

[54] **PRESSURE-FILL CONTAINER FILLING MACHINE**

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[58] Field of Search **141/37, 39, 45, 59, 141/89, 90, 115, 119, 120, 123, 126, 127, 140-143, 311, 67, 68, 286, 295**

[56] **References Cited**

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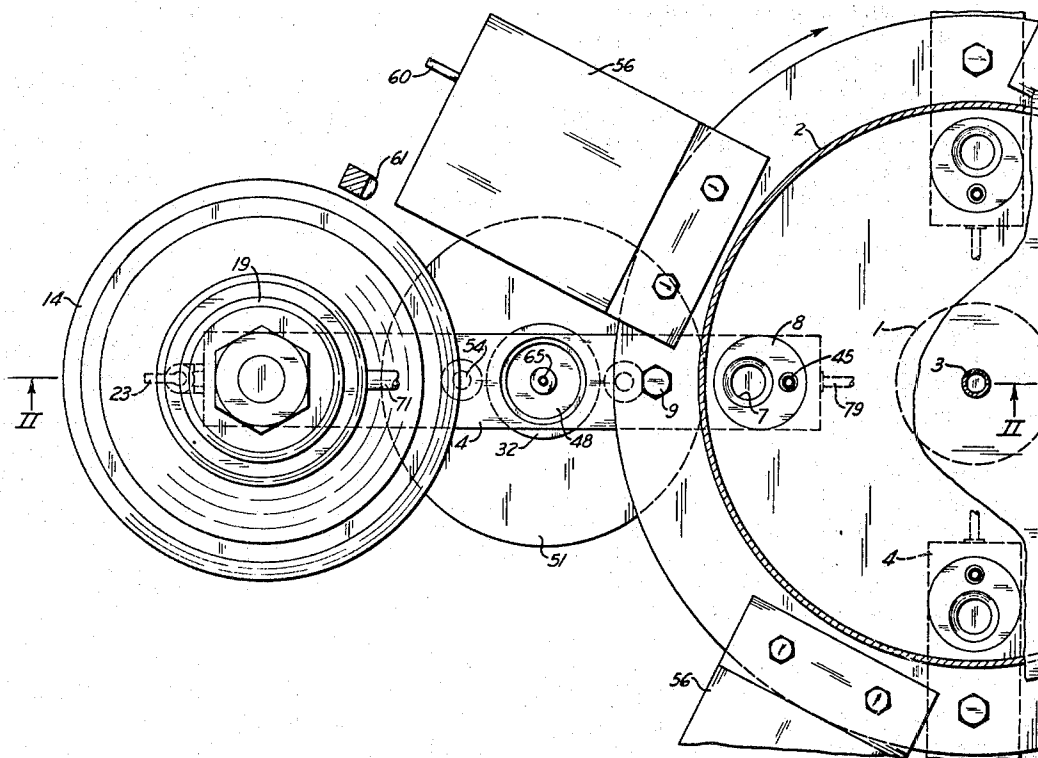
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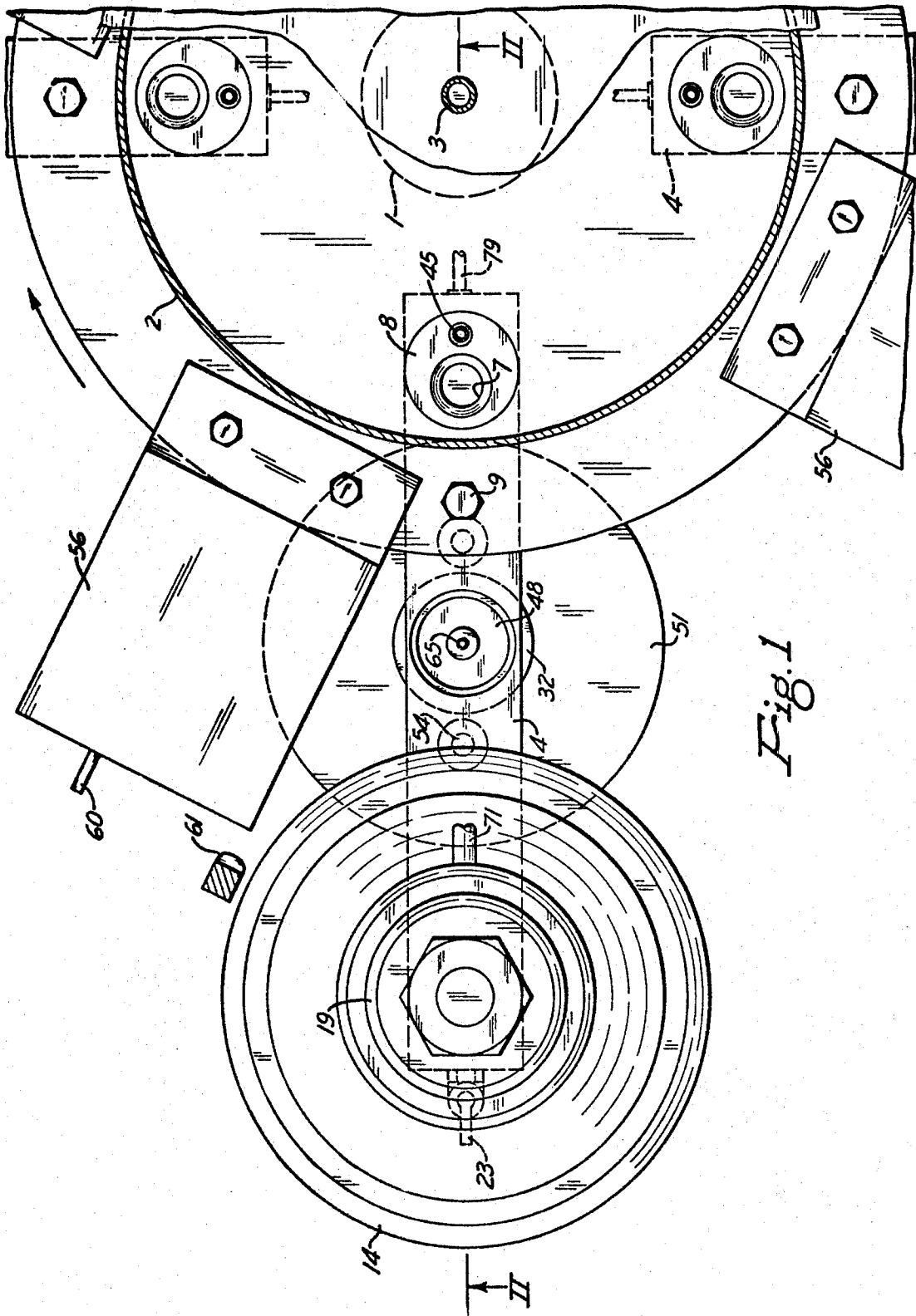
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ABSTRACT

