METHOD AND APPARATUS FOR FILLING BOTTLES

Inventor: Chester W. Held, Bayside, Wis.
Assignee: Federal Manufacturing Company, Milwaukee, Wis.
Filed: Oct. 10, 1973
Appl. No.: 404,938

U.S. Cl. 141/5; 141/99; 141/114
Int. Cl. B65b 3/04
Field of Search 141/99-110, 141/114, 234-248, 1-8

References Cited
UNITED STATES PATENTS
2,775,269 12/1956 Breeback 141/99
3,047,032 7/1962 Carter 141/99

ABSTRACT

To minimize the time for filling large numbers of bottles with liquid such as milk which is apt to foam, each bottle is initially filled by gravity flow to somewhat less than its full content, and then by vacuum assisted gravity flow to its precise full content. A machine for automatically performing such two stage filling method is provided with a continuous bottle conveying system including a slowly rotating fluid dispensing and bottle conveying turret for the gravity filling stage and with a somewhat faster rotating fluid dispensing and bottle conveying turret of smaller diameter for the vacuum assisted filling stage.

8 Claims, 11 Drawing Figures
1
METHOD AND APPARATUS FOR FILLING BOTTLES

BACKGROUND OF THE INVENTION

For the bottling of milk and other liquids which are apt to foam during bottle filling, machines have heretofore been developed in which a continuous row of bottles is steadily advanced in a circular path and wherein each bottle is successively connected to and disconnected from a liquid dispensing device as it moves along the circular path. In such machines as heretofore used, empty bottles are moved in sequence one by one upon a continuously rotating turret which has a series of up and down movable bottle support pedestals distributed around its circumference, and an elevated liquid supply bowl with a circular series of fluid dispensing devices, one over each pedestal. The up and down movement of the pedestals is controlled in such a manner that each pedestal is in a lowered position at the point of its circular path where it receives an empty bottle from a feeding conveyor. Rotation of the turret advances the bottle and raises it so that a discharging and vent tube assembly of the overlying dispensing device will enter the open neck of the bottle. The upward movement of the bottle causes a valve of the dispensing device to be opened, and the pedestal with the bottle on it is then kept in the raised position during a protracted part of one revolution of the turret. Thereafter, the pedestal and the now filled bottle are lowered so as to withdraw the neck of the bottle from the overlying dispensing device. Such withdrawal causes the valve of the dispensing device to close in time to prevent overfilling.

To achieve precise filling, particularly of plastic bottles, in turret type filling machines, provisions have heretofore been made to place the supply bowl under subatmospheric pressure by means of a vacuum pump which withdraws air from the space above the liquid in the bowl. A machine of this type wherein the gravity flow of the liquid into the bottles is assisted by vacuum is disclosed, for instance, in U.S. Pat. No. 3,578,038, issued May 11, 1971 to C.O. Burford for Receptacle Filling Method.

One major problem, however, which has not heretofore been solved in a fully satisfactory manner is the ever increasing demand for bottle filling equipment which is capable of precisely filling large numbers of bottles, and particularly plastic bottles, with liquid such as milk, in a minimum of time. Just enlarging the size of a conventional turret type filling machine is not the answer because that would result in an excessively large and unduly expensive machine. Also the large size fluid supply bowl of such a machine, if constructed for operation under subatmospheric pressure, would make the required frequent cleaning more difficult than a moderately sized fluid supply bowl.

SUMMARY OF THE INVENTION

Generally, it is an object of the present invention to provide an improved method of precisely filling large numbers of bottles with liquid in a minimum of time. More particularly, it is an object of the invention to provide an improved filling method of the mentioned character which may be used for filling liquid, such as milk, into plastic bottles or other non-rigid containers which during the filling operation change their shape under the weight of the accumulating liquid.

A further object of the invention is to provide a machine for carrying out an improved bottle filling method in a practical and wholly satisfactory manner. A further object of the invention is to provide an integrated bottle conveying and filling machine which is relatively compact and which is capable to precisely fill a large number of bottles, and particularly plastic bottles, in a minimum of time.

A further object of the invention is to provide an integrated filling machine of the above mentioned character, which lends itself to the required frequent cleaning without undue difficulties.

A still further object of the invention is to provide an integrated machine incorporating equipment for filling each of a series of steadily moving bottles first by gravity flow to somewhat less than its full content, then by vacuum assisted gravity flow to its precise full content, and capping equipment for sealing each bottle after it has been filled to its full content.

