator such that the second actuator is configured to maneuver one of the cups by the gripper in a second direction to one of the shelves of the carousel.

SUMMARY

This Summary is provided to introduce a selection of concepts that are further described herein below in the Detailed Description. This Summary 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 scope of the claimed subject matter.

A beverage dispensing machine extends from top to bottom in a vertical direction, from right side to left side in a width direction that is perpendicular to the vertical direction, and from front to back in a depth direction that is perpendicular to the vertical direction and perpendicular to the width direction. The beverage dispensing machine includes a countertop that extends in the width direction and in the depth direction. A conveyor is on the countertop and carries a plurality of cup holders around a track. The conveyor has a front side oriented towards the front of the beverage dispensing machine and a back side oriented towards the back of the beverage machine. The front side is accessible by an operator to remove cups from the plurality of cup holders. A cup tower is located above the countertop in the vertical direction. The cup tower has a plurality of cup dispenser tubes that are each configured to hold a respective stack of cups. The cup tower is rotatable about a vertical cup tower axis. A cup grabber is located above the countertop and adjacent to the cup tower and between the back side of the track and the back of the beverage dispensing machine. The cup grabber is movable up and down in the vertical direction into and between a raised position in which the cup grabber is positioned to grab a cup from one of the stacks of cups, a lowered position in which the cup grabber is positioned to place a cup into one of the plurality of cup holders, and an intermediate position between the raised and lowered positions wherein the cup grabber is spaced apart from and between the cup tower and the plurality of cup holders in the vertical direction so that the cup tower is free to rotate about

the cup tower axis and the conveyor is free to carry the plurality of cup holders around the track.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front right side perspective view of a first embodiment of a beverage dispensing machine.

FIG. **2** is another front right side perspective view of the beverage dispensing machine shown in FIG. **1**.

FIG. **3** is a front left side perspective view looking down on the beverage dispensing machine shown in FIG. **1**.

FIG. **4** is a front left side perspective view of the beverage dispensing machine shown in FIG. **1**, having a cover on the conveyor removed.

FIG. **5** is a front left side perspective view looking up at the beverage dispensing machine shown in FIG. **1**.

FIG. **6** is a sectional view of the beverage dispensing machine shown in FIG. **1** and showing a conveyor for conveying a plurality of cup holders around a track.

FIG. **7** is a front right side perspective view looking up at dispensing valves on the beverage dispensing machine shown in FIG. **1**.

FIG. **8** is a detailed view of the connection between a cup holder and a conveyor belt and showing one cup holder removed from the belt.

FIG. **9** is another detailed view of the connection.

FIG. **10** depicts a clean in place system for the beverage dispensing machine shown in FIG. **1**.

FIG. **11** is a front right side perspective view of another embodiment of the beverage dispensing machine

FIG. **12** is another front right side perspective view of the beverage dispensing machine shown in FIG. **11**.

FIG. **13** is a front left side perspective view looking down on the beverage dispensing machine shown in FIG. **11**.

FIG. **14** is a front left side perspective view of the beverage dispensing machine shown in FIG. **11**, having a cover on the conveyor removed.

FIG. **15** is a front left side perspective view looking up at the beverage dispensing machine shown in FIG. **11**.

FIG. **16** is a sectional view of the beverage dispensing machine shown in FIG. **11** and showing a conveyor for conveying a plurality of cup holders around a track.

FIG. **17** is a front right side perspective view looking up at dispensing valves on the beverage dispensing machine.

FIG. **18** is a front perspective view of an example cup tower with a plurality of cup dispenser clips.

FIG. **19** is a front perspective view of an example cup tower with a cup dispenser clip.

FIG. **20** depicts a schematic diagram of an example control system.

FIGS. **21-23** depict an example operational sequence of the beverage dispensing machine with a front view of a user interface and a schematic view of the conveyor and the cup holders.

FIG. **24** is an example system software block diagram according to the present disclosure.

FIGS. **24A-24G** depict the details of the system software block diagram of FIG. **24**.

DETAILED DESCRIPTION OF THE DRAWINGS

The present disclosure arose during research and development efforts to improve upon the beverage dispensing apparatuses disclosed in the above-incorporated U.S. Patents, and particularly U.S. Pat. Nos. 6,102,246 and 6,053,359.

FIGS. **1-7** depict a first embodiment of a beverage dispensing machine **10** for dispensing a post-mix beverage according to the present disclosure. The beverage dispensing machine **10** extends from top **12** to bottom **14** in a vertical direction V and from right side **16** to left side **18** in a width direction W, which is perpendicular to the vertical direction V. The beverage dispensing machine **10** further extends from a front **20** to a back **22** in the depth direction D, which is perpendicular to the vertical direction V and perpendicular to the width direction W.

