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METHODS AND MEANS FOR FILLING CONTAINERS WITH FOAMABLE LIQUID

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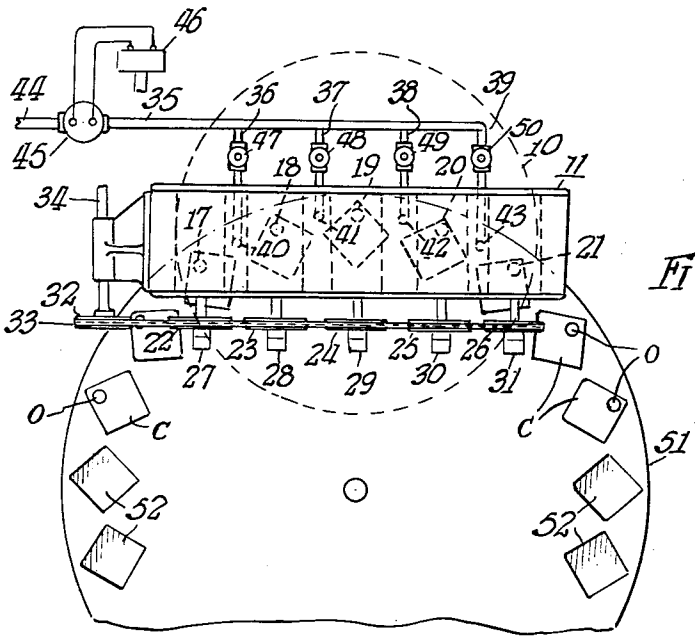


FIG. 1.

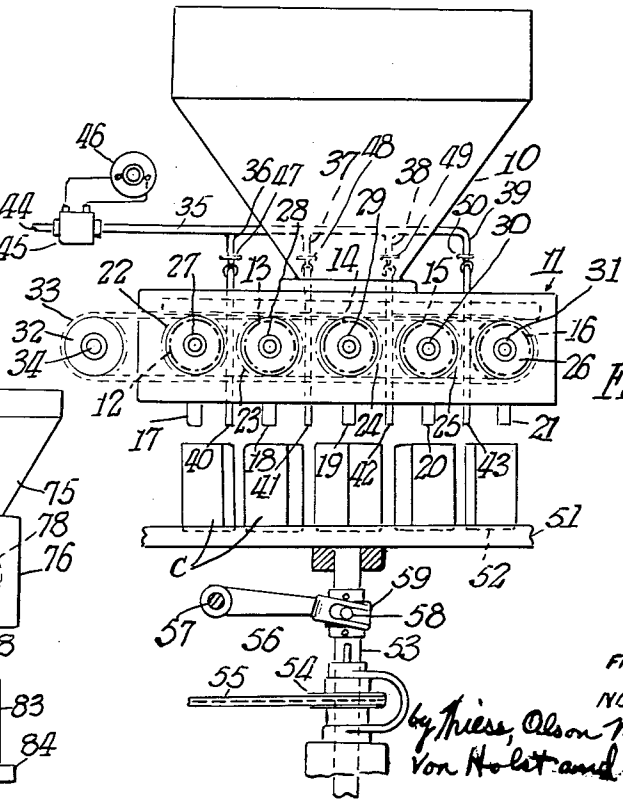


FIG. 2.

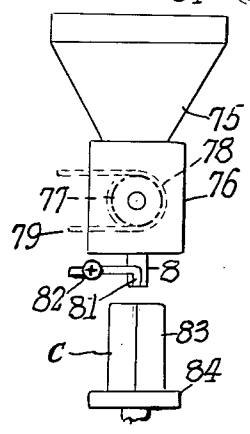


FIG. 3.