These and other objects and advantages of the present invention will appear hereinafter as this disclosure progresses, reference being had to the accompanying drawings.

THE DRAWINGS

FIG. 1 is a perspective elevational view of a bottle filling and capping machine embodying the invention;
FIG. 2 is a somewhat diagrammatical sectional view on line 2—2 of FIG. 1;
FIG. 3 is a sectional view partly in elevation, on line 3—3 of FIG. 2;
FIG. 3a is a section on line 3a—3a in FIG. 3;
FIG. 4 is a diagrammatic view of a first turret assembly shown in the left part of FIG. 1, component parts of the turret assembly in FIG. 4 being shown in positions of circumferential development;
FIG. 5 is a diagrammatic view of a second turret assembly shown in the right part of FIG. 1, component parts of the turret assembly in FIG. 5 being shown in positions of circumferential development;
FIG. 6 is a diagrammatic view of a bottle capping turret assembly shown in the right part of FIG. 1, component parts of the turret assembly in FIG. 6 being shown in positions of circumferential development;
FIG. 7 is a sectional view on line 7—7 of FIG. 1, showing a liquid dispensing valve in a closed position;
FIG. 8 is a sectional view similar to FIG. 7 and showing the valve in an open position;
FIG. 9 is a sectional view on line 9—9 of FIG. 1, showing a liquid dispensing valve in a closed position;
FIG. 10 is a sectional view similar to FIG. 9 and showing the valve in an open position.

DESCRIPTION OF A PREFERRED EMBODIMENT

The principal components of the machine shown in FIG. 1 are a base 1; a first filling turret assembly 2; a second filling turret assembly 3; and a turret type bottle capping mechanism 4.

The base 1 comprises a generally rectangular casing 6 which is supported at its four corners on legs 7 in a horizontal position, and which serves two principal purposes, namely first, to mount the turret assemblies 2 and 3, the capping mechanism 4, and bottle feeding star wheels 8, 9, 11 and 12 in operative positions; and second, to enclose a drive mechanism for the turrets, capping mechanism and star wheels.

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

FIG. 10
3

The turret assemblies 2 and 3 are generally similar in that each comprises a circular series of bottle supporting pedestals, an elevated liquid supply bowl, and a circular series of liquid dispensing devices connected with the supply bowl, one over each pedestal. However, an important difference between the turret assemblies is that the supply bowl of the second turret assembly 3 can be sealed against air entry and evacuated by means of a vacuum pump 13 (FIG. 2) so as to establish a sub-atmospheric pressure therein, whereas the supply bowl of the first turret assembly 2 remains at atmospheric pressure at all times. The turret assemblies also differ in that the first turret assembly 2 has more bottle supporting pedestals than the second turret assembly 3; in that the pedestals of the first turret assembly 2 are arranged on a pitch circle of larger diameter than those of the second turret assembly 3; and in that the turret assembly 3 is rotated at a higher speed than the turret assembly 2.

The turret assembly 2 comprises a circular series of eighteen bottle supporting pedestals which are designated in FIG. 2 by the reference characters A–R, and which are carried at the periphery of a rotary spider 14 shown in section in FIG. 3.

Referring to FIG. 3, the spider 14 has a hub 16 and a number of radiating arms 17, one for each pedestal A–R. The hub 16 is rotatably supported by means of an antifriction thrust bearing 18 on a stationary vertical sleeve 19 secured to and extending upwardly from the casing 6. Centrally mounted within the hub 16 for rotation therewith is a vertical, elongated drive sleeve 21 which extends downwardly through the sleeve 19 into the casing 6 where a drive gear 22 is secured to its lower end. A liquid supply bowl 23 of the turret assembly 2 is supported in an elevated position above the spider 14 by means of a depending elongated shaft 24 and a rotatable adjusting sleeve 25 in screw threaded engagement with the lower end of the shaft 24. The adjusting sleeve 25 is rotatably supported within the drive sleeve 21 by means of an antifriction bearing 20, and at its lower end the sleeve 21 has a downwardly extending shaft extension 25a within the casing 6. Coaxially mounted on the shaft extension 25a is a rotatable relative thereto is a worm gear 87. A clutch collar 88 for coupling the worm gear to and uncoupling it from the shaft extension 25a is connected with the shaft extension 25a in up and down shiftable and non-rotatable relation thereto. The worm gear 87 meshes with a manually rotatable worm element 89, and the clutch collar 88 may be engaged with and disengaged from the worm gear 87 by a manually operable shift fork 91.

