July 20, 1965 P. R. FECHHEIMER 3,195,585
FLOW REGULATING MEANS FOR CONTAINER
FILLING MACHINES AND METHOD
Filed Feb. 12, 1962 2 Sheets-Sheet 1

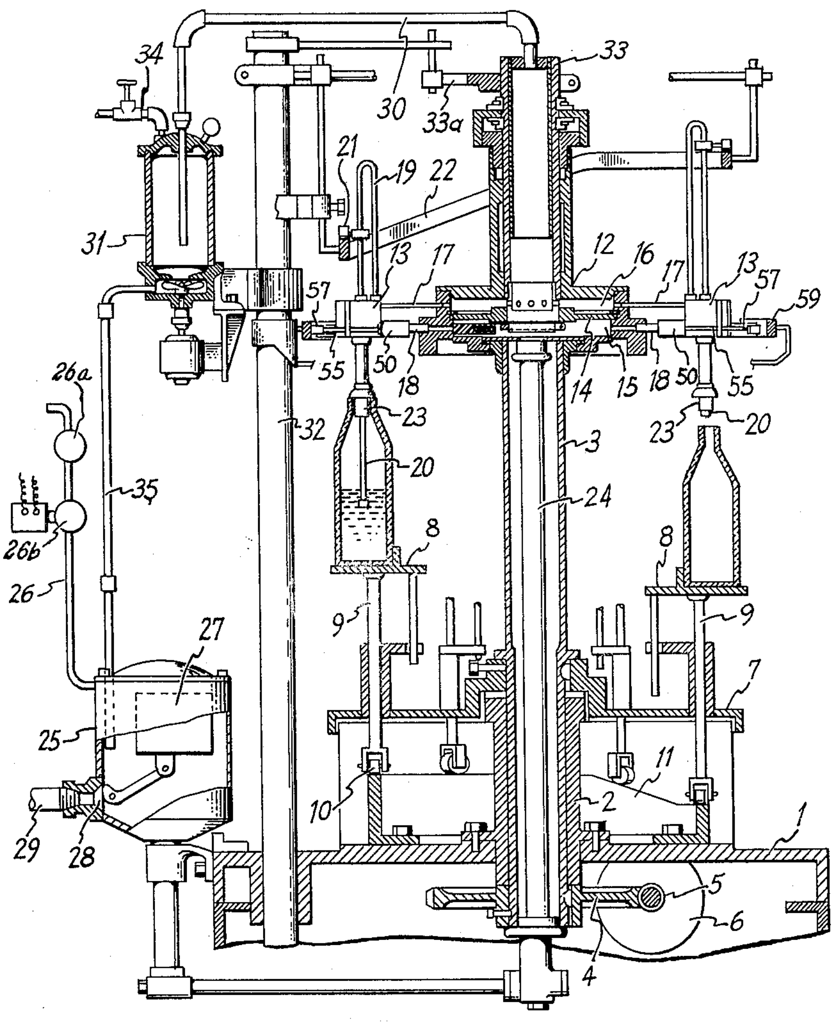

Fig. 1

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2 Sheets-Sheet 2

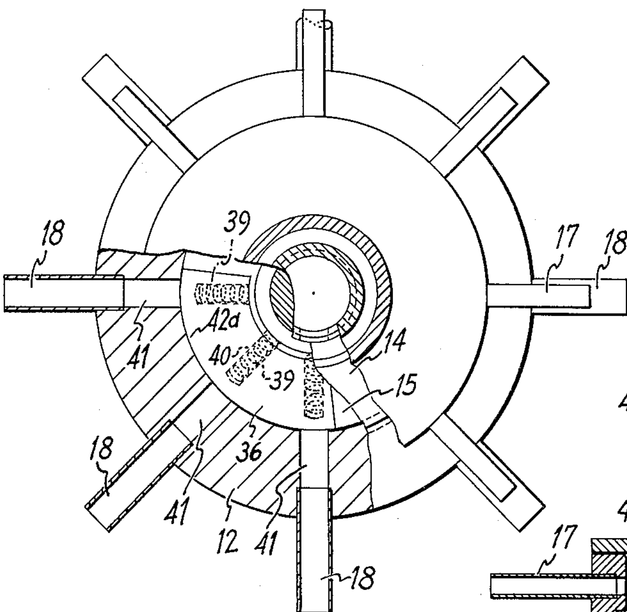

Fig. 2

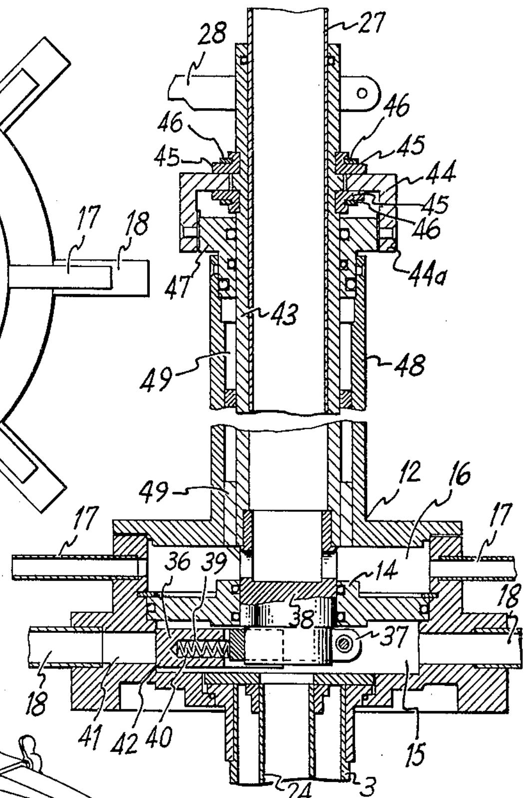

Fig. 3

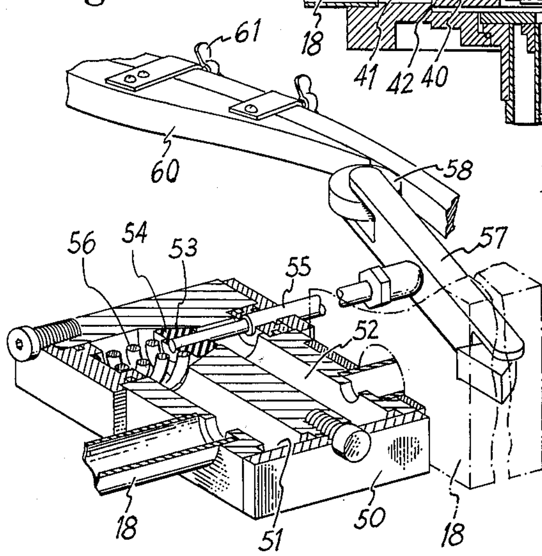

Fig. 4

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FLOW REGULATING MEANS FOR CONTAINER FILLING MACHINES AND METHOD

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This invention relates to container filing machines and more particularly to rotary filling machines of the type wherein a plurality of radially disposed filling spout structures are rotated in unison with an underlying table mounting a corresponding number of lift platforms arranged to receive containers to be filled, present the containers to the filling spout structures for filling, and then lower the filled containers for removal during each rotative cycle of the machine.

The actual filling operation may be conducted in a number of different ways, depending upon the filling system being used. In the more refined devices, the filling spout structures incorporate vacuum tubes which assist in the control of product flow. For example, in a vacuum filler, the mouth of the container being filled is sealed against the filling spout structure, whereupon the flow of product into the container is induced by drawing a vacuum on the container, the flow of product being interrupted and the fill height established when the product reaches and closes the vacuum tube. In a pressure-vacuum filler, the product supply reservoir is sealed and pressurized and the fill height is controlled by a balancing pressure in the head space of the container. That is, when the container is sealed and a vacuum drawn on it, liquid will flow into the container until the liquid level closes the vacuum