



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.04.2008 Bulletin 2008/14

(51) Int Cl.:
B67C 3/30 (2006.01)

(21) Application number: **07253779.8**

(22) Date of filing: **24.09.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventor: **Horikoshi, Takayoshi**
Tatebayashi-shi
Gunma 374-0073 (JP)

(74) Representative: **Stoner, Gerard Patrick et al**
Mewburn Ellis LLP
York House
23 Kingsway
London WC2B 6HP (GB)

(30) Priority: **27.09.2006 JP 2006262747**

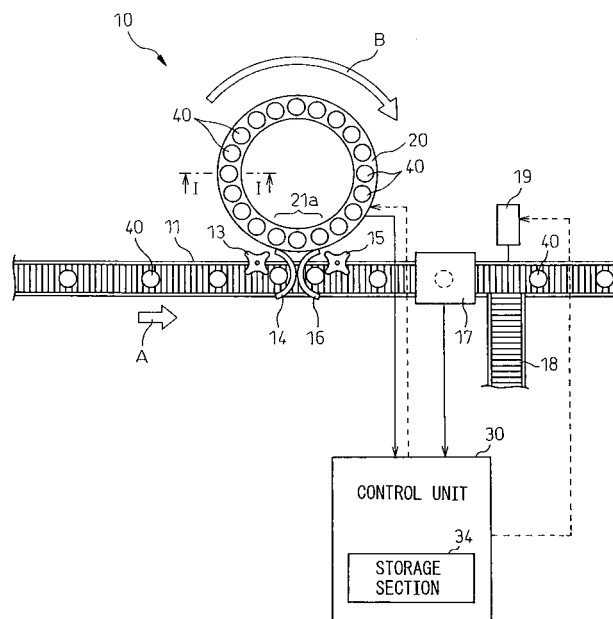
(71) Applicant: **SUNTORY LIMITED**
Osaka-shi,
Osaka 530-8203 (JP)

(54) **Filling method, filling device and container**

(57) A filling device (10) includes: a liquid filling means (21) for filling a predetermined filling weight of a liquid into a container (40); and a temperature measurement means (24) for measuring a temperature of the liquid filled by the liquid filling means. In the filling device, in a case where a measured temperature of the liquid measured by the temperature measurement means is

higher than a predetermined value, a filling speed of filling the liquid from the liquid filling means is reduced according to the measured temperature. Due to this, foaming action of beer can be suppressed without requiring a large volume of inert gas. It is preferable to reduce the filling speed of filling the liquid by a liquid control valve (26), which is arranged in a supply pipe line, and/or a pre-stress gas control valve (57).

Fig.1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a filling method for filling a barrel such as a beer barrel with a liquid, for example, beer. The present invention also relates to a filling device for executing the method. The present invention also relates to a container filled by such a method.

2. Description of the Related Art

[0002] Generally, beer is sold in bottles or cans. In addition, beer is also sold in glasses or mugs. In such a case, beer is filled into beer barrels or tanks, which are exclusively used for beer, in breweries and then delivered to restaurants, etc. In the restaurants, etc., beer is poured into the glasses or mugs exclusively through dispensers attached to the beer barrels.

[0003] In a brewery, beer is filled into beer barrels by a filling device. The filling device includes a plurality of filling sections. Each filling section includes: a flow control valve for adjusting a flow rate of beer; and a filling head.

[0004] At the time of filling beer into a beer barrel, pre-stress gas, for example, inert gas is previously filled into the beer barrel so that the beer barrel can be pre-stressed at a predetermined pressure. Pre-stress gas prevents carbon dioxide, which is dissolved in beer, from separating from the beer at the time of filling beer into the beer barrel, and prevents the beer itself from foaming when filling the beer into the beer barrel.

[0005] In this connection, it is known that a volume of gas dissolved in a liquid is changed depending on a temperature of the liquid, and when the temperature of the liquid is raised, a volume of gas capable of being dissolved in the liquid is reduced. In the case where the liquid is beer, when a temperature of the beer is raised, carbon dioxide dissolved in the beer is separated from the beer.