Spaced around a supply tank is a plurality of dispensing chambers, each of which is mounted on a conduit arm extending laterally away from the tank and connecting the bottom of the tank with the bottom of the chamber. There is a first valve for closing the tank outlet and a second valve for closing an outlet from the conduit arm to a downwardly extending filling tube. A suction tube extends along the filling tube and has an inlet at its lower end located above the lower end of the filling tube. The suction tube is connected with the inside of the tank, which is maintained under subatmospheric pressure. Means are provided for filling each dispensing chamber in succession with liquid from the tank while the first valve is open and the second valve is closed. Means also are provided for causing each dispensing chamber to force liquid down through the associated filling tube into a container that has been raised around the outlet of the tube. Liquid product that rises in the container above the lower end of the suction tube therein returns through that tube directly to the supply tank.

12 Claims, 5 Drawing Figures





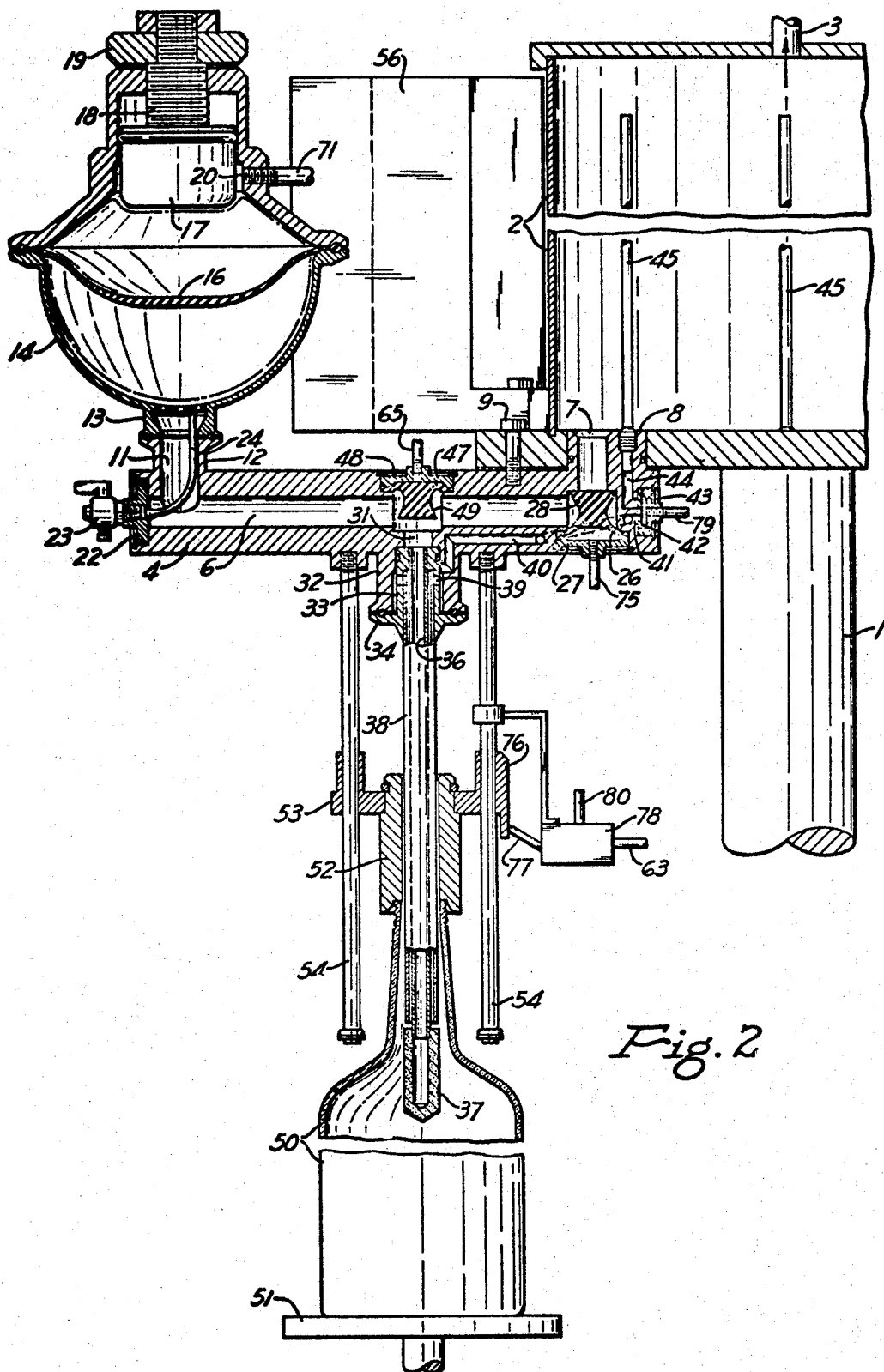


Fig. 2

PRESSURE-FILL CONTAINER FILLING MACHINE

It is among the objects of this invention to provide a high speed container filling machine which will fill containers very rapidly, which will fill all containers to the same desired level, which does not have to seal the containers during filling, which has no flexible tubes for handling the liquid product, which has no sensing cut-off for the liquid filling a container, which will shut off the filling operation in the absence or loss of a container, and which returns excess liquid product from the containers directly to the tank that contains the liquid with which the containers are filled.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is a fragmentary plan view, partly broken away in section, of my filling machine;

FIG. 2 is a reduced vertical section taken on the line II—II of FIG. 1 and showing a container in filling position;

FIG. 3 is a diagram of the pneumatic circuit that controls the operation of the machine, showing the condition of the circuit while a dispensing chamber is being refilled;

FIG. 4 is a like view but showing the condition of the circuit during filling of a container; and

FIG. 5 is a fragmentary view of part of the circuit when no container is present.

