United States Patent

Hansen

[15] **3,670,787**

[45] **June 20, 1972**

[54] APPARATUS FOR FILLING A CHAMBER

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[22] Filed: **Dec. 10, 1968**

[21] Appl. No.: **782,613**

[30] **Foreign Application Priority Data**

Jan. 3, 1968 Germany ..... P 16 57 206.8

[52] **U.S. Cl.** **141/250,** 91/35, 222/334

[51] **Int. Cl.** **B65b 3/30**

[58] **Field of Search** 91/35; 141/25–27, 141/251, 262, 250; 222/1, 334, 384, 504; 417/53, 900, 507, 519

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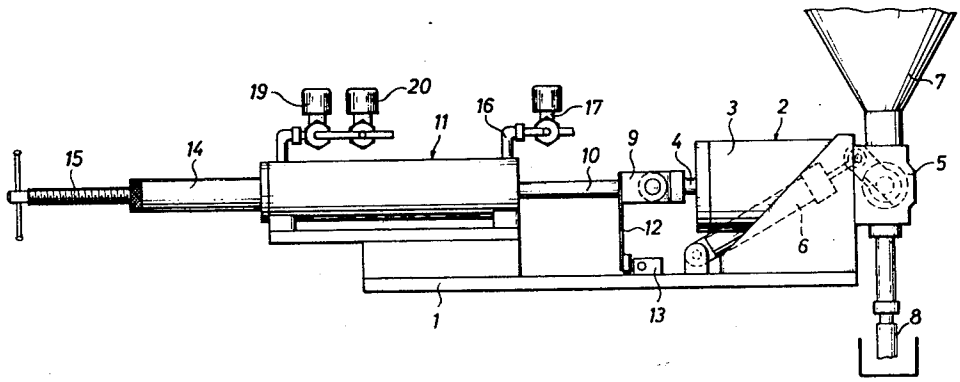
[57] **ABSTRACT**

A fluid flow regulating apparatus uses the control displacement of first and second pistons to vary the fluid flow rate. A reversible two-way valve mechanism is positioned between a supply of pressure fluid and the first and second pistons and valve control means are connected between the two-way valve mechanism and respective ingress and egress ports of one of the pistons. Settable restrictive fluid flow means are connected between the two-way valve mechanism and the control means so that the first piston is displaced at a low speed and at a high speed throughout different portions of its movement.