The particular configuration of the beverage dispensing machine **10** can vary from that which is shown. In the illustrated example, the beverage dispensing machine **10** is supported with respect to the ground by a plurality of legs **24** and has an inner framework **25** that is covered by an outer cladding or housing **26**. Generally, the beverage dispensing machine **10** includes a lower compartment **28** (FIG. **6**) that houses storage space and certain refrigeration components and/or related electrical connections, as is conventional. The beverage dispensing machine **10** further includes an upper compartment **30** that houses an ice bin and associated cold plate for retaining and supplying ice to an ice chute and dispenser **31**, all as is conventional. A plurality of dispensing valves **34** (FIG. **7**) are located adjacent the ice bin and cold plate, above the lower compartment **28**, and are configured to control flow of beverage or beverage components that are dispensed via a common dispensing nozzle **36**. The type and configuration of the dispensing valves **34** and dispensing nozzle **36** can vary and for example can include the dispensing valves and dispensing nozzle disclosed in the above incorporated U.S. patents. In certain examples, interlock switches (not shown) are positioned at the ice bin lid, ice chute, and/or door **51** to thereby sense the operational state of each of these components (e.g. open or closed). Based on the state of the interlock switches the operation of the beverage dispensing machine **10** can be stopped. For example, if an interlock switch is open indicating that the door **51** is ajar, the beverage dispensing machine **10** does not operate.

The beverage dispensing machine **10** includes a countertop **38** located above the lower compartment **28** and below the ice chute and dispenser **31** and dispensing nozzle **36**. The countertop **38** extends in the width direction W and the depth direction D. A conveyor **40** is located on the countertop **38** and is configured to carry a plurality of cup holders **42** around an oblong track **44** having a front side oriented towards the front **20** of the beverage dispensing machine **10** and a back side oriented towards the back **22** of the beverage dispensing machine **10**. The front side is easily accessible by an operator so that the operator can manually remove cups from the plurality of cup holders **42**, as will be described further herein below. Referring to FIG. **3**, a bi-directional electric motor **33** (FIG. **6**) is connected to the conveyor **40** and configured to move the conveyor **40** around the track **44**, similar to the embodiments described in the above-incorporated U.S. Pat. Nos. 6,102,246 and 6,053,359.

A cup tower **50** is located above the countertop **38**. The cup tower **50** is located between the back side of the track **44** and the back **22** of the beverage dispensing machine **10** with respect to the depth direction D. The cup tower **50** includes a plurality of cup dispenser tubes **52**, which in this example are elongated tubes that are configured to hold respective stacks of cups **54***a*, **54***b*, **54***c*, etc. Each tube **52** can have a retaining structure for temporarily holding the stacks of cups, as is disclosed in the above-incorporated U.S. Pat. No. 9,204,734. The cup tower **50** is rotatable about a vertical cup tower axis via a center mandrel **57** (FIG. **3**) and

a cup tower motor **58**. The cup tower motor **58** can be an electric motor that is configured to rotate the cup tower **50** about the cup tower axis. The cup tower motor **58** is advantageously located above the cup tower **50** in the vertical direction V, apart from any beverage that happens to spill on the countertop **38**. A door **51** encloses the stacks of cups **54** within the cup tower **50**

A cup grabber **60** is located above the countertop **38** and adjacent the cup tower **50** and between the back side of the track **44** and the back **22** of the beverage dispensing machine **10**. The cup grabber **60** is located between the cup tower **50** and the dispensing nozzle **36**. The cup grabber **60** is movable up and down in the vertical direction V into and between a raised position in which the cup grabber **60** is positioned to grab a cup **54** from one of the stacks of cups, a lowered position in which the cup grabber **60** is positioned to place a cup into one of the plurality of cup holders **42**, and an intermediate position in between the raised and lowered positions wherein the cup grabber **60** is spaced apart from and between the cup tower **50** and the plurality of cup holders **42** in the vertical direction V so that the cup tower **50** is free to rotate about the cup tower axis and the conveyor **40** is free to carry the plurality of cup holders **42** around the track **44**. A pneumatic actuator is configured to move the cup grabber **60** up and down along a cup grabber center shaft **61**, into and between the noted lowered, raised, and intermediate positions. Advantageously, the cup grabber motor is located vertically above the cup grabber **60**, apart from any beverage that happens to spill on the countertop **38**. As described in the above-incorporated U.S. Pat. Nos. 6,102,246 and 6,053,359, the cup grabber **60** has a pair of grabber arms that are configured to open and close with respect to each other to grab a cup from the cup tower **50** and then place the cup into the particular cup holder **42** located below the cup grabber **60**.