Referring to FIGS. 1 and 2 of the drawings, a vertical center post 1 of a container filling machine is rotatably mounted and driven continuously by conventional means not shown. Mounted on the upper end of this post is a supply tank 2 for the liquid product with which containers are to be filled. The top of the tank is sealed, except for an outlet opening that is connected by a hose 3 to suitable apparatus for maintaining subatmospheric pressure in the tank. Directly below the tank a plurality of horizontal conduit arms 4 extend radially away from the post at circumferentially spaced intervals. Each rigid arm is provided with a longitudinal passage 6, the inner end of which opens into the lower end of a vertical passage 7 extending up through a boss 8 on the inner end of the arm. The boss is sealed in an opening in the bottom of the tank, and the arm is fastened to the bottom of the tank by means of a screw 9. The outer end of the arm passage opens into the lower end of a vertical passage 11 extending up through a boss 12 on the outer end of the arm. Rigidly mounted on this boss is the lower end of a neck 13 around openings in the bottom of a dispensing chamber 14, which is a volumetric measuring device.

This chamber preferably has a substantially hemispherical lower section, on which an upwardly tapered upper section is mounted. Between the two sections the edge of a flexible diaphragm 16 is clamped. The diaphragm forms a flexible partition wall dividing the chamber into upper and lower sections. The upper section has an upwardly extending central portion, in which a vertically movable plug 17 is disposed. The plug has a central threaded stem 18 that is screwed into an opening through the top of the chamber, and a hand wheel 19 is rigidly mounted on the projecting upper end of the stem to enable it to be turned in order to adjust the plug up and down. The side wall of the chamber is spaced laterally from the lower portion of the plug and is provided with an opening 20 through it. The diaphragm normally sags into the lower section of the chamber and is elastic enough to be forced down into

engagement with the inner surface of the lower section, or upwardly into engagement with the tapered inner surface of the upper section and the bottom of the plug. The position of the plug determines the distance the diaphragm can move upwardly.

The outer end of passage 6 through the conduit arm is closed at the outer end of the arm by a sealing disc 22 provided with a central opening in which a normally closed, manually operable, valve 23 is screwed. The inlet of the valve is connected to a tube 24 that extends up nearly to the supply chamber outlets. The purpose of this valve and tube is to bleed the system of air when the dispensing chamber is filled the first time.

The capacity of the dispensing chamber is only great enough to fill a single container, so every time a container is filled from the chamber, the chamber must be refilled. The chamber is filled from the central supply tank 2 through the connecting arm 4, but the outlet from the tank normally is closed by a valve at the lower end of vertical passage 7. A preferred type of valve is a diaphragm valve that includes a flexible diaphragm 26, the edge of which is clamped in an opening in the bottom of an arm by means of a sealing disc 27 that has an opening in its center. Extending upwardly from the center of the diaphragm is a solid closure member 28, the upper end of which is larger than the lower end and normally engages a valve seat around the lower end of passage 7. When this valve is opened by reducing the air pressure below its diaphragm, the passage from the tank to dispensing chamber 14 is opened. However, since the tank is under vacuum, means must be provided for drawing the liquid out of it through the conduit arm and up to the dispensing chamber. This is done, as will be explained in detail later, by reducing the air pressure above the chamber diaphragm 16 sufficiently for the diaphragm to be drawn upwardly to draw liquid down out of the bottom of the tank and up into the dispensing chamber. The valve 28 then is closed.