At the upper end of the shaft 24, a supporting disc 24a for the bowl 23 is rigidly connected thereto as by welding, and three guide rods 92 (FIG. 3a) which are rigidly secured in depending positions to the disc 24a, extend slidable through guide lugs 93 on the upper end of the drive sleeve 21. When the worm gear 87 is coupled to the shaft extension 25 and the worm element 89 is rotated, the bowl 23 moves up or down relative to the spider 14 depending on the direction in which the worm element 89 is rotated. The threadedly interconnected shaft 24 and adjusting sleeve 25 provide a telescopically extendable and retractable support column for the liquid supply bowl 23, by means of which the turret assembly 2 may be adjusted to accommodate bottles of various heights.

4

The bottle support pedestal N shown in FIG. 3 comprises a platform 27 and a depending hollow stem 28 which is guided for up and down movement in a tubular mounting head 29 at the outer end of the spider arm 17. A coil spring 31 within the hollow stem 28 urges the pedestal N to a raised limit position which is determined by engagement of an abutment 32 at the lower end of the stem 28 with the tubular mounting head 29. Rotatably mounted on the lower end of the stem 28 is a cam follower roller 33 which is operable with a stationary cam track 34 (FIG. 1) carried by the housing 6 for causing up and down movement of the bottle supporting pedestal N during rotation of the turret assembly 3 about its vertical axis on the casing 6. The foregoing explanations regarding the mounting of the pedestal N analogously apply to each of the eighteen pedestals of the turret assembly 3.

The liquid supply bowl 23 of the turret assembly 2 is provided at its underside with a circular series of eighteen liquid dispensing devices 36, one over each of the pedestals A–R. A sectional view of one of the dispensing devices 36 is shown in FIG. 7. It comprises a tubular spout 35, a tubular vent 37, an axially back and forth shiftable sleeve 39 and a bellows 40 which is sealingly connected at its lower end with the sleeve 39. The spout 35 is rigidly secured to the supply bowl 23, and the vent tube 37 is suspended in a vertically fixed position on the spout 35 by means of a hanger bracket 41. The vent tube 37 extends axially through the spout 35 and terminates at its lower end in a circular head 42. The upper part of the vent tube 37 extends within the supply bowl 23 to a height above the level 38 (FIG. 3) of the fluid stored therein, in conformity with conventional practice. The interior of the vent tube 37 provides a vent passage which is open on top and terminates at its lower end in a radial aperture 37'. The radial space between the vent tube 37 and spout 35, and between the vent tube 37 and the sleeve 39 provides a supply passage through which fluid may flow from the supply bowl 23 to the lower end of the sleeve 39. The sleeve 39 is guided on the vent tube 37 which for that purpose is provided with an arcuate peripheral outer surface and with a rib 37" which bear against the cylindrical inner surface of the sleeve 39.

The lower end of the sleeve 39 telescopically engages the head 42 of the vent tube 37. An O-ring 42' within a groove of the head 42 forms a valve seat which in the condition of the valve as shown in FIG. 7 is engaged by the circular lower edge of the sleeve 39 with the O-ring 42' and closes the supply passage around the vent tube 37 and the vent passage therethrough.

The bellows 40 is made of rubber or rubber-like material and is shown in FIG. 7 in its axially expanded condition in which it urges the lower edge of the sleeve 39 into sealing engagement with the O-ring 42'.

When the bottle 47 is lifted from its FIG. 7 position to the position in which it is shown in FIG. 8, it lifts the sleeve 39 from the O-ring 42' which causes opening of the supply passage around the vent tube 37 and of the vent passage through the interior of the vent tube 37. This permits relatively fast gravity flow of fluid from the bowl into the container or bottle to be filled. When the bottle has been partially filled to the desired height, lowering of the bottle, when the pedestal is lowered, causes the sleeve 39 to be seated on the O-ring 42 and thereby close the supply and vent passages.
The second turret assembly 3 comprises a circular series of 12 bottle supporting pedestals which are designated in FIG. 2 by references a through l (a–l). The explanations hereinafter with reference to the bottle supporting pedestals A–R of the turret assembly 2 analogously apply to the pedestals a–l of the turret assembly 3. That is, the pedestals a–l are carried by a rotatable spider similar to the spider 14 shown in FIG. 3 but having only 12 radial arms and connected mounting heads for the pedestals a–l. As shown in FIG. 2, the pedestals a–l are arranged on a pitch circle of smaller diameter than the pitch circle of the pedestals A–R.