tube, and then will rise slightly higher until the air in the head space has been compressed to a point where the air pressure in the head space balances the pressure applied in the supply reservoir. The vacuum tube may then be utilized to draw off the overfill. In another type of pressure-vacuum filling system, the container remains unsealed, the flow of product into the container being controlled by the opening and closing of a product valve set to close when the liquid level in the container has reached a predetermined height, whereupon any overfill is withdrawn through the vacuum tube. There are, needless to say, numerous variations to the foregoing systems; but irrespective of the particular system employed, certain difficulties are encountered in all of them depending upon the type of liquid product being handled, the configuration of the containers being filled, and the accuracy of fill required.

For example, in filling unsealed containers if the liquid level is close to the top of the container, there may be a surge of product over the top of the container as the product control valve is turned off. Even though the closing of the product control valve may appear to be substantially instantaneous, there is nevertheless a finite time lapse which may be sufficient to produce an overfill. A similar situation is encountered when filling a container having limited head space over the liquid level and/or a restricted neck opening which is substantially filled by the filling spout. For example, if the rate of liquid rise in the container is one inch per second as the product is filling the major cross section of the container, when the product arrives at the restricted neck, the same rate of flow represents an almost astronomical increase in the rate of linear rise of the liquid level. Consequently, even in the instant the product control valve is shutting off, there is a tendency for the liquid to puff out of the top of the container.