In order to fill a container from the dispensing chamber, the conduit arm 4 has an outlet opening 31 in its bottom between the tank valve 28 and the dispensing chamber. Extending downwardly from this opening is a cylindrical flange 32, in which there is a sleeve 33 that is encircled by a collar 34 attached to the lower end of the flange. Rigidly mounted in the upper end of the sleeve is the upper end of a container filling tube 36, on the lower end of which a porous nozzle 37 preferably is mounted. Such a nozzle avoids splashing inside the container and also reduces or prevents foaming. A short distance below its upper end, the inside of the sleeve is enlarged and the upper end of a second tube 38 (suction tube) is rigidly mounted in it. This tube encircles the filling tube but is spaced from it, and its lower end is spaced from the upper end of the nozzle. The upper end portion of the outer tube is provided with radial openings that register with like openings 39 in the sleeve. These openings open into an annular space around the sleeve, which is connected by a passage 40 through the wall of arm 4 to a laterally opening inlet 41 of a vent valve that normally is closed by a vertical flexible valve diaphragm 42 clamped in a recess in the inner end of the arm by means of a sealing disc 43 that has an opening in its center. Above inlet 41 there is a laterally opening outlet that also is closed by the diaphragm. This outlet is the lower end or inlet of a passage 44 in the arm and boss 8 and extends up into the

supply tank. Mounted in the upper end of this passage is a rigid tube 45 that extends up into the tank above the level of the liquid therein. The purpose of this tube will be explained later.

While the dispensing chamber is being filled from the tank, the outlet port 31 in the bottom of the arm is closed by a valve, preferably one like the diaphragm valve described above; except that it is inverted. Thus, the diaphragm 47 of this valve is at the top and is clamped in a recess at the top of the arm by a sealing disc 48 that has a passage through its center. The downwardly flaring closure portion 49 of the valve will seat against a seat surrounding the upper end of the outlet port when air pressure is admitted above the diaphragm. This valve does not block passage 6 while the dispensing chamber is being filled.

After the chamber has been filled, the tank valve 28 is closed and outlet valve 49 is allowed to open. Then air pressure is supplied to the upper part of the dispensing chamber 14 through opening 20 to force diaphragm 16 down in order to discharge the liquid from the chamber in only a few seconds and down through the filling tube and nozzle into a container 50, in which the nozzle is inserted. The container rests on a conventional vertically movable support 51. During the time the container is being filled, the vent valve 42 is open so that air is drawn up between the inner and outer tubes 36 and 38, through passages 40 and 44 and up through tube 45 in the tank. The capacity of the dispensing chamber is adjusted by hand wheel 19 so that it will slightly overfill the container, the overfill or excess liquid being drawn up through the path just mentioned and returned to the tank. The level of the liquid in each successive container will then be at the same level as the lower end of the suction tube 38, so all containers presented to this filling tube will be filled to the same level.

Before the container, such as a bottle, is raised, its upper end is directly below a socket in the lower end of a sleeve 52 loosely encircling the nozzle. This sleeve is carried by a slide 53 mounted on a pair of guide rods 54 extending downwardly from the bottom of arm 4. When the bottle is lifted by its support 51, the top of the bottle enters the sleeve socket and then raises the sleeve and slide. The sleeve does not need to seal the opening into the bottle because the bottle is filled by liquid under pressure. However, if there is any likelihood of "spitout" as a container is being filled, the sleeve can be provided with a gasket, for example, to seal the container opening during filling.

In order to operate the valves and fill and discharge the supply chamber, a pneumatic circuit is provided and illustrated in FIGS. 3 and 4. Several of the valves in the circuit are enclosed in a control box 56 secured to a suitable part of the machine for rotation with it. There are a separate control box and a separate circuit for each radial arm 4. The valves include a pilot valve 57 operated by a pair of vertically spaced and normally closed valves or pneumatic switches 58 and 59, which are provided with projecting actuating elements 60 projecting from the side of the control box for striking stationary cams 61 and 62 once during each revolution of the center post. The cams are spaced circumferentially around the tank and may be supported in any suitable manner, such as by being suspended from above the machine. There is only one set of these cams for all of the control boxes.