A computer controller **64** has a processor and a memory and is configured to control the conveyor **40** by controlling operation of the conveyor motor **33**, control rotation of the cup tower **50** about the cup tower axis by controlling operation of the cup tower motor **58**, and control the cup grabber **60** into and between the noted lowered, raised, and intermediate positions by controlling operation of the pneumatic actuator. A user interface **32** is disposed on the front **20** of the beverage dispensing machine **10**, adjacent the noted ice bin and above the lower compartment **30**. The user interface **32** can include one or more touch screens and/or push buttons and/or switches and/or dials and/or the like for accepting operator inputs. The user interface **32** is configured to electrically communicate operator inputs to the computer controller **64**, which in turn controls the noted conveyor motor **33**, cup tower motor **58**, and cup grabber motor based upon the inputs. The controller **64** is further programed and configured to control the plurality of dispensing valves **34** to dispense a particular post-mix beverage to the dispensing nozzle **36**, based upon the operator inputs via the user interface **32**, all as is conventional.

Referring to FIGS. **8** and **9**, each cup holder **42** includes a base **66**, sidewalls **68** which extend upwardly from the base **66** and a front window **70** defined by the sidewalls **68** and having an open top. The front window **70** is oriented away from the center of the track **44** and is sized to facilitate manual grasping and removal of a cup **54** from the cup holder **42** when the cup holder **42** is located on the front side of the track **44**. Each cup holder **42** further includes a rear window **74** oriented towards the center of the track. The rear window **74** has an open top and facilitates manual access to a dovetail connection **78** between the cup holder **42** and the conveyor **40**. The rear window **74** is located directly opposite (i.e. diametrically opposite) the front window **70** so that the sidewalls **68** form a pair of side flanges on opposite sides of the cup. The conveyor **40** includes a conveyor belt **80** that extends around the track **44**. The conveyor belt **80** is driven by the conveyor motor **33**. Each cup holder **42** is connected to the conveyor belt **80** by the dovetail connection **78**. Each dovetail connection **78** includes a vertical dovetail channel **84** and vertical dovetail tab **86** that is received in the dovetail channel **84** by manually sliding one of the dovetail channel **84** and dovetail tab **86** with respect to the other. A bracket **85** is attached to retain the dovetail connection in place.

Referring to FIGS. **2-4**, an ultrasonic sensor **88** is located between the front **20** of the beverage dispensing machine **10** and the track **44**. The ultrasonic sensor **88** is configured to sense whether a cup **54** is present in the cup holders **42**. Specifically, the ultrasonic sensor **88** is configured to sense the presence of a cup **54** via the noted front window **70** in the cup holder **42**. The controller **64** is in communication with the ultrasonic sensor **88** and is configured to control the conveyor **40**, in part, based upon an output from the ultrasonic sensor **88**. As shown in FIG. **4**, the ultrasonic sensor **88** is spaced apart from the track **44** so that a gap exists between the ultrasonic sensor **88** and the track **44**. The ultrasonic sensor **88** is configured to repeatedly emit ultrasonic waves to thereby sense whether a cup **54** is present in the respective cup holders **42**. The ultrasonic sensor **88** is configured to sense in succession in order to rule out a false reading caused by a temporary obstruction, such as an operator's hand, located in the gap between the ultrasonic sensor **88** and the track **44**. In certain examples, the ultrasonic sensor **88** could instead be an optical sensor or any type of proximity sensor.

Referring to FIG. **10**, the beverage dispensing machine **10** has an integrated clean-in-place system **100** that is contained within the lower compartment **28** and enclosed by the housing **26**. The clean-in-place system **100** includes a hose **102** having a first end **104** and a second end **106**. The first end **104** has an inlet with a strainer **108** for receiving and straining a cleaning solution from, for example, a bucket or other source of cleaning solution. The second end **106** has an outlet with a nozzle **110** for dispensing, e.g. spraying, the cleaning solution for cleaning of the beverage dispensing machine **10**, for example the noted ice bin. A pump **112** is disposed in the lower compartment **28** and is connected to the hose **102**. The pump **112** is configured to draw cleaning solution into the first end via strainer **108** and pump the cleaning solution through the hose **102** to the nozzle **110** at the second end **106**. The exact configurations of the strainer **108** and nozzle **110** can vary from that which is shown. In the illustrated example, the strainer **108** has inlet holes **114** that are radially spaced around the body of the strainer **108** to facilitate inflow of cleaning solution into the first end **104** when, for example, the body of the strainer **108** is resting at the bottom of the bucket in which the cleaning solution is contained.