The liquid supply bowl 48 of the turret assembly 3 is sustained in an elevated position on a telescopically extendable and contractable supporting column like the column 24, 25 shown in FIG. 3, and the supply bowl 48 is provided at its underside with a circular series of twelve liquid dispensing devices 49, one over each of the pedestals a–l.

Each of the dispensing devices 49 is constructed as shown in FIG. 9 and comprises a vent tube 137 which is open at both ends and communicates with the interior of the supply bowl 48 above the level of the liquid therein in accordance with conventional practice. Surrounding and spaced from the vent tube 137 is a sleeve 139 which is guided for up and down movement in a depending cylindrical spout extention 141 of the supply bowl 48. A valve seat 142 is formed at the lower end of the valve tube 137 for cooperative engagement with the lower end 139' of the valve sleeve 139. A coil spring 143 bears at its upper end against a shoulder on the spout extension 141 and at its lower end upon a deflector plate 144 which is connected with the sleeve 139 for up and down movement therewith. The lower end 139' of the sleeve 139 is urged into sealing engagement with the valve seat 142 by the pressure of the spring 143. A sealing ring 146 of flexible material surrounds the sleeve 139 below the deflector plate 144, and the portion of the sleeve 139 below the sealing ring forms a nozzle of suitable diameter for insertion into the neck of a bottle into which liquid is to be dispensed from the supply bowl 48.

In the condition of the dispensing device 49 as shown in FIG. 10, a bottle 147 has been lifted by upward movement of its supporting pedestal. During such upward movement the neck of the bottle has telescoped over the lower end of the sleeve 139; the sealing ring 146 has been engaged by the mouth of the bottle and sealed it, and the sleeve end 139' has been raised from the seat 142 in opposition to the pressure of the coil spring 143.

As distinguished from the bowl 23 of the turret assembly 2 which is not sealed against the entry of atmospheric air pressure into the space above the liquid therein, the bowl 48 of the turret assembly 3 is provided with an air-tight cover 51 and connected by a pipe 52 with the vacuum pump 13 so that a subatmospheric pressure can be established in the space above the liquid in the supply bowl 48. In this respect the second turret assembly 3 is similar to the turret assembly disclosed in the hereinafter mentioned Burford U.S. Pat. No. 3,578,038. To facilitate filling of the bottles, and particularly plastic bottles, precisely to their exact full content, the Burford patent discloses provisions for varying the subatmospheric pressure in the supply bowl in rapid succession, and it is within the purview of the present invention to also provide for such rapidly changing or pulsating subatmospheric pressure in the supply bowl 48 of the turret assembly 3.

Opening and closing of the valves in the dispensing devices 49 of the second turret assembly is effected in a manner similar to that in which the valves of the dispensing devices 36 of the first turret assembly are opened and closed. Each of the pedestals a–l has a cam follower roller 53 (FIG. 5), and a stationary cam track 54 is mounted on the casing 6 and engaged by the rollers 3 as the turret assembly 3 rotates about its vertical axis. The pedestals a–l are spring biased upwardly, and coaction of the rollers 53 with the cam track 54 causes sequential upward and downward movement of the pedestals which in turn establishes and interrupts gravity flow of liquid from the supply bowl 48 into bottles on the pedestals. However, due to the presence of subatmospheric pressure in the space above the liquid in the supply bowl 48, the gravity flow of liquid therefrom will be arrested by vacuum, as distinguished from the flow of liquid from the supply bowl 23 which takes place by gravity only.

Like the first turret assembly 2, the second turret assembly 3 includes a telescopically extendable and contractable support column for the liquid supply bowl. The explanations hereinafter regarding the raising and lowering of the supply bowl 23 by rotating the worm element 89 in one direction and the other, similarly apply to the raising and lowering of the supply bowl 48. Aside from the up and down adjustment of the bowl for the purpose of accommodating bottles of various heights, such up and down movement of the bowls may also be utilized to vary the flow rate of the liquid through the valves 36 of the first turret assembly 2, and the flow rate of the liquid through the valves 49 of the second turret assembly 3.