OPERATION

Assuming that a given dispensing chamber has just filled a container that is still in its raised position, pilot valve 57 is in the position indicated in FIG. 4, but immediately after the filling operation the actuating element 60 of pneumatic switch 59 strikes cam 62 as shown in FIG. 3 to cause the switch to open and connect an air pressure line 63 with one end of a shuttle valve 64 momentarily, through which the air pressure acts on the pilot valve so that it will be shifted and connect line 63 with a line 65 leading to a spring-biased three-way valve 70 and also to the center passage of sealing disc 48 above valve diaphragm 47. The air pressure will close outlet valve 49 and simultaneously shift valve 70 to connect a line 71 from opening 20 in the supply chamber with a line 72 leading to a vacuum pump. Connected to this vacuum line is a check valve 73 that allows the high pressure above the diaphragm 16 in the supply chamber 14 to escape to the atmosphere quickly so that the vacuum pump can start at once to evacuate the upper part of the chamber in order to raise the diaphragm. The chamber is evacuated to a greater degree than the supply tank. At the same time, another spring-biased three-way valve 74 is allowed to return to its normal position, in which it connects vacuum line 72 with a line 75 connected to the passage through the sealing disc 27 of tank outlet valve 28 in order to open that valve. With valve 49 closed and valve 28 open, the dispensing chamber is soon filled.

All of this switching occurs before the filled container is lowered by its support. Filling of the dispensing chamber may continue after the filled container is lowered. As long as the container is up, surplus liquid can be drawn out of it and into the tank because vent valve 42 is not held closed. This is because the container slide 53 is provided with a cam 76 which, while raised, bears against an actuating element 77 projecting from a normally open spring-biased pneumatic switching valve 78, called a no-container no-fill valve, that may be supported from one of the guide rods 54. The cam holds the valve in the closed position indicated in FIGS. 3 and 4, in which it disconnects the air pressure from a line 79 leading to the sealing disc 43 of the vent valve. However, as soon as the container and cam are lowered, valve 78 returns to its normal position shown in FIG. 5 and connects the pressure line 63 with line 79 to close the vent valve so that the air inlet to the tank will be shut off. This reduces the amount of air drawn into the supply tank and also reduces the load on the vacuum system that maintains subatmospheric pressure in the tank. Valve 78, when open, also connects pressure line 63 with a line 80 leading to the end of shuttle valve 64 opposite to the end connected with pneumatic switch 59. The purpose of line 80 will be given presently.

As the filled dispensing chamber 14 approaches the filling station, an empty container 50 is raised around the filling tube, causing cam 76 to close valve 78 so that the valve disconnects the pressure line 63 from lines 79 and 80. Just as the container reaches its upper position the actuating element 60 of pneumatic switch 58 strikes cam 61 as shown in FIG. 4 and opens the switch to connect the pressure line with the adjacent end of the pilot valve just long enough to shift the valve. This reversal of the pilot valve disconnects pressure line 63 from line 65 to permit valve 49 to open and valve 70

to return to its normal position shown in FIG. 4, in which it connects another air pressure line 81 with line 71 to the dispensing chamber. At the same time, the pilot valve connects pressure line 63 with a line 82 leading to valve 74 to shift it so that it will connect the pressure line with line 75 leading to valve 28 and thereby close that valve.

The pressure in the top of the dispensing chamber forces its diaphragm down and thereby discharges the liquid from the chamber and arm outlet 31 and down through the filling tube into the container. Since there is no air pressure in line 79 at this time, the vent valve 42 is free to open so that overflow liquid in the container will be drawn back into the supply tank through tube 45.

In case there is no container on support 51 when it is raised after refilling is completed and valve 59 has closed, cam 76 will not be raised and therefore the no-container no-fill valve 78 will not be closed, so it will not disconnect pressure line 63 from line 80. The pressure from line 80 will shift shuttle valve 64 to its other position, in which air pressure will still be applied to the adjoining end of the pilot valve to hold it in the refill position shown in FIG. 3. Consequently, liquid will not be discharged from the dispensing chamber onto the floor when pneumatic switch 58 is actuated by cam 61. The short blast of control air from switch 58 will not override the air pressure from the shuttle valve. Another advantage of line 80 is that if a container closes valve 78 and the filling operation starts, but then the container breaks and falls off its support, valve 78 will open immediately and connect pressure line 63 with line 80 so that that the pilot valve will be shifted back to its refill position shown in FIG. 3. This shuts off discharge of liquid from dispensing chamber 14.