The clean-in-place system **100** further includes an inlet door **116** on the housing **26**. The inlet door **116** is manually positionable into and between an open position, shown in the middle view in FIG. **10** wherein the first and second ends **104**, **106** of the hose **102** are manually accessible via the inlet door **116** and a closed position, shown in the left view in FIG. **10**, wherein the first and second ends **104**, **106** of the hose **102** are enclosed within the housing **26**. When the inlet door **116** is in the open position, the first and second ends **104**, **106** of the hose **102** are manually removable from the housing **26** via the inlet door **116**. The hose **102** is conve-

niently coiled (guided) into the housing **26** via a partition wall **118** and a sidewall **120** of the housing **26**. This allows for easy storage and removal of the hose **102**.

Instructions for operation of the clean-in-place system **100** are provided in FIG. **10**. In use, the first end **104** of the hose **102** is manually withdrawn from the housing **26** via the inlet door **116** and placed into the cleaning solution. The second end **106** is manually removed and a valve **122** on the nozzle **110** is manually operated to open a flow of cleaning solution via the nozzle **110**, under force from the pump **112**. The nozzle **110** can be configured to provide a 45° spray pattern of cleaning solution; however, other configurations are contemplated and are within the scope of this disclosure. In some examples, the pump **112** can be a dual diaphragm pump, which is driven by compressed air and controlled by solenoid. Other configurations are contemplated and are within the scope of this disclosure. The hose **102** can be a plastic tubing, or any other type of conduit for facilitating flow of the cleaning solution. In certain examples, the clean-in-place system **100** can be added to or retrofitted to a previously installed beverage dispensing machine **10**. In certain examples, the clean-in-place system **100** will periodically activate and provide cleaning instructions to the operator via the user interface **32**. The operator has the option of performing cleaning when promoted or dismiss the cleaning instructions or prompts.

FIGS. **11-17** depict a second embodiment of the beverage dispensing machine **10** for dispensing a post-mix beverage, according to the present disclosure. A person having ordinary skill in the art will recognize that the beverage dispensing machine **10** depicted in FIGS. **11-17** can include various components described herein with respect to FIGS. **1-10**. The beverage dispensing machine **10** depicted in FIG. **11-17** includes a cup tower **50** with a plurality of cup dispenser clips **121** (FIG. **12**) in lieu of the cup dispenser tubes **52** (FIG. **2**).

Referring FIGS. **18-19**, an example cup tower **50** with a plurality of cup dispenser clips **121** is depicted. Each cup dispenser clip **121** is configured to hold a stack of cups **54** (see stack of cups **54***a*, **54***b*, **54***c* in FIG. **1**). A retaining structure **123** is positioned vertically directly below each cup dispenser clip **121** and is for temporarily holding the stacks of cups **54**, as is disclosed in the above-incorporated U.S. Pat. No. 9,204,734. The cup dispenser clips **121** are coupled to the center mandrel **57** and rotate about the vertical cup tower axis as the cup tower motor **58** (FIG. **4**) is actuated. The size and shape of the cup dispenser clips **121** can vary. For example, a large cup dispenser clip **121** is used to hold large cups **54** and a small cup dispenser clip **121** is used to hold small cups **54**. The cup dispenser clips **121** are interchangeable such that the type and/or size of the cups **54** held in the cup dispenser clips **121** can be modified as the beverage dispensing machine **10** is operated.

Referring specifically to FIG. **19**, a single dispensing clip **121** is depicted coupled to the center mandrel **57**. The cup dispenser clip **121** has a planar base **124** that is mounted flush to the outer surface of the center mandrel **57**, an open upper end **130**, an opposite open lower end **131**, and a pair of opposing arms **126** that define an interior space **128** and a side opening **132**. The arms **126** are elastic or bendable and are configured to elastically deform as the stack of cups **54** are loaded into the cup dispenser clip **121**. The arms **126** and/or the cup dispenser clip **121** are advantageously designed such that the stack of cups **54** (see FIG. **4**) can be loaded into the interior space **128** in a variety of ways. For instance, the stack of cups **54** can be top-loaded into the interior space **128** by passing the stack of cups **54** through the open upper end **130**. The stack of cups **54** can also be bottom-loaded into the interior space **128** through the open lower end **131**. In some instances, the stack of cups **54** is elongated such that the stack of cups **54** cannot be easily top-loaded or bottom-loaded into the cup dispenser clip **121**. Furthermore, space constraints around the beverage dispensing machine **10** or the proximity of other machines may prevent the stack of cups **54** from being top-loaded and/or bottom-loaded. Accordingly, the stack of cups **54** is side-loaded into the interior space **128** by pressing the stack of cups **54** into the arms **126** such that the arms **126** elastically deform thereby permitting the stack of cups **54** to pass into the interior space via the side opening **132**. The arms **126** return to their original shape (e.g. "snap back") after the stack of cups **54** are positioned into the interior space **128**.