INVENTORS
FRED E. ULLMAN
NORMAN A. VIRTA
by Thiess, Olson Mecklenburger
Von Holst and Eltman
ATTYS

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METHODS AND MEANS FOR FILLING CONTAINERS WITH FOAMABLE LIQUID

Fred E. Ullman, Winnetka, and Norman A. Virta, Mount Prospect, Ill., assignors to Triangle Package Machinery Company, Chicago, Ill., a corporation of Illinois

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13 Claims. (Cl. 226—68)

This invention refers to certain new and useful improvements in methods and means for filling containers with foamable liquid, of which the following is a specification:

In filling liquids into containers, it is common practice to use relatively high speed automatic machines. Some of the liquids that are so filled are of a type which produce relatively substantial amounts of foam when filled at desired speeds in such equipment. To make this problem still more difficult, many of the containers into which these foamable liquids are filled must be filled through openings which are relatively smaller in cross sectional area than the cross section of the container itsef. This requires that the filling tube and/or nozzle must be small enough to enter, or direct the liquid, through a relatively small opening, and therefore requires that the velocity of the liquid entering the container must be relatively high when a relatively high speed operation is attained.

It is common practice in this art to give a considerable amount of attention to the design of nozzles which will reduce the amount of foam produced as much as possible, because of their ability to direct the liquids into the container in such a manner as to reduce the foam produced in filling to a minimum.

Usually, this is attained either by directing the flow down a side or sides of the container, or by inserting a filling tube and/or nozzle all the way into the container so that filling is obtained from the bottom of the container, and the filling tube and/or nozzle is covered with liquid at an early stage in the filling operation.

We assume that all possible and practical steps have been taken to provide a filling tube, nozzle, and other pertinent factors which results in the least possible foaming during fill that the conditions will allow, but that the operation still results in a considerable amount of foaming during fill. In such an operation, the amount of foam produced will be inversely proportional to the time taken to fill the container (actual flow time of liquid entering container) or in equivalent the velocity of the fluid entering the container. Therefore, the speed at which foamable liquids can be filled into specific containers is very often limited by the amount of foam produced in filling at various levels the amount of space left in the container for foam after the container has been filled to the proper level.

We have found that actual flow time under these conditions can be reduced if the liquid is introduced into the container in increments and at relatively high velocities (which, of course, produces excessive amounts of foam) if we can provide means for breaking down the foam between increments of fill. We have further found that a jet of relatively high speed gas (such as steam or air) directed into the container will break down some, or even possibly all of the foam. This depends, of course, to some extent on the ability to direct this jet of gas so that it strikes the entire cross sectional area of the foam, and this is usually not practical, due to the construction

of the usual container. However, even where the entire area of foam cannot be struck with the gas jet, we are able to break down a substantial percentage of foam.

It is important to note that with a container at a filling station, while the actual flow time might be reduced by defoaming in the manner to be described, a time for defoaming is also a time factor and therefore the factor in determining the net speed of filling. Therefore, with possible unusual exceptions, to be noted, the ability to attain higher operating rates of automatic filling machinery through the use of defoaming, such as will be indicated, will be generally restricted to applications wherein there will be a multiplicity of filling stations, so that a mutiplicity of packages can receive increments of the liquid to be filled simultaneously, and provision made to apply the defoaming jet between increments of fill. Most filling machines are designed with stationary filling stations, and provided with means for transferring the packages from filling station to filling station with the packages being stopped at the filling stations to receive the liquid being filled. When each filling station is used to fill an increment the defoaming jet can be applied to the containers either at extra dwell station, between filling stations, or while the containers are in motion between filling stations because of the extremely short time required for application of the gas jet to do its work in breaking down foam.

While the specifications of the defoaming jet are variable for different types of liquids and containers, we have found that in general, satisfactory jet velocities will be obtained from gas pressures of 10 to 50 lbs. per sq. in. where the jets are applied to the surface of the foam for periods of from .05 to 1/10 of a second. The design of the gas jet nozzle depends upon the particular liquid and container involved.

The general object of our invention is to provide a method for filling containers with a foamable liquid at a more rapid rate without causing the foam to overflow.

Another object of the invention is to provide simple, effective apparatus whereby the method may be practiced.

Other objects and advantages of our invention will appear as we proceed with a description of our invention as illustrated in the accompanying drawing.

In the drawing:

Figure 1 is a top plan view illustrating apparatus embodying our invention and wherewith the method may be practiced, the hopper being shown in dotted lines to facilitate illustration.

Fig. 2 is a front elevation of the apparatus shown in Fig. 1.

Fig. 3 is an illustration of a modified apparatus wherewith our invention may be practiced.