Highly foamable products also present decided problems due to splashing and air entrainment. For example,

in a submerged fill type of unit, that is, a unit wherein the filling tubes are extended to the bottoms of the containers so that the outlet ports at the lowermost ends of the tubes will be quickly submerged so as to minimize splashing and foaming of the product and the entrainment of air as the filling operation begins, there is nonetheless a problem in that the initial surge of product through the filling tube causes splashing and foaming. Somewhat similar problems are encountered in filling wasp waist containers, i.e. containers having a relatively large bottom portion, a narrow or restricted intermediate portion, and an enlarged upper portion. If the rate of product flow remains constant during filling, the rate of liquid rise in the container will vary widely, depending upon the particular configuration of the container, and considerable turbulence may be encountered which causes foaming and air entrainment.

In accordance with the instant invention, I have found that the foregoing difficulties can be essentially eliminated or minimized by controlling and varying the rate of product flow in accordance with the type of container being filled and the type of product being handled.

Accordingly, a principal object of the instant invention is the provision of flow regulating means effective to vary the rate of product flow during portions of the filling cycle, thereby effectively controlling the foaming and entrainment of air in the product being filled and at the same time assuring extreme accuracy of fill without excessive overfill.

Another object of the instant invention is the provision of procedures for the filling of containers, which procedures are effective to essentially eliminate or minimize foaming and air entrainment and the possibility of excessive overfill.

A further object of the instant invention is the provision of valve means which may be incorporated in a rotary filling machine, such valve means being adjustable to selectively control the rate of product flow depending upon the type of container being filled and the particular type of filling spout structures employed for the filling operation.

Still a further object of the instant invention is the provision of valve means operative to selectively control the rate of product flow at either the beginning or end of the filling cycle or, if the conditions of use require, at any intermediate point in the filling cycle.

Still a further object of the instant invention is the provision of valve means of the character described which are automatic in action and which can be readily adjusted to meet diverse needs encountered in commercial filling operations.

The foregoing, together with other objects of the instant invention which will appear hereinafter or which will be apparent to the skilled worker in the art upon reading this specification, I accomplish by that construction and arrangement of parts of which I shall now describe a certain exemplary embodiments.

Reference is made to the accompanying drawings wherein:

FIGURE 1 is a vertical sectional view through exemplary filling apparatus in accordance with the instant invention.

FIGURE 2 is a plan view with parts broken away of the product chamber in the filling head, illustrating a segmental valve in accordance with the invention.

FIGURE 3 is an enlarged vertical sectional view of the filling head assembly.

FIGURE 4 is a cut away perspective view illustrating an alternate form of valve arrangement adapted to be interposed between the filling head and the filling spout structures.

Referring now to FIGURE 1 of the drawings, I have therein illustrated a rotary filling machine comprising a base 1 mounting a bearing sleeve 2 in which the main column 3 of the filling machine is rotatably journaled. The column 3 is rotated by means of a worm wheel 4 engaged by a worm 5 operatively connected to drive motor 6. A table 7 is fixedly secured to the main column 3 for rotation therewith, and the table mounts a plurality of lift platforms 8 adapted to be sequentially raised and lowered to present the containers for filling. In the exemplary embodiment illustrated, the lift platforms are mounted on rods 9 vertically slidable through the table 7 and having cam followers 10 on their lowermost ends positioned for contact with the contoured cam track 11. It will be evident that as the table 7 is rotated, the lift platforms 8 will be raised and lowered in accordance with the contour of cam track 11. It will be understood, of course, that containers to be filled will be delivered to the lift platforms by suitable conveyor means, not shown, and at the completion of the filling cycle the filled containers will be removed from the lift platforms, as by means of a star wheel, also not shown.