FIG. 4 schematically illustrates the operation of the first turret assembly 2. The bottle supporting pedestals A through R are strung out linearly from the pitch circle on which they are actually arranged as shown in FIG. 2. The pedestal A is shown in its lowered bottle receiving position in which it is held by engagement of its cam follower roller 33 with the cam track 34. The pedestal B is shown in a partly raised position; the pedestals C–N are shown in the fully raised position, and the pedestal O is shown in a partly lowered position, and the pedestals P, Q and R are shown in their lowered bottle delivering positions. As the turret assembly 2 rotates in the direction of arrow 56 in FIGS. 1, 2 and 4, the bottles on the pedestals A–R remain vertically aligned with the overlying dispensing devices 36, but movement of the cam follower rollers 33 along the stationary cam track 34 causes each bottle to open the valve of its overlying dispensing device; keep it open during a protracted part of one turret revolution; and then close the valve and thereby terminate the gravity flow of liquid from the bottle 23 into the bottle. In FIG. 4, gravity flow of liquid into the bottle on pedestal C begins when the cam roller 33 of that pedestal runs up on one end of the cam track 34. The gravity flow then continues until the cam roller 33 of pedestal C runs down on the other end of the cam track 34.

FIG. 4 also illustrates the amounts of liquid which have accumulated in the bottles after one full revolution of the turret assembly 2. Liquid flow into the bottles on pedestals A and B has not yet started; successively increasing amounts of liquid have accumulated in the bottles on pedestals C–N, the amount of liquid
accumulated in the bottle on pedestal N being somewhat less that the full bottle content, as for instance one quarter less in which case the bottle on pedestal N would only be three-quarters full. The bottles on pedestals O-R are withdrawn from the overlying dispensing devices 36; fluid flow into the bottles on these pedestals has therefore stopped, and the incompletely filled bottles on the pedestals O-R are ready for transfer to the second turret assembly 3 where filling is progressively completed to the precise full bottle content.

Transfer of the incompletely filled bottles from the turret assembly 2 to the turret assembly 3 is accomplished as indicated in FIG. 2 by means of the star wheel 8 which is continuously rotated in the direction of arrow 57.

FIG. 5 schematically illustrates the operation of the second turret assembly 3. Here again, as in FIG. 4, the pedestals are linearly strung out from the pitch circle on which they are arranged in the machine. The pedestal a is shown in its lowered bottle receiving position in which it is held by engagement of its cam follower roller 53 with the cam track 54. The pedestal b is shown in a partly raised position; the pedestals c-i are shown in their fully raised positions; the pedestal j is shown in a partly lowered position; and the pedestal k is shown in its lowered bottle delivering position. As the turret assembly 3 rotates in the direction of arrow 57 in FIGS. 1, 2 and 5 bottles on the pedestals a-k remain vertically aligned with the overlying dispensing devices 49 but movement of the cam follower rollers 53 along the stationary cam track 54 causes each bottle to open the valve of its overlying dispensing device; keep it open during a protracted part of one turret revolution and then close the valve and thereby terminate the vacuum assisted gravity flow of liquid from the bowl 48 into the bottle.

In FIG. 5 vacuum assisted gravity flow of liquid into the bottle on pedestal c begins when the cam follower roller 53 of that pedestal runs up at one end of the cam track 54. The vacuum assisted gravity flow of liquid into the bottle on pedestal c then continues until the cam follower roller 53 of that pedestal runs down on the other end of the cam track 54.

The extent to which the bottles on pedestals a-k have been filled after one complete revolution of the turret assembly 3 is indicated in FIG. 5. At the start of such revolution the bottles on pedestals a and b contain the amount of liquid with which they were filled in the turret assembly 2, as for instance three quarters of their full content. The bottle on pedestal c contains somewhat more liquid than the bottles on pedestals a and b, but still less than its full content. The bottles on pedestals d-i contain progressively increasing amounts of liquid, the amount accumulated in the bottle on pedestal i being the exact full content of the bottle. The bottles on pedestals j and k are withdrawn from the overlying dispensing devices 49; fluid flow into the bottles on these pedestals has stopped, and the completely filled bottles are ready for transfer to the capping mechanism 4. Pedestal l is vacant and ready to receive an empty bottle from the star wheel 8 at the start of the next revolution of the turret assembly 3.