Referring first to the arrangement shown in Figs. 1 and 2: 10 represents a hopper for holding a supply of milk and which is supported upon a valve casing structure 11, in which a plurality of control valves 12, 13, 14, 15 and 16 are positioned.

Depending from the valve casing structure 11 are a plurality of discharge nozzles 17, 18, 19, 20 and 21, which are adapted at times to communicate with the valves 13, 14, 15 and 16 respectively to receive periodically and discharge measured quantities of liquid into the containers.

For actuating the valves 12 to 16 inclusive there is provided a plurality of sprockets 22, 23, 24, 25 and 26, which may be operatively connected to driving studs carried by the valves, by means of clutch members 27, 28, 29, 30 and 31.

The various sprockets 22 to 26 inclusive are driven from a common drive sprocket 32 by means of the endless chain 33. The sprocket 32 is driven by shaft 34

which is timed so as properly to control the actuation of the valves.

Means are provided for periodically introducing a high pressure gas (such for example as steam) into the containers as increments of liquid are supplied to the containers to be filled. As here shown this means comprises a manifold 35, to which there is connected a plurality of gas lines 36, 37, 38 and 39, which terminate in nozzles 40, 41, 42 and 43 positioned between certain of the liquid discharge nozzles, as indicated in Figs. 1 and 2.

A conduit 44 supplies high pressure gas from a source not shown, to the manifold 35, under the control of a solenoid valve 45, which is timed to open and close at the proper times by means of the timer 46.

In the gas supply lines 36 to 39 inclusive are manually manipulatable valves 47, 48, 49 and 50 whereby gas from the manifold may be cut off from any or all of the gas supply lines at will.

A turret 51 is provided, having therein a plurality of recesses 52 disposed on a circle of which the center is the vertical axis of the turret supporting shaft 53. The turret may be rotated step by step and raised and lowered by any suitable means. As here shown a sprocket 54 is splined on shaft 53 and driven by the chain 55 from a source of power, not shown.

For raising and lowering the shaft 53, we provide a lever 56, pivoted at one end at a fixed point 57, the other end being bifurcated to engage a pin 58 on a collar 59, which is longitudinally movable with the shaft but in which relative rotative movement between shaft and collar can take place.

Operation of the method and apparatus

It will be understood that the turret 51 will be periodically raised and lowered and advanced step by step to position the containers under the various filling nozzles and there held for a period sufficient to permit the discharge of the fluid, which is discharged through the various nozzles 17 to 21 inclusive.

Figs. 1 and 2 illustrate a typical ideal condition for the use of our invention. The illustration is typical because it indicates containers C wherein the size of the fill opening O therein is considerably smaller in cross section than the size of the container.

At the first station, nozzle 17, one-half of the liquid to be filled into the container may be deposited, leaving slightly more than half of the volume of the container available for foam. In transferring from the first station to the second station, nozzle 18, a gas jet 40 may be used to break down all or at least a substantial percentage of the foam produced at the first station. At the second station one-fourth of the total volume of liquid to be filled may conveniently be added, leaving slightly more than one-fourth of the volume of the container for foam. In transferring from the second station to the third station, nozzle 19, the container may again be subjected to the action of a gas jet 41, which again breaks down a substantial portion of the foam existing in the container. At the third station one-eighth of the liquid to be filled may be added, leaving slightly more than one-eighth of the volume of the container available for foam, and in transferring from the third station to the fourth station we may apply a jet of gas by jet 42 for defoaming. At the fourth station we add one-sixteenth of the volume of the liquid to be filled, thereby leaving slightly more than one-sixteenth of the container for foam. The final defoaming jet is applied as we transfer the container from the fourth station to the fifth station, at which station the final increment of fill is applied, and the foam space for this increment is that volume which is allowed in the design of the container in excess of the exact total volume of the liquid to be filled. It will be understood the stations 1 to 5 inclusive are coincident with the positions of the various filling nozzles 17 to 21 inclusive.