At its upper end, the main column 3 mounts a filling head 12 fixed to the column for rotation therewith, and the head mounts a plurality of radially extending filling spout structures 13 arranged in vertical alignment with the lift platforms 8. The filling head 12 is divided by a diaphragm 14 into a product chamber 15 and a vacuum chamber 16, the chambers each being in communication with the filling spout structures 13 by means of sets of conduits 17 and 18. In the embodiment illustrated, which illustrates a submerged fill type of filling spout structure, the product conduits 18 are connected through the bodies of spout structures 13 to flexible tubes 19 which in turn are connected to the filling tubes 20 which are arranged to be raised and lowered relative to the containers being filled by means of cam followers 21 and cam track 22. The vacuum conduits 17, on the other hand, are connected through the spout bodies to the vacuum tubes 23. Product is supplied to the product chamber 15 through conduit 24 contained within the column 3, the conduit 24 being connected to a closed and pressurized reservoir 25 to which air under pressure is supplied through a pipe 26 which may be provided with a pressure regulating valve 26*a* and a cut off valve 26*b* the latter being solenoid actuated and wired to the motor circuit of the machine drive so that the valve will be open only when the filling machine motor is running. A float 27 may be provided in the reservoir 25 to operate a valve 28 which prevents overfilling of the reservoir and maintains a constant level of product introduced into the reservoir through supply pipe 29. Needless to say, the product supplied through pipe 29 will be at a pressure sufficient to overcome the internal pressure built up in the supply tank.

The vacuum chamber 16 in the head is connected by a conduit 30 to a vacuum chamber and trap 31 which may be conveniently mounted on the standard 32 forming a part of the machine frame. A gland 33 secured to bracket 33*a* also mounted on standard 32 permits rotation of the main head relative to the conduit 30. The vacuum chamber and trap 31 is connected by a pipe 34 to a source of vacuum not shown. Any product drawn into the vacuum side of the machine will be drawn into the vacuum chamber where it will be separated from the air stream and returned to the reservoir through conduit 35.

In accordance with the instant invention and as best seen in FIGURES 2 and 3, the rate of flow of product from product chamber 15 to the filling spout structures is controlled by means of a segment valve 36 in the form of a shoe positioned to ride in sliding contact with the inner wall surface of chamber 15. Preferably, this shoe will be formed from a plastic material, such as Teflon, to avoid any galling action; and the segment valve 36 is mounted on a spider 37 attached to the bottom of the vacuum nipple 38. Springs 39 set in sockets 40 act to bias the segment valve 36 into tight contact with the annular wall surfaces of the product chamber 15. As will be evident from FIGURE 2, as the filling head 12 rotates, the ports 41, which are in communication with the conduits 18, are sequentially contacted and at least partially closed by the segment valve 36.

As best seen in FIGURE 3, the segment valve 36 has a beveled edge 42 which may be on either its top or bottom edge—it being shown on the bottom edge in FIGURE 3. In addition, the segment valve is movable vertically in a manner which will be explained more fully hereinafter; however, by moving the segment valve to its extreme bottom position, the flow of product from chamber 15 into ports 41 is completely cut off for that section of the chamber subtended by the segment valve. By adjusting the segment valve upwardly, the beveled edge 42 comes into communication with the ports 41, thereby permitting limited flow of product into the ports, the rate of flow being dependent upon the area of the ports 41 exposed by the beveled edge of the segment valve. In addition to effectively reducing the rate of product flow during a portion of the operating cycle, by rotating the spider 38 relative to the head, the reduced filling portion of the cycle can be located at any desired point, i.e. at the beginning, middle, or end of the cycle. In addition, if it is desired to have full flow throughout the entire filling cycle, the segment valve may be rotated to the front of the machine where there are no active stations.

The mechanism by means of which the segment valve is adjusted, both vertically and rotatively, comprises a nipple 43 secured at its lowermost end to vacuum nipple 38 and adapted at its upper end to receive the sleeve 27 with respect to which the nipple 43 is movably mounted. Where it is desired to rotate the nipple, this may be conveniently done by loosening the bracket 33*a*, which may be in the form of a split clamp, the split clamp being tightened after the nipple has been rotated to position the segment valve in the desired location.

Axial adjustment of the nipple 43—which effects vertical movement of the segment valve—is obtained by means of adjustment ring 44 attached to nipple 43 by means of split bushings 45 held together by retaining rings 46. With this arrangement, the adjustment ring 44 is free to rotate relative to nipple 43; and its skirt portion 44*a* is internally threaded for engagement with the fitting 47 fixedly secured to the uppermost end of sleeve 48 forming a part of the filling head 12. Suitable bushings 49 act to rotatably journal the nipple 43 relative to the sleeve 48. Preferably, the adjustment ring 44 will carry dial markings on its external circumference calibrated to indicate linear movement of the nipple 43 and hence vertical movement of segment valve 36.