The arms **126** are curved and each have an side edge **133**. The side edges **133** define an side edge distance D**1** that is less than a center distance D**2** defined between centers **127** of the arm **126**. The side edge distance D**1** is less than the diameter of the cups **54** such that the stack of cups **54** retained by the cup dispenser clip **121** do not easily tilt through the side opening **132** and fall out of the cup dispenser clip **121**. Each arm **126** has a guide member **134** that extends away from the side edge **133** and guides the stack of cups **54** toward the side opening **132** as the stack of cups **54** is side-loaded.

FIG. **20** depicts an example schematic diagram of a control system **150** for the beverage dispensing machine **10**. In the example shown, the control system **150** includes the computer controller **64**, which is programmable and includes a processor and a memory. The computer controller **64** can be located anywhere in the control system **150** and/or located remote from the control system **150** and can communicate with various components of the beverage dispensing machine **10** via a networks, peripheral interfaces, and wired and/or wireless links. Although FIG. **20** shows one computer controller **64**, the control system **150** can include more than one computer controller. Portions of the method disclosed herein below can be carried out by a single computer controller or by several separate computer controller.

In some examples, the computer controller **64** may include a computing system that includes a processing system, storage system, software, and input/output (I/O) interfaces for communicating with peripheral devices. The systems may be implemented in hardware and/or software that carries out a programmed set of instructions. For example, the processing system loads and executes software from the storage system, such as software programmed with a dispensing method, which directs the processing system to operate as described herein below in further detail. The computing system may include one or more processors, which may be communicatively connected. The processing system can comprise a microprocessor, including a control unit and a processing unit, and other circuitry, such as semiconductor hardware logic, that retrieves and executes software from the storage system. The processing system can be implemented within a single processing device but can also be distributed across multiple processing devices or sub-systems that cooperate according to existing program instructions. The processing system can include one or many software modules comprising sets of computer executable instructions for carrying out various functions as described herein.

As used herein, the term "computer controller" may refer to, be part of, or include an application specific integrated circuit (ASIC); an electronic circuit; a combinational logic

circuit; a field programmable gate array (FPGA); a processor (shared, dedicated, or group) that executes code; other suitable components that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip (SoC). A computer controller may include memory (shared, dedicated, or group) that stores code executed by the processing system. The term "code" may include software, firmware, and/or microcode, and may refer to programs, routines, functions, classes, and/or objects. The term "shared" means that some or all code from multiple computer controllers may be executed using a single (shared) processor. In addition, some or all code from multiple computer controllers may be stored by a single (shared) memory. The term "group" means that some or all code from a single computer controller may be executed using a group of processors. In addition, some or all code from a single computer controller may be stored using a group of memories.

The storage system can comprise any storage media readable by the processing system and capable of storing software. The storage system can include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer-readable instructions, data structures, software program modules, or other data. The storage system can be implemented as a single storage device or across multiple storage devices or sub-systems. The storage system can include additional elements, such as a memory controller capable of communicating with the processing system. Non-limiting examples of storage media include random access memory, read-only memory, magnetic discs, optical discs, flash memory, virtual and non-virtual memory, various types of magnetic storage devices, or any other medium which can be used to store the desired information and that may be accessed by an instruction execution system. The storage media can be a transitory storage media or a non-transitory storage media such as a non-transitory tangible computer readable medium.

The computer controller communicates with one or more components of the control system via the I/O interfaces and a communication link, which can be a wired or wireless link. The computer controller is capable of monitoring and controlling one or more operational characteristics of the control system and its various subsystems by sending and receiving control signals via the communication link. In one example, the communication link is a controller area network (CAN) bus, but other types of links could be used. It should be noted that the extent of connections of the communication link shown herein is for schematic purposes only, and the communication link in fact provides communication between the computer controller and each of the peripheral devices noted herein, although not every connection is shown in the drawing for purposes of clarity.

The computer controller functionally converts input signals, such as but not limited to order signals, inputs received via the user interface **32**, or information from sensors, to output signals, such as but not limited component control signals, according to the computer executable instructions. Each of the input signals can be split into more than one branch, depending on how many functions are to be carried out and/or how many actuators are to be controlled with each of the input signals. The input signals may be fed to several software modules within the computer controller through branch signals. The exact signals input into the software modules can be taken directly from the corresponding control input device or sensor, or could be pre-processed in some way, for example by scaling through an amplifier or by converting to or from a digital signal or an analog signal using a digital-to-analog or an analog-to-digital converter. It should be appreciated that more than one input signal can be combined to provide an output signal, in which case the individual input signals may be input to the same software modules or may each be provided to an individual software module. Note that in the event that more than one signal is used to generate an output signal, a post-processing module, such as a summer, a selector, or an averaging module is used to combine the input signals into an output signal

The provided description of the computer controller is conceptual and should be interpreted generally, as those skilled in the art will recognize many ways to implement such a computer controller. These include implementation using a digital microprocessor that receives input signals or branch signals and performs a calculation using the input signals to produce the corresponding output signals or actuator control signals. Also, analog computers may be used, which comprise circuit elements arranged to produce the desired outputs. Furthermore, look-up tables containing predetermined or calibrated data points may be stored in any fashion to provide the desired output corresponding to a given input signal.