[0006] The temperature of beer is easily raised when the filling device is stopped over a long period of time especially during summer time. In this case, when beer is filled into a beer barrel, the beer easily foams, and may overflow during filling the beer barrel.

[0007] Therefore, in the filling device disclosed in Japanese Utility Model No. 2583744, a counter pressure in a tank for filling liquid is set at the most appropriate pressure corresponding to a temperature of the liquid to be filled. In other words, in Japanese Utility Model No. 2583744, in the case where a temperature of the liquid to be filled is high, a counter pressure in the tank for filling liquid is also set high so as to suppress foaming of the liquid.

[0008] The counter pressure described in Japanese Utility Model No. 2583744 is increased by supplying gas, for example, inert gas. Accordingly, in the case where a

temperature of the liquid to be filled is high, a volume of inert gas to be supplied is also increased. Especially in the summer, the temperature of beer can rise relatively quickly. Therefore, it is necessary to supply a large volume of inert gas, which is not economical. Further, using a large volume of inert gas, for example, a large volume of carbon dioxide, is not environmentally friendly, which is not describe.

[0009] The present inventors carried out extensive studies into the above matter so as to solve the above problems, and as a result, the present inventors determined that foaming of beer can be suppressed without using a large volume of inert gas by varying the beer filling speed depending on the temperature of the beer.

[0010] The present invention has been accomplished in view of the above circumstances. An object of the present invention is to provide a filling method capable of suppressing a foaming of beer without using a large volume of air. Another object of the present invention is to provide a filling device for executing such a method. Another object of the present invention is to provide a container filled by the method.

SUMMARY OF THE INVENTION

[0011] In order to accomplish the above object, the first aspect provides a filling method for filling a liquid into a container comprising the steps of: measuring a temperature of the liquid by a temperature measurement means; increasing or decreasing a filling time of the liquid per a unit of filling weight according to a measurement temperature of the liquid measured by the temperature measurement means; and filling the liquid by a predetermined filling weight by a liquid filling means into a container during the filling time that was increased or decreased before.

[0012] In other words, in the first aspect, the filling time of the liquid is increased or decreased according to the temperature of the liquid. Therefore, the liquid can be prevented from foaming at the time of filling the liquid without using a large volume of inert gas.

[0013] The second aspect provides a filling method for filling a liquid into a container comprising the steps of: measuring a temperature of the liquid by a temperature measurement means; increasing or decreasing a filling speed of the liquid according to a temperature of the liquid measured by the temperature measurement means; and filling the liquid by a predetermined filling weight by a liquid filling means into a container at the filling speed that was increased or decreased before.

[0014] In other words, in the second aspect, the filling time of the liquid is increased or decreased according to the temperature of the liquid. Therefore, the liquid can be prevented from foaming at the time of filling the liquid without using a large volume of inert gas.

[0015] The third aspect provides a filling method for filling a liquid into a container comprising the steps of: measuring a temperature of the liquid by a temperature

measurement means; decreasing a filling speed of the liquid according to a temperature of the liquid measured by the temperature measurement means; and filling the liquid by a predetermined filling weight by a liquid filling means into a container at the filling speed that was decreased before.

[0016] In other words, in the third aspect, in the case where the temperature of the liquid is relatively high, a filling speed of the liquid is reduced. Therefore, the liquid can be prevented from foaming at the time of filling the liquid without using a large volume of inert gas.

[0017] According to the fourth aspect, as in the third aspect, the filling speed of filling the liquid is decreased by a liquid control valve arranged in a supply pipe line for supplying the liquid to the liquid filling means.

[0018] In other words, in the fourth aspect, the filling speed can be reduced by a relatively simple structure.