The completely filled bottle on the pedestal l is subject to the static pressure head of the liquid in the supply bowl 48. Consequently, if the bottle is made out of elastic material such as is commonly used for the manufacture of plastic milk bottles, such a bottle will be somewhat distended by the weight of the accumulated liquid therein and by the static pressure head of the liquid in the bowl while the pedestal l keeps the bottle engaged with the overlying dispensing device and in communication with the fluid in the bowl 48. Withdrawal of the bottle on pedestal l from the overlying dispensing device 49 by continued rotation of the turret assembly 3, and simultaneous lowering of the pedestal i, closes the valve in the overlying dispensing device, and the bottle becomes relieved of the pressure head of the liquid in the bowl 48. The distending pressure of the liquid in the plastic bottle on pedestal l will therefore be diminished, the bottle will contract and some of the accumulated liquid therein will tend to spill over the edge of the open mouth of the bottle. However, the subatmospheric pressure in the bowl 48 is suitably controlled so that the amount of liquid which is apt to be spilled by the contraction of the bottle is drawn back into the bowl 48 through the vent tube of the dispensing device after the fluid flow has been stopped by closure of the valve in the dispensing device. In this manner, filling of the bottles to their precise full content will be completed by the second turret assembly 3.

Transfer of the completely filled bottles to the capping mechanism 4 is accomplished as indicated in FIG. 2 by means of the star wheel 11 which is continuously rotated in the direction of arrow 58.

The capping mechanism 4 comprises a circular assembly of five bottle supporting pedestals m, n, o, p, q which are mounted on a rotatable spider and are moved up and down by means of cam follower rollers 59 (FIG. 1) and a stationary cam track 61 (FIG. 6), the capping mechanism being in this respect similar to the turret assemblies 2 and 3. Above the pedestals m-q, a circular series of five screw cap attaching units 62 are suspended from a rotary driving head 63, one unit 62 over each pedestal m-q. A rotary tubular supporting column 64 for the driving head 63 is mounted in an upright position and concentrically with the pedestals m-q on the casing 6. Planetary gearing, not shown, of the driving head 63 causes the screw cap attaching units 62 to rotate in unison with the pedestals m-q about the column 64 and at the same time to spin about their individual axes. During such planetary movement of the cap attaching units 62 bottles with caps initially placed thereon are moved up and down by the pedestals m-q, so that the caps will be tightened while the bottles are raised and their caps are engaged by the spinning attaching units 62.

A cap feeding mechanism 66 is suitably arranged to place a closure cap on each of the filled bottles as they are transferred from the turret assembly 3 to the capping mechanism 4 by the rotating star wheel 11. A friction drive, not shown, for the caps starts turning them upon the threaded necks of the bottles as they are circularly conveyed by the rotating star wheel 11. For a more detailed description of the capping mechanism 4 and of the cap feeding mechanism 66, reference may be had to the copending U.S. Pat. application Ser. No. 181,827 filed Sept. 20, 1971 by H. Boeckman and W. F. Hammerink for "Capping Apparatus", now U.S. Pat. No. 3,771,284, issued on Nov. 13, 1973.

Transfer of the filled and capped bottles from the capping mechanism 4 to an output conveyor 67 is accomplished as indicated in FIG. 2 by means of the continuously rotating star wheel 12, and transfer of empty bottles from a feeding conveyor 68 to the turret assembly.
bly, 2 is accomplished by the star wheel 9. The directions of rotation of the star wheels 12 and 9 are indicated in FIG. 1 by the arrows 69 and 71, respectively.

The casing 6 encloses drive means for simultaneously rotating the first and second turret assemblies 2 and 3 at relatively slow and fast speeds, respectively. As indicated in dash-dotted lines in FIG. 2, said drive means comprises first and second gear wheels 22 and 72 secured, respectively, to the spider 15 (FIG. 3) of the first turret assembly 2 and to the corresponding spider of the second turret assembly 3; a gear wheel 73 for the star wheel 8 in mesh with the gear wheels 22 and 72; a gear wheel 74 for the second star wheel 9 in mesh with the first gear wheel 22; a gear wheel 76 for the third star wheel 11 in mesh with second gear wheel 72; a gear wheel 77 for the tubular drive shaft 64 of the capping mechanism 4 in mesh with the drive gear 76 for the third star wheel 11; a power input mechanism having a gear wheel 78 in mesh with the drive gear 77 for the capping mechanism; and a gear wheel 81 for the fourth star wheel 12 in mesh with the gear wheel 77 on the drive shaft 64 for the capping mechanism 4.

The power input mechanism comprises a worm and gear drive 82 for the gear wheel 78, an electric motor 83, and a belt drive 84 connecting the motor 83 to the worm and gear drive 82.