3 Claims, 2 Drawing Figures



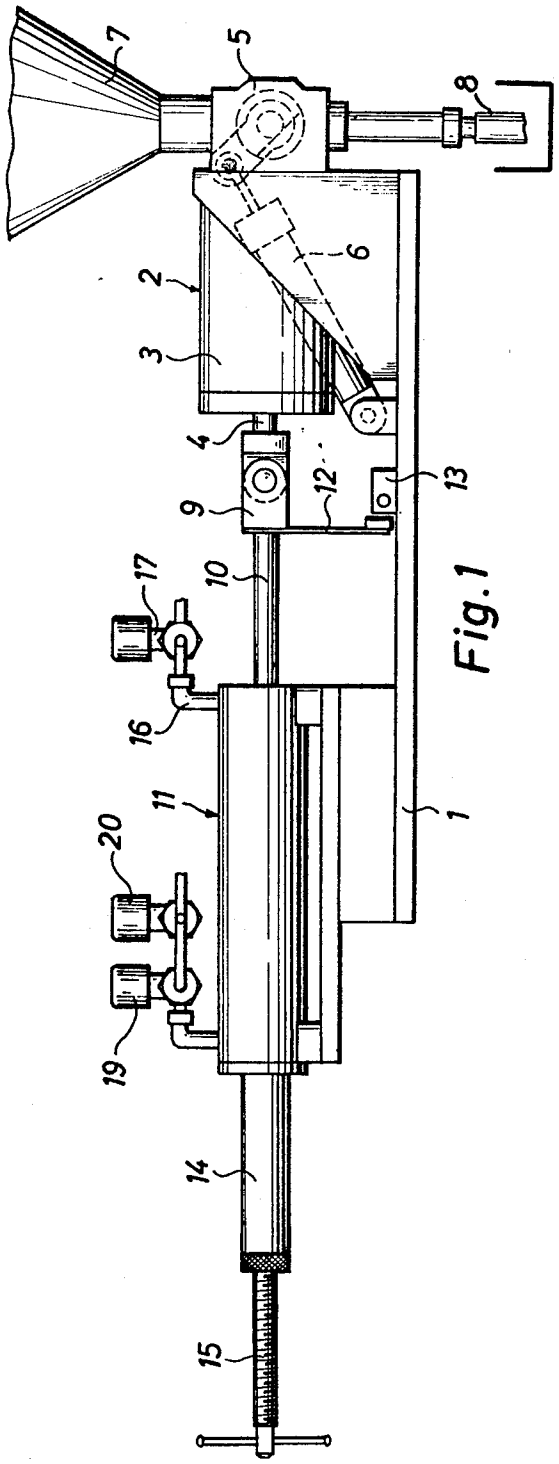


Fig. 1

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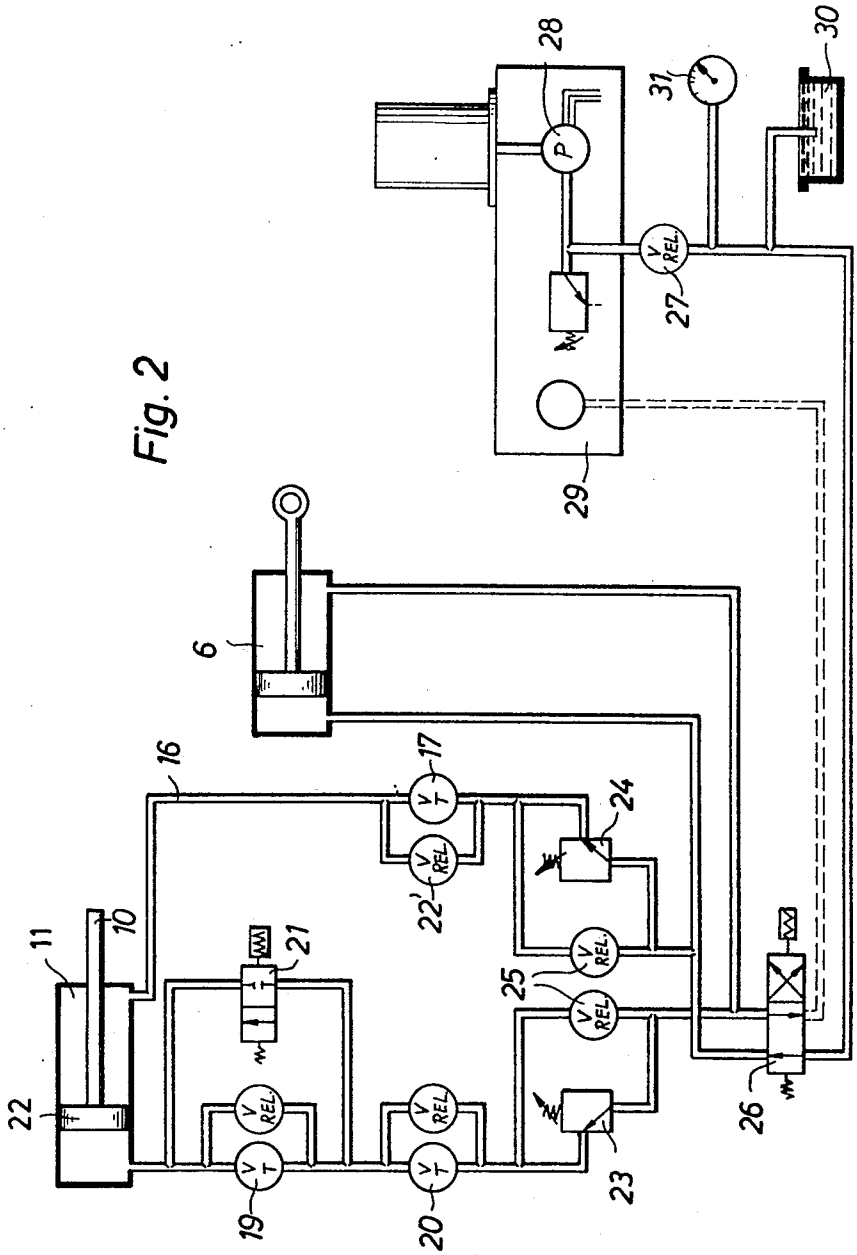