The rigid conduits for the liquid product in this machine are easy to keep clean. The arms 4 not only serve as the main conduits, but they support the dispensing chambers and all of the valves that control the flow of liquid in the machine. A predetermined volume of liquid is dispensed to each successive container, so no liquid-level sensing device is required for shutting off the flow to the containers. Such devices sometimes fail to work for one reason or another and permit the liquid to overflow the containers. No pump is required for returning the excess liquid from each container to the supply tank; the vacuum maintained in that tank serving that purpose. While this return is taking place the refilling of the dispensing chamber begins, thereby permitting faster operation of the machine.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A high speed pressure-fill container filling machine comprising a supply tank provided with outlets, a plurality of dispensing chambers spaced laterally from the tank, a separate rigid laterally extending conduit arm connecting each tank outlet with the bottom of one of said chambers, a first valve for closing each tank outlet, means for maintaining subatmospheric pressure in the tank, each conduit arm having an outlet spaced laterally from the adjoining valve and chamber, a second

valve for closing said conduit arm outlet, a filling tube extending down from the conduit arm outlet, a suction tube extending along the filling tube and having an inlet at its lower end located above the lower end of the filling tube, a suction line connecting the upper end of the suction tube with the inside of the tank, means for filling each dispensing chamber in succession with liquid from the tank while the first valve is open and the second valve is closed, a vertically movable support below each filling tube, means for raising each support to move the open top of a container thereon up around the filling tube above it, and further means operable when the first valve is closed and the second valve is open for causing each dispensing chamber in succession to force liquid from the chamber down through the associated filling tube into a raised container to fill the container to a height above the lower end of the suction tube therein, whereupon the suction tube and line will return to the tank the liquid in the filled container above the lower end of the suction tube.

2. A filling machine according to claim 1, in which said conduit arm outlet is located in the bottom of the arm between the adjoining tank outlet and dispensing chamber.

3. A filling machine according to claim 1, including a bleeder tube extending into said conduit arm and having an inlet adjacent the chamber outlet, and a manually operable valve normally closing the outer end of said tube.

4. A filling machine according to claim 1, including a normally open third valve in said suction line, and means actuated when a filled container is lowered for closing that valve until an empty container is raised by said support.

5. A filling machine according to claim 4, in which said second and third valves are pneumatically operated and are closed by air pressure.

6. A filling machine according to claim 1, in which said dispensing chambers are disposed around the outside of the tank, the machine including means for moving said conduit arms and container supports continuously in a path around a vertical axis, valve means movable with said conduit arms for controlling said first and second valves, stationary cams, and means carried by said conduit arms for engaging said cams to actuate said valve means.

7. A filling machine according to claim 1, in which each of said dispensing chambers is provided inside with a flexible partition wall, said means for filling each chamber include means for evacuating it above said wall to draw the wall upwardly to fill the area of the chamber below it with liquid from the tank, and said further means include means for applying air pressure above said flexible partition wall.

8. A filling machine according to claim 7, in which each dispensing chamber has adjustable means at the side of its partition wall opposite the liquid for selectively limiting the distance that wall can be drawn away from said opposite wall of the chamber.

9. A filling machine according to claim 7, in which said first valve is pneumatically operated, the machine including means for connecting the first valve with a source of reduced air pressure for drawing that valve open when said partition wall is drawn away from the opposite wall of the chamber.

10. A filling machine according to claim 1, including a fourth valve controlling said further means to nor-

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mally keep said means inactive, and means movable upwardly with a container on said support for operating the fourth valve to allow said further means to function.

11. A filling machine according to claim 10, including a normally open third valve in said suction line, and means connecting said fourth valve with the third valve to normally hold the third valve closed, said operation

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of the fourth valve disconnecting it from the third valve to permit the third valve to open.

12. A filling machine according to claim 1, in which said suction tube surrounds the filling tube, and the inlet of the suction tube is annular.

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