The control system **150** is in communication, via wired or wireless communication links **152**, with a point-of-sale (POS) order system **160** that receives beverage order signals from order entry terminals or stations **162** into which crew members or operators input food and beverage orders. The order entry terminals **162** can be located in-store at a customer countertop or at drive-thru windows, and the computer controller **64** can simultaneously receive orders from multiple order entry terminals **162**. The order entry terminals **162** transmit order signals corresponding to the food and beverage orders through a local area network (LAN) **164** to the computer controller **64**. An order controller and/or processing module **166** is connected to the local area network **164** and can be configured to process the order signals.

The user interface **32** is in communication with the computer controller **64**. In the example depicted in FIG. **1**, the user interface **32** includes a pair of touch-screens that receive inputs from an operator stationed at the beverage dispensing machine **10**. A combination processing system and storage system **170** is in communication with the computer controller **64** and has various software programs, data sets, data bases, operating configuration, recipes, usage logs, error logs, and the like stored thereon. The computer controller **64** can further include a separate processing system and/or additional software storage system with additional information stored thereon such as state machines, intermachine communications, control protocols, cleaning clean-in-place system, procedures, and the like.

The computer controller **64** is in communication with a multiflavor valve module **172** that controls the dispensing valves **34** such that the flow of beverage or beverage components dispensed through the common dispensing nozzle **36** (FIG. **1**) creates or forms the ordered beverage. The computer controller **64** is also in communication with a motion control module **174** that is configured to receive control signals from the computer controller **64**, send operational control signals to components of the beverage dispensing machine **10**, and receive signals from components of the beverage dispensing machine **10**. For example, the motion control module **174** can send an operational control signal to the conveyor **40** to thereby cause the conveyor **40** to move the cup holders **42** (FIG. **6**). In another instance, the motion control module **174** can receive signals from the

ultrasonic sensor **88** that correspond to the presence of a cup in a cup holder **42**. The motion control module **174** is also in communication with cup tower or turret motor **58**, the actuator that actuates the cup grabber **60**, an ice dispensing valve **176** that controls the flow of the ice into a cup **54**, and the cleaning clean-in-place system **100**.

Referring to FIGS. **21-23**, an example operational sequence of the beverage dispensing machine **10** is depicted. During operation, the operator or crew member engages with the order entry terminal **162** (FIG. **20**) to enter a food and beverage order. For example, the order may consist of a large cola, a small white soda, and three cheese burgers. The order entry terminals **162** relay order signals corresponding to the order through the POS order system **160** to the computer controller **64**. Based on the order signals received, the computer controller **64**, along with the multi-flavor valve module **172** and motion control module **174**, controls the components of the beverage dispensing machine **10** to form the beverages ordered by the customer.

Orders signals related to the ordered beverages are received by the computer controller **64** and placed into a queue or order list as they are received. The beverages are then formed by the beverage dispensing machine **10** in the order they are received. That is, the beverage received first is formed, followed by the beverage received second, the beverage received third, and so on. That is, beverages are formed in the order in which the order signals are received by the computer controller **64**. In other examples, order signals received from certain order entry terminals **162**, such as quick-delivery terminals or drive thru terminals, are given priority over earlier received order signals and accordingly the beverages related to the order signals from these order entry terminals **162** are given "priority" and made before beverages related to order signals from other order entry terminals **162**.

The order signals received by the computer controller **64** are assigned origination codes that are displayed on the user interface **32** such that the beverages formed can be easily matched to the customer's food and beverage order. For example, order signals received from the order entry terminals **162** are assigned origination codes that correspond to the order number, such as Order #1235, Order #1236, and Order #1239. It is further contemplated that the origination codes can include additional information to assist the crew members with correctly matching the beverage formed by the beverage dispensing machine **10** to the food and beverage order (e.g. the origination code may include an order entry terminal value that corresponds to the specific order entry terminal **162** at which the order was entered).

To form a beverage, the cup tower **50** is rotated such that a stack of cups **54** with the correctly sized cup **54** for the beverage is directly vertically above the cup grabber **60** (see FIG. **1** for components not shown in FIGS. **21-23**). The cup grabber **60** then grabs the cup **54** and drops the cup **54** into a cup holder **42** vertically directly below the cup grabber **60** (see first beverage forming position **181**). The conveyor **40** then moves the cup **54** to a second beverage forming position **182** where the cup **54** is filled with ice and a third beverage forming position **183** where the cup **54** is filled with the beverage. The cup **54** is then conveyed to and through a series of beverage staging positions (see **191-196**) that are positioned toward or along the front **20** of the beverage dispensing machine **10** such that the operator or crew member can easily remove the cup **54**.