Fig. 2

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APPARATUS FOR FILLING A CHAMBER

The invention relates to an apparatus for filling an outwardly closed chamber with a given amount of liquid by displacement of a displaceable part of a wall bounding the chamber. The object of the invention is to reduce the formation of gas on drawing in a liquid, or the foaming of the liquid when filling a container, and more particularly to draw-off foaming liquids more rapidly than with previously known filling devices. This object is achieved according to the invention in that, the power exerted on the liquid during its feed into the closed chamber is considerably less during the commencement of the filling than during the rest of the filling process and has in the main two different magnitudes. By means of the maintenance of optimum speeds of filling over approximately the whole of the filling time, the latter can be kept exceptionally short. In filling devices driven by a crank gear, the speed of filling varies as a rule in a sinusoidal manner so that an optimum speed of filling cannot be maintained.

On drawing liquid into a dosing device, a dosing piston displaceable at substantially two speeds over a given length of travel, is displaced at the start of the suction, at a considerably less speed than over the rest of its travel. In this way the creation of a high vacuum leading to the formation of gas in the dosing device is prevented, as long as the amount of liquid flowing into the dosing device is accelerated from a standstill. The speed of the dosing piston may be increased after the first acceleration of the amount of liquid to be drawn in. The speed of suction depends on the type of liquid. The greater the formation of gas on suction into the dosing device, the greater the formation of foam on subsequently filling of a container from the dosing device.

In a method for the filling of a pre-determined amount of liquid, from a dosing device through a filling device having a nozzle into a container, a slight flow-back pressure is exerted on the amount of liquid in the dosing device, substantially until the aperture of the nozzle dips into the liquid in the container to be filled, and subsequently a considerable higher pressure is exerted on the liquid to be forced into the liquid already located in the container. Foaming of the liquid can only take place as long as the liquid moves in a gas or in the atmosphere. Liquid forced in under a level of liquid does not foam as a rule so long as no gas is taken in with it. It is an advantage if a body exerting return pressure on the liquid moves substantially at two speeds, which have a relative ratio of from 1:5 to 1:15.

A device for carrying out the invention by the displacement of a wall part limiting the chamber, is characterized in that the wall part is displaceable at at least two very different speeds which are substantially constant, and can be displaced, at the commencement of the filling of the outwardly closed chamber, at a low speed. The speed of the wall part is the factor determining the vacuum or excess pressure produced in the chamber, which serves to draw liquid into the chamber or to force the liquid out of the chamber.

The invention furthermore provides a reversible displacement device for the movement in two speed stages of the wall part. The essential feature of the displacement device is a very rapid change over from one given speed to another.

If a work cylinder serves for the displacement of the wall part, a throttle member is provided in a feed pipe to the work cylinder which may be made ineffective and/or be adjusted as desired. The throttle member restricts the feed of pressure medium to the work cylinder so that its piston is displaced at a lower speed than when running without restriction. The inner cross-section of the passage of the throttle member is advantageously adjusted to correspond to the requirements on each occasion. It is also possible to arrange in a bypass pipe of the throttle member an adjustable throttle member of larger inner cross-section.

Apparatus for carrying out the invention will now be described further, by way of example only, and is shown schematically in the accompanying drawings, in which:

FIG. 1 shows a side elevation and

FIG. 2 is a circuit diagram.

A dosing device 2, in whose cylinder 3, a dosing piston (not shown) is adapted to be displaced, is mounted on a base plate 1. A piston rod 4 attached to the piston projects outwardly through a sealed off end wall. A valve arrangement 5 is mounted, on the side of the dosing device 2 opposite to the piston rod 4, whose suction and pressure valves are controlled by means of a work cylinder 6. The valve arrangement 5 is disposed below a hopper 7 to which the suction valve is attached and the pressure valve is connected to an outlet pipe 8. The valves may be of the type known per se for use in a pump.