In addition to the simple bevel illustrated in FIGURE 3 of the drawings, it will be evident that various configurations may be employed if it is desired to have a varying flow rate. For example, it may be advisable to have a gradually increasing rate of flow, in which event the contour of the bevel would be machined accordingly. Similarly, in a submerged fill type of operation wherein the filling tube is first extended to the bottom of the container being filled, it may be advisable to cut off the flow of product completely during the time the stem is dropping and then permit a limited flow rate until the product ports are submerged. This would mean that the segment valve would carry no bevel throughout the leading portion of its effective length, whereupon the beveled edge would begin and continue throughout the remainder of its length. Such partial bevel is indicated in dotted lines at 42*a* in FIGURE 2. It will also be evident that instead of a unitary segment valve, such valve could be divided into a plurality of spaced apart segments with or without the beveled edge, again depending upon the particular conditions of use encountered.

Referring now to FIGURE 4 of the drawings, I have therein illustrated an alternative embodiment of the invention wherein the filling spout structures are equipped with individual flow control valves. These individual valves may be employed in replacement of the segment type valve just described, or, if desired, they may be used in conjunction with the segment valve in the filling head. Essentially, the individual valves each comprise a body **50** divided internally into an inlet passageway **51** and an outlet passageway **52**, the two passageways being interconnected by means of a tapered opening **53** which serves as a seat for valve element **54**. The valve element is opened and closed by means of a valve stem **55** which projects outwardly from the body of the valve; and the valve element and stem are normally biased to the close position by means of a spring **56**.

Referring now to FIGURE 1, the valve **50** is preferably attached to the inlet sides of the filling spout structures, with the outlet passageways **52** of the valves in communication with the inlet side of filling spout structures, and the inlet pasageways **51** of the valves in communication with the conduits **18** through which product is delivered from the product chamber **15** of the filling head. The valve stems **55** project outwardly beyond the filling spout structures where they are adapted to be contacted by pivoted arms **57** carried by the filling spout structures, the arms mounting cam followers **58** on their free ends for contact with the cam track **59** which is supported in part at least from vertical support **32** in much the same manner as cam track **22**.

It will be evident from FIGURE 4 that when the valve element **54** is closed, there will be no product flow through the valve; but that flow will be initiated upon the opening of valve element **54**, the rate of flow depending upon the degree to which the valve element is displaced against the compression of spring **56**. The amount of displacement will be determined by the contour of cam track **59** which may comprise a circular ring on which are mounted one or more adjustable dogs or cam segments **60** suitably contoured to effect the desired axial displacement of the valve stem. The segments **60** may be adjustably secured to the track **59** by means of nuts **61**, and their number, size and position will determine the opening and closing movement of the valve element and hence the rate of product flow during any given portion of the filling cycle.

As will be evident from the foregoing, the use of the flow control means and procedures of the instant invention will enable the user to precisely control the rate of fill of any container being filled irrespective of any special filling problems which might be encountered. Since one of the major objectives of any automatic filling machine is to fill the containers as rapidly as possible, the instant invention permits filling at the maximum rate whenever possible, and yet by appropriate adjustment of the rate of product flow, the flow of product can be cut off completely or reduced during any desired portion or portions of the filling cycle.

Having thus described the invention in certain exemplary embodiments, and with the understanding that modification may be made without departing from its spirit and purpose, what I desire to secure and protect by Letters Patent is:

1. A method of filling a fluid product into containers continuously fed to a rotary filling machine having a plurality of filling spouts supplied with product from a product source, said method comprising the steps of: feeding the containers to said machine onto supports juxtaposed to said filling spouts, continuously rotating said spouts and supports together in a path around the machine, presenting each container on a support to the corresponding filling spout near the beginning of said path, commencing the flow of product from said source into each container upon presentation of the container to a filling spout, varying the rate of flow of the product according to the position of the container in said circular path, withdrawing each container from its corresponding filling spout near the end of each path, and discharging the filled containers from the machine.

2. The method of claim **1** wherein a rate of product flow less than the maximum rate is provided to each container when it is presented to a filling spout near the beginning of said path, said lesser rate of flow continuing for a predetermined distance along said path, the maximum rate of flow being provided to each container for the remaining distance along said path until the container is withdrawn from its filling spout.

3. The method of claim **1** in which the maximum rate of product flow is provided to each container when it is presented to a filling spout near the beginning of said path, said maximum rate of flow continuing for a predetermined distance along said path, and a rate of product flow less than the maximum is provided to each container for the remaining distance along said path until the container is withdrawn from its filling spout.

4. The method of claim **1** in which a rate of product flow less than the maximum is provided to each container when it is presented to a filling spout near the beginning of said path, said lesser rate of flow continuing for a predetermined distance along said path, then the maximum rate of product flow being provided to each container for a predetermined distance along said path, followed by a lesser rate of flow for the remaining distance along said path until the container is withdrawn from its filling spout.

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