The user interface **32** includes a pair of touch-screens, namely a first touch-screen **32**A and a second touch-screen **32**B (note that FIGS. **21-23** depict the user interface **32** and the conveyor **40** with cup holders **42** immediately adjacent each other for clarity purposes). The first touch-screen **32**A displays a beverage selection screen that allows the operator to manually enter a beverage order into the beverage dispensing machine **10** without entering the beverage order into a remote order entry terminal **162**. This feature is advantageous when a previous beverage order was incorrectly entered via the remote order entry terminal **162** or if the beverage is accidentally spilled. In certain examples, the beverage order entered via the first touch-screen **32**A is given priority over the beverages listed in the beverage queue such that the beverage inputted via the first touch-screen **32**A is formed before other beverages in the beverage queue. In other examples, the beverage order entered via the first touch-screen **32**A is placed at the bottom of the beverage queue and is formed after the beverages already in the beverage queue. The first touch-screen **32**A includes a plurality of beverage options **201**, such as brands, levels of ice, additives (e.g. flavor shots), and the like, which are selected to form the beverage. The layout of the beverage options **201** can vary and may change based on the operational mode of the computer controller **64**, such as auto mode in which the computer controller **64** automatically forms beverages as they are received from the order entry terminals **162** and semi-auto mode in which the computer controller **64** forms beverages based on the order signals or inputs from the order entry terminals **162** and the first-touch screen **32**A.

The second touch-screen **32**B displays a graphical representation of the physical location of the beverages and cups **54** at each of the beverage staging positions (see **191-196**). That is, the second touch-screen **32**B displays an image of the beverage, including size, type, and/or order origination code, that corresponds to the physical location of the beverage in the conveyor **40**. Specifically, the second touch-screen **32**B displays images for real-time tracking of the beverages in the cup holders **42** of the conveyor **40**. FIG. **21** depicts the a first beverage **211** (a large "L" cup of "Brand **6**" beverage) in beverage staging position **196** and a second beverage **212** (an extra small "Xs" cup of "Brand **3**" beverage) in beverage staging position **191**. The first beverage **211** is removed by the operator such that the ultrasonic sensor **88** does not sense a cup **54** in beverage staging position **196** and accordingly, the conveyor **40** moves the cup holders **42** and the second beverage **212** to a different beverage staging position (see FIG. **22**).

FIG. **22** depicts the second beverage **212** moved into beverage staging position **194** and a third beverage **213** (a large "L" cup of "Brand **1**" beverage) in beverage staging position **191**. The computer controller **64** is configured to display a graphical animation of the beverages **212**, **213** moving to the different beverage staging positions **191-196** represented on the second touch-screen **32**B as they are physically moved by the conveyor **40**. FIG. **23** depicts the second beverage **212** moved to beverage staging position **196**. The ultrasonic sensor **88** senses the second beverage **212** in beverage staging position **196** and therefore sends a signal to the computer controller **64** such that the conveyor **40** does not move the beverages **212**, **213** further and thereby prevents the second beverage **212** from being moved to the first beverage forming position **181**.

The touch-screen **32**A, **32**B can display other information to the operator based on the operational mode of the computer controller **64**. For example, the touch-screen **32**A, **32**B may display the number and types of beverages that have been created by the beverage dispensing machine **10**, cleaning steps to be followed by the operator to properly clean the

beverage dispensing machine **10**, and the like. In certain examples, if one of the touch-screens **32**A, **32**B fails the remaining operational touch-screen can function in a secondary mode such that the operation of the beverage dispensing machine **10** does not fully stop due to the failure of one of the touch-screens **32**A, **32**B.

FIG. **24** is an example system software block diagram according to the present disclosure, and FIGS. **24**A-**24**G depict the details of the system software block diagram of FIG. **24**. The software is fully modularized, and each specific device subsystem has a dedicated software module assigned to it. The central software module is the staging module which handles the progress of drink building modules called "Builders" through their drink building process including dispensing of cup, ice, and beverage in dedicated locations. Each built beverage or drink is assigned its own Builder module which serves the beverage according to its assigned drink order. When the drink building process is finished and the beverage is moved past the last staging location protected by the cup presence sensor then the assigned Builder module is fully reinitialized to receive a pending drink order. In addition to the core functionality of the central software module, the software contains additional modules dedicated to drink order reception and queuing and modules dedicated to device configuration, maintenance, diagnostics, error detection and persistence, usage data maintenance, and application startup and termination management.