The piston rod 4 is connected by means of a coupling 9 to a piston rod 10 of a work cylinder 11. A switch member 12 is attached to the piston rod 10 and cooperates with an end switch 13 secured on the base plate 1. A threaded socket 14 is secured on the end wall of the work cylinder 11 remote from the piston rod 10 and has at its open end a thread into which a threaded spindle 15 is screwed. The position of the threaded spindle 15 in relation to the threaded socket 14 is assured by means of a lock nut. The threaded spindle 15 projects into the work cylinder 11 and has a cylindrical part on its end inside the cylinder 11 for the purpose of sealing in the area of the end wall of the cylinder 11. It forms a stop for a piston 22 inside the cylinder 11. The work cylinder 11 is likewise secured to the base plate 1.

An adjustable throttle member 17, capable of being bypassed by means of a non-return valve 22' closing in a direction towards the work cylinder 11, is attached to a connection pipe 16 on the end of the cylinder 11 adjacent the piston rod 10. At the throttle 17, adjustment of the cross-section of flow-through may be carried out in order to alter the speeds of suction. The adjustment can also be effected by means of a magnetic valve operable as desired. The cross-section of flow-through adjustable during operation may also be adjusted per se according to each requirement.

Two further throttle members 19 and 20 are provided at the end of the work cylinder 11 adjacent the threaded socket 14, lying behind one another and each individually adjustable and capable of being by-passed by means of a non-return valve, similar to that marked 22', closing in a direction towards the work cylinder 11, the throttle 19 having a considerably smaller inner cross-section than the throttle 20. The throttle 19 may be by-passed by another valve, operated as desired, such as a magnetic valve 21. The throttles 19 and 20 and the throttle 17 are respectively connected to pre-tension valves 23 and 24. Each of the pre-tension valves 23, 24 can be bypassed by means of a non-return valve 25 closing towards the work cylinder 11. The valves 23, 25, and 24, 25 are connected, in parallel, to a magnetically operated multi-way valve 26 to which the work-cylinder 6 is also connected. The multi-way valve 26 is connected, in the normal manner, by means of a non-return valve 27 to a pump 28 which is built into a reservoir 29. An accumulator 30 and a pressure gauge 31 are also connected to the pump.

It is also possible to arrange the throttles 19 and 20 in parallel, the throttle 20 being in series with the valve 21. Furthermore a magnetic valve can be connected in parallel with the throttle 17 as with the throttle 19. The work cylinders 2 and 11 may be operated hydraulically or pneumatically. Before the filling of the dosing device 2, the piston 22 of the work cylinder 11 is located in its right hand position to the right in FIG. 2. At the beginning of the suction stroke pressure medium is passed by the pump 28 via the, now narrowly adjusted, throttle 17, in front of the piston and urges the latter to the left, the space on the left hand side of the piston 22 being connected, via the non-return valve by-passing the throttles 19 and 20, the non-return valve 25 and the multi-way valve 26, to the reservoir 29. After suction of a given amount of material, the throttle 17 is adjusted to the wide position and the piston 22 moves at a greater speed than previously until it has reached its end position determined by the positioning spindle 15. Consequently at the start of suction, less pressure is exerted on the material being drawn in than during the further course of the suction so that formation of gas is greatly avoided. The suction valve of the dosing device 2 is naturally

open during suction, operation of the suction valve being by the work cylinder 6 which, because of the pre-tension valves 23 and 24, is acted on by pressure fluid before the work cylinder 11. The speed of suction can be chosen as desired within limits and abruptly altered. For example, it is possible by means of the device according to the invention to draw into the dosing device 500 cubic centimeters of milk in one second.

To fill a container with the liquid taken up by the dosing device, the piston 22 is first acted on by means of pressure applied via the throttles 19 and 20, so that liquid is at first forced out of the dosing device 2 at slight force and therefore less speed, the pressure valve of the valve arrangements having been previously opened. Only after the outlet nozzle of the filling device (not shown) lies below the level of liquid, in a container to be filled and closed, is the magnetic valve 21 opened, thus by-passing the throttle 19, and the piston 22 acted on via the throttle 20 having a cross-section of flow-through which can be adjusted. The differential speeds of filling are in a range of about 1:5 to 1:15. On filling with milk, for example, during the first second, 40 cubic centimeters are delivered into the container and the residual amount of 460 cubic centimeters within 2 seconds, a filling aperture of about 15 millimeters inner cross-section being used. The amount to be filled at the start depends on the slimness of the container to be filled, the starting amount being less with a slim container than with a wide one. As short a filling time as possible is of significance in the case where the container has been extruded shortly beforehand out of a plastics tube, and is cooling down, in order that the head portion thereof has sufficient residual heat for satisfactory closure after filling. By means of the device, optimum speeds may be produced with different lengths of strokes carried out by the piston 22.