The above description of the operation is one in which it is assumed that the amount of foam produced will be somewhat less than the volume of the liquid filled into the container at each station. Obviously, where more or less foam is produced when filling, the number of filling stations and defoaming operations must be correspondingly increased or decreased to attain optimum results. It is important to note that in applying the defoaming jets as indicated the single control valve 45 for turning the defoamer nozzles on and off can be utilized, thereby making the equipment quite simple.

The above described arrangement is one wherein all filling stations are used and may conveniently be employed where containers of substantial size, such for example as quart containers are used.

Our machine is well adapted to fill half-pint, pint and quart containers, and we can make use of the increment fill idea so that we measure the proper amount in each case by using only certain of the filling valves at the appropriate stations.

We have restricted the velocity of fill to the extent that sufficient foam is not generated when filling quarts at stations 1, 2 and 3 to cause the foam to overflow the container. However, were we to fill the fourth increment without defoaming, the foam would overflow the container.

Therefore we apply our defoaming jet between the third and fourth fill stations as indicated.

It is apparent then that when filling pint containers we fill the first increment at either station 1, 2 or 3 and obtain defoaming action before filling the second increment at station 4. When filling half-pint containers, we do not make use of the defoaming jet at all because this container is filled at one station. The absence of the defoaming jet in filling half-pint containers is satisfactory in this case, because the design of the half-pint container allows a greater percentage of total carton volume for foam space than is the case with the one pint or one quart containers.

It is the use of the defoaming jet on our machine which permits us to run a given liquid, such as homogenized milk, at a given temperature, for example 40° (which affects the foaming characteristics of homogenized milk), at a given speed for example of twenty packages per minute, without producing foam over the top of the container. We have observed operation of the machine at this speed with this liquid at this temperature, which will not foam over when the defoaming jet is in operation and which will foam over at the fourth filling station when the defoaming jet is inoperative.

It will also be understood that because of the clutches any or all valves may be operated as desired. Also that high pressure gas may be discharged through any or all of the jets 40 to 43 inclusive. Again, the arrangement is such that the several valves may cause to discharge different amounts of liquid per unit of time so that larger amounts of fluid may be deposited into one container than in another in the same length of time.

Modified construction

The modified construction, Fig. 3, shows means for filling in increments at a single station and between the deposition of such increments, subjecting the generated foam to a discharge of high pressure gas, such as steam.

The modified construction comprises hopper 75, valve 76, casing valve 77 and sprocket 78 and driving chain 79. 80 is the liquid discharge nozzle, 81 a line for high pressure gas, such as steam and 82 a valve controlled in such manner as to discharge the gas into the container between the discharge of increments of liquid into the container 83. The arrangement is also such that larger volumes of liquid can be discharged through the nozzle per unit of time at certain times than at others. Means 84 for raising and lowering the container may be the same as described in connection with Figs. 1 and 2.

Since there is only a single container, the means for rotating the container support is omitted.

We claim:

1. The method of filling a container with a foamable liquid which consists in depositing the liquid into the container in a plurality of increments, and in subjecting the foam generated by the deposition of at least one increment, prior to the deposition of at least a second increment, to at least one stream of gas at a velocity sufficient to break down at least a substantial part of the previous generated foam.

2. The method defined in claim 1 in which the volume of increments is different and in which at least one of the earlier deposited increments is larger than at least one of the following increments.

3. The method defined in claim 1 wherein the first increment deposited is the largest in volume and the successive increments decrease in volume.

4. The method of filling a container with a foamable liquid which consists in depositing the liquid into the container in a plurality of increments, and wherein each increment is of a lesser volume than the preceding increments, and in subjecting the foam generated by each increment, excepting the last, to at least one stream of gas at a velocity sufficient to break down at least a substantial part of the foam generated by the deposition of the preceding increment.

5. Mechanism for filling containers with a foamable liquid comprising in combination, means for supporting a container having an opening at the top through which the liquid can be charged into the container, means for depositing into the container, through said opening, a charge of liquid under conditions which cause the generation of foam in the container, the unfoamed liquid volume of which charge is less than that which the container is designed to hold, means for injecting into the container, through said opening, a stream of gas sufficient to break down at least a substantial part of said foam, and means for subsequently depositing an additional charge of liquid into the container through said container opening.