In the present description, certain terms have been used for brevity, clearness and understanding. No unnecessary limitations are to be implied therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The different apparatuses and methods described herein may be used alone or in combination with other apparatuses and methods. Various equivalents, alternatives and modifications are possible within the scope of the appended claims.

We claim:

1. A beverage dispensing machine that extends from top to bottom in a vertical direction, from right side to left side in a width direction that is perpendicular to the vertical direction, and from front to back in a depth direction that is perpendicular to the vertical direction and perpendicular to the width direction, the beverage dispensing machine comprising:

a countertop that extends in the width direction and in the depth direction;

a conveyor on the countertop, wherein the conveyor carries a plurality of cup holders around a track having a front side oriented towards the front of the beverage dispensing machine and a back side oriented towards the back of the beverage machine, wherein the front side is accessible by an operator to remove cups from the plurality of cup holders;

a cup tower located above the countertop in the vertical direction, the cup tower comprising a plurality of cup dispenser tubes that are each configured to hold a respective stack of cups, wherein the cup tower is rotatable about a vertical cup tower axis;

a cup grabber located above the countertop and adjacent to the cup tower and between the back side of the track and the back of the beverage dispensing machine, wherein the cup grabber is movable up and down in the vertical direction into and between a raised position in which the cup grabber is positioned to grab a cup from one of the stacks of cups, a lowered position in which the cup grabber is positioned to place a cup into one of the plurality of cup holders, and an intermediate position in between the raised and lowered position wherein the cup grabber is spaced apart from and between the cup tower and the plurality of cup holders in the vertical direction so that the tower is free to rotate about the cup tower axis and the conveyor is free to carry the plurality of cup holders around the track;

wherein each cup holder in the plurality of cup holders comprises a base, sidewalls extending upwardly from the base, and a front window formed in the sidewalls having an open top, wherein the front window is oriented away from a center of the track, the front window oriented and sized to facilitate manual grasping and removal of a cup from the cup holder when the cup holder is located on the front side of the track; and

an ultrasonic sensor that senses whether a cup is present in each of the plurality of cup holders via the front window in the cup holder, and further comprising a controller that is configured to control the conveyor based upon an output from the sensor.

2. The beverage dispensing machine according to claim **1**, wherein the cup tower is located between the back side of the track and the back of the beverage dispensing machine with respect to the depth direction.

3. The beverage dispensing machine according to claim **1**, further comprising a controller configured to control the conveyor, control rotation of the cup tower about the cup tower axis, and control the cup grabber into and between the lowered position, raised position, and intermediate position.

4. The beverage dispensing machine according to claim **3**, further comprising a cup tower motor configured to rotate the cup tower about the cup tower axis, wherein the cup tower motor is located above the cup tower in the vertical direction, and wherein the controller is configured to control the cup tower motor to thereby rotate the cup tower into a plurality of positions in which the cup grabber is able to grab a cup from one of the plurality of cup dispenser tubes.

5. The beverage dispensing machine according to claim **1**, further comprising a pneumatic actuator configured to move the cup grabber into and between the lowered position, raised position and intermediate position.

6. The beverage dispensing machine according to claim **1**, wherein each cup holder further comprises a rear window oriented towards a center of the track and having an open top, wherein the rear window facilitates manual access to a connection point between the cup holder and the conveyor.

7. The beverage dispensing machine according to claim **6**, wherein the rear window is located directly opposite the front window so that the sidewalls form a pair of side flanges on opposite sides of the cup holder.

8. The beverage dispensing machine according to claim **7**, further wherein the conveyor comprises a conveyor belt that extends around the track, and wherein each cup holder is connected to the conveyor belt by a dovetail connection.

9. The beverage dispensing machine according to claim **8**, wherein the dovetail connection comprises a vertical dovetail channel and a vertical dovetail tab that is received in the vertical dovetail channel by manually sliding one of the vertical dovetail channel and vertical dovetail tab with respect to the other of the vertical dovetail channel and vertical dovetail tab.

10. The beverage dispensing machine according to claim **1**, wherein the ultrasonic sensor is located between the front of the beverage dispensing machine and the track.

11. The beverage dispensing machine according to claim **10**, wherein the ultrasonic sensor is spaced apart from the

track so that a gap exists between the sensor and the track and wherein the ultrasonic sensor is configured to repeatedly emit ultrasonic waves to sense whether a cup is present in one of the plurality of cup holders.

12. The beverage dispensing machine according to claim **11**, wherein the ultrasonic sensor is configured to repeatedly sense whether a cup is present in one of the plurality of cup holders to rule out a false reading caused by an obstruction located in the gap between the sensor and the track.

13. The beverage dispensing machine according to claim **1**, further comprising a dispensing nozzle for dispensing a beverage into a cup residing in one of the plurality of cup holders, wherein the cup grabber is located between the cup tower and the dispensing nozzle.

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