The magnetic valves 21 and 26, may each be controlled individually by means of time relays, cams, magnetic switches or the like.

The end switch 13 to be operated by the switch member 12 closes the feed of pressure medium to the left hand side of the piston 22 of the work cylinder 11, when the piston of the dosing device has reached its position nearer to the valve arrangement 5 and initiates, by reversal of the magnetic valve 26, the return movement of the piston 22 whose displacement path is limited to both sides by means of a mechanical stop. At the same time the work cylinder 6 is reversed. The dosing device 2 is preferably used for the filling of single containers produced in a single two part mold in a continuous operation from an extruded plastics tube, to be filled by means of a filling nozzle adapted to be raised and lowered, the head part of each container being closed after filling by welding together its walls without the addition of heat, so long as the container is still located in the production mold. For this purpose the dosing device is connected to the mandrel by means of the pipe 8.

A suitable device is described, for example, in the published documents of German Petty Pat. No. 1934054. The method and apparatus of the invention can also be used for filling glass bottles, containers of sheet metal and the like.

The speeds of filling a container depend on the type of material being fed. As long as the nozzle lies above the level of the liquid, in order to prevent the formation of foam, only very low filling speeds are often permissible. For example, with liquid soaps only about 50 cubic centimeters per second can be filled using an aperture with 15 millimeters inner diameter. The filling speed with the nozzle below the surface can be raised to about 600 cubic centimeters per second so that for 1,000 cubic centimeters of liquid soap a total filling time of 2.6 seconds results, about one second of that time being at the lower filling speed.

The proportions of the two speeds are very different while the nozzle is above and below the level of the liquid. The greater the tendency of the filler material to create the formation of foam, the greater in general is the difference between the two speeds. With liquids which foam very readily, the ratio is about 1:15, with liquids that foam less, at 1:10 and with highly viscous liquids for example foam bath concentrates, at 1:5. The maximum speed is limited by the viscosity of the liquid and maximum pressure obtainable in the filling device taking into account the resistance of the pipes and the diameter of the filling aperture. The speed with the nozzle outside the liquid is limited, inter alia, by the characteristic of the filler material, particularly its viscosity, and by the space present in a filled container above the level of the liquid, which can at the start be filled with foam, which later builds itself back. As about 90 percent of the foam on flowing out of liquid forms into air, the formation of foam can be affected by the choice of the out flow.

What I claim is:

1. Apparatus for regulating the flow of fluid, comprising;

a valve mechanism,

a first cylinder including a first piston displaceable between first and second positions in accordance with the ingress and egress of pressure fluid at respective input and output ports,

a second cylinder including a second piston for operating said valve mechanism,

means for supplying said pressure fluid to said first and second pistons from a pressure fluid supply,

means for controlling the supply of pressure fluid to said first and second pistons, said means including a reversible two-way valve mechanism between said means for supplying pressure fluid and said first and second pistons, restrictive fluid flow control means connected between said two-way valve and said first piston for moving said first piston at a first low speed, and non-restrictive fluid flow control means connected between said two-way valve and said first piston for moving said first piston at a subsequent high speed, and

means actuated by said first piston for displacing a controlled amount of fluid into a container from said valve mechanism, whereby said first piston is displaced at a low speed and at a high speed throughout different portions of its movement to provide a low and high fluid flow rate respectively.

2. Apparatus for regulating the flow of fluid as in claim 1 wherein said restrictive and said non-restrictive fluid flow control means each include means for adjusting the cross section of the fluid path to regulate the fluid flow.

3. Apparatus for regulating the flow of fluid as in claim 1 wherein said restrictive and said non-restrictive fluid flow control means each include means for by-passing fluid.

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