In operation, the star wheel 9, turret assembly 2, star wheel 8, turret assembly 3, star wheel 11, capping mechanism 4 and star wheel 12 are rotated at the necessary number of revolutions per minute which will cause a continuous flow of bottles to advance steadily at the same linear speed from the feed conveyor 68 to the output conveyor 67. This linear speed is one of the determining factors for the output capacity of the machine. Other factors which determine the output capacity are the flow rate at which the liquid is dispensed from the supply bowls 23 and 48, and the timing of the dispensing valves 36 and 49 which is obtained by the coaction of the cam follower rollers 33 and 59 and their associated cam tracks 34 and 54. By properly coordinating these factors, output capacities of 65 gallons per minute and better may readily be obtained by the herein disclosed method and machine.

When the machine is used for filling bottles with liquid such as milk which is apt to foam, the flow rate at which the liquid is dispensed from the bowl 23 of the first turret assembly may nevertheless be kept relatively high, because the fluid flow is stopped when the bottles are only partially filled, and foam formation during such partial filling is not objectionable. During the final filling stage by the turret assembly 3 foam formation is taken care of by the maintenance of a subatmospheric pressure in the supply bowl 48 of the second turret assembly 3.

Although the machine is operable, as stated, at a high output capacity, the size of the liquid supply bowls 23 and 48 does not have to be unduly large which would make the required frequent cleaning by hand difficult.

I claim:

1. The method of filling open-mouthed receptacles with liquid, which comprises the steps of inserting a first liquid discharge nozzle into the mouth of the receptacle; advancing the receptacle and inserted nozzle along a first path of predetermined length; establishing liquid flow by gravity from said first nozzle into said receptacle at a rate which will initially fill said receptacle to less than its full content during said advancement thereof along said first path; terminating said gravity liquid flow; removing said first nozzle from and inserting a second nozzle into the mouth of said initially filled receptacle; advancing said initially filled receptacle and inserted second nozzle along a second path of predetermined length; and establishing vacuum assisted liquid flow by gravity from said second nozzle into said initially filled receptacle at a rate which will complete filling of said receptacle to its full content during said advancement thereof along said second path.

2. The method set forth in claim 1, wherein the length of said first path and said liquid flow rate by gravity are relatively proportioned so that a major part of the full receptacle content will be accumulated in the receptacle during said advancement thereof along said first path.

3. A filling machine comprising a first and second filling turret assembly rotatable on vertical spaced axes and each comprising a circular series of bottle supporting pedestals, an elevated liquid supply bowl, and a circular series of liquid dispensing devices, one over each pedestal, connected with said supply bowl; first control means operable to establish and interrupt gravity flow of liquid through said dispensing devices of said first turret assembly during rotation of the latter; bottle feeding means operable to transfer bottles from the pedestals of said first turret assembly to the pedestals of said second turret assembly; air evacuating means operatively connected with the liquid supply bowl of said second turret assembly so as to establish a subatmospheric pressure therein; and second control means operable to establish and interrupt vacuum assisted gravity flow of liquid through the dispensing devices of said second turret assembly during rotation of the latter, said first and second control means being timed so as to fill successive bottles progressively to less than their full content by said first turret assembly and so as to complete filling of said bottles by said second turret assembly.

4. A filling machine as set forth in claim 3 and further comprising drive means operable to simultaneously rotate said first and second turret assemblies at relatively slow and fast speeds, respectively; the pedestals of said first turret assembly being greater in number and arranged on a pitch circle of larger diameter than the pedestals of said second turret assembly.

5. A filling machine as set forth in claim 3 and further comprising a rotatable star wheel affording said bottle feeding means, said drive means including a first gear wheel secured to said first turret assembly, a second gear wheel secured to said second turret assembly, and a third gear wheel secured to said star wheel and in mesh with said first and second gear wheels.

6. A filling machine as set forth in claim 5 and further comprising a second bottle engaging star wheel operable to feed bottles to the pedestals of said first turret assembly, and a drive gear for said second star wheel in mesh with said first gear wheel.

7. A filling machine as set forth in claim 6 and further comprising a third bottle engaging star wheel operable to convey bottles away from the pedestals of said second turret assembly, and a drive gear for said third star wheel in mesh with said second gear wheel.

8. A filling machine as set forth in claim 3 wherein each of said first and second turret assemblies includes a telescopically extendable and retractable support column for the respective liquid supply bowl.