6. The combination set forth in claim 5 in which the means for depositing a first charge into the container functions to discharge a volume which is different from that deposited by the means for depositing the additional charge.

7. The combination set forth in claim 5 in which the means for depositing a first charge into the container functions to deposit a charge of a volume greater than the volume deposited by the means which deposits the additional charge.

8. Mechanism for filling, with a foamable liquid, containers, the upper ends of which are provided with an opening through which the liquid can be charged into the containers, comprising means for advancing a series of containers, past a plurality of spaced filling stations, means operable at one of said filling stations for charging through said opening into each successive container, a quantity of liquid, under conditions which cause generation of foam within the container, the liquid volume of which charge is less than that which the container is designed to hold and the foamed and unfoamed volume of which does not exceed the container volume, means operable prior to the arrival of each successive container at another filling station for injecting into each successive container, through said opening, a stream of gas operating to break down at least a substantial part of foam in the container and means at another of said filling stations for charging an additional quantity of liquid into each successive container.

9. Mechanism for filling, with a foamable liquid, containers, the upper ends of which are provided with an opening through which the liquid can be charged into the containers, comprising means for advancing a series of containers, past a plurality of spaced filling stations, means operable at one of said filling stations for charging through said opening into each successive container, a quantity of liquid, under conditions which cause generation of foam within the container, the liquid volume of which charge is less than that which the container is designed to hold and the foamed and unfoamed volume of which does not exceed the container volume, means operable prior to the arrival of each successive container at another filling station for injecting into each successive container, through said opening, a stream of gas operating to break down at least a substantial part of foam in the container and means for charging into each successive container, at another filling station, a further increment of liquid in such amount and under such foam generating conditions that the foam generated at said other filling station, when added to the contained liquid and any previously generated remaining foam will not exceed the unfilled space then remaining in the container.

10. The process of filling containers, having an opening at the top, with liquids which foam when charged into the container at relatively high velocities, comprising depositing at least one charge of such liquid into a container under conditions causing the generation of foam within the container in amounts insufficient to overflow the container, the total volume of the deposited liquid being less than that for which the container is designed, injecting through said container opening a stream of gas effective to break down at least enough of the foam to provide space sufficient to accommodate the final charge, and thereafter depositing a final charge into the container through said opening, said final charge being of such order that the aggregate volume of all charges equals that which the container is designed to accommodate.

11. The process of filling containers, having an opening at the top, with liquids which foam when charged into the container at relatively high velocities, comprising depositing a plurality of separate charges of such liquid into a container under conditions causing the generation of foam within the container, in amounts insufficient to overflow the container, the total volume of the deposited liquid being less than that for which the container is designed, injecting through said container opening a stream of gas effective to break down at least enough of the foam remaining after the last of said charges to provide space sufficient to accommodate the final charge, and thereafter depositing a final charge into the container through said opening, said final charge being of such order that the aggregate volume of all charges equals that which the container is designed to accommodate.

12. The process of filling containers with liquids which foam when charged into a container at relatively high velocity, comprising providing a closed container having an opening at one end only, the size of which opening is but a small part of the size of the container end, comprising depositing into said container, through said opening, at least one charge of such liquid at such velocity as to cause the generation of foam within the container in an amount insufficient to overflow the container, the total volume of the deposited liquid being less than that for which the container is designed, injecting through said container opening a stream of gas effective to break down at least enough of the foam to provide space sufficient to accommodate the final charge, and thereafter depositing a final charge into the container through said opening, said final charge being of such order that the aggregate volume of all charges equals that which the container is designed to accommodate.

13. The process of filling containers with liquids which foam when charged into a container at relatively high velocity, comprising providing a closed container having an opening at one end only, the size of which opening is but a small part of the size of the container end, com-

prising depositing into said container, through said opening, a plurality of separate charges of such liquid at such velocity as to cause the generation of foam within the container in an amount insufficient to overflow the container, the total volume of the deposit-liquid being less than that for which the container is designed, injecting through said container opening a stream of gas effective to break down at least enough of the foam to provide space sufficient to accommodate the final charge, and

thereafter depositing a final charge into the container through said opening, said final charge being of such order that the aggregate volume of all charges equals that which the container is designed to accommodate.

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