[0019] According to the fifth aspect, as in the third or the fourth embodiment, an exhaust control valve, which is arranged in an exhaust pipe line for exhausting pre-stress gas previously pressurized in the container, reduces the filling speed of the liquid by reducing an exhausting speed of the pre-stress gas in the container at the time of filling the liquid into the container by the liquid filling means.

[0020] In other words, in the fifth aspect, it is difficult for the pre-stress gas to be exhausted from the container by the exhaust control valve. Therefore, it is possible to suppress the liquid from flowing into the container. Accordingly, a filling speed of the liquid can be reduced. In other words, a reduction of the filling speed of the liquid can be assisted by the exhaust control valve.

[0021] According to the sixth aspect, as in any one of the third to the fifth aspect, the filling speed is decreased in such a manner that a gradient of the filling speed right after the start of filling the liquid can be reduced according to the measurement temperature.

[0022] In other words, in the sixth aspect, it is possible to suppress the liquid from foaming at the initial stage of filling the liquid. Accordingly, it is possible to suppress the liquid from continuously foaming after the liquid was sparked at the initial stage of filling the liquid. That is, foaming of the liquid at the time of filling the liquid can be effectively suppressed.

[0023] According to the seventh aspect, as in any one of the third to the sixth aspect, the liquid filling means is provided on a rotary passage for rotating the container in the circumferential direction, a predetermined filling weight of the liquid is filled into the container while the rotary passage is rotating by a predetermined rotary angle range, and a rotating speed of the rotary passage is reduced according to the measurement temperature.

[0024] In other words, in the seventh aspect, while the rotary passage is rotating in a predetermined rotary angle range, filling of a predetermined weight of the liquid can be completed.

[0025] According to the eighth aspect, it is possible to provide a container filled by the filling method described

in any one of the first to the seventh aspect.

[0026] The ninth aspect provides a filling device for filling a container with a liquid comprising: a liquid filling means for filling a predetermined filling weight of the liquid into the container; and a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein a filling time of filling the liquid per a unit of filling weight is increased or decreased according to a measurement temperature of the liquid measured by the temperature measurement means.

[0027] In other words, in the ninth aspect, it is possible to provide the same effect as that of the first aspect.

[0028] The tenth aspect provides a filling device for filling a container with a liquid comprising: a liquid filling means for filling a predetermined filling weight of the liquid into the container; and a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein a filling speed of filling the liquid filled by the liquid filling means is increased or decreased according to a temperature of the liquid measured by the temperature measurement means.

[0029] In other words, in the tenth aspect, it is possible to provide the same effect as that of the second aspect.

[0030] The eleventh aspect provides a filling device for filling a container with a liquid comprising: a liquid filling means for filling a predetermined filling weight of the liquid into the container; and a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein a filling speed of filling the liquid filled by the liquid filling means is decreased according to the measurement temperature in the case where the measurement temperature of the liquid measured by the temperature measurement means is higher than a predetermined value.

[0031] In other words, in the eleventh aspect, it is possible to provide the same effect as that of the third aspect.

[0032] According to the twelfth aspect, as in the eleventh aspect, the filling speed of filling the liquid is decreased by a liquid control valve arranged in a supply pipe line for supplying the liquid to the liquid filling means.

[0033] In other words, in the twelfth aspect, it is possible to provide the same effect as that of the fourth aspect.

[0034] According to the thirteenth aspect, a filling device for filling a container with a liquid, as in the eleventh or the twelfth aspect further comprises an exhaust control valve arranged in an exhaust pipe line for exhausting pre-stress gas previously pressurized in the container, wherein an exhaust control valve reduces the filling speed of the liquid by reducing an exhausting speed of the pre-stress gas in the container at the time of filling the liquid into the container by the liquid filling means.

[0035] In other words, in the thirteenth aspect, it is possible to provide the same effect as that of the fifth aspect.

[0036] According to the fourteenth aspect, as in any one of the eleventh to the thirteenth aspect, the filling speed is decreased in such a manner that a gradient of the filling speed right after the start of filling the liquid can be reduced according to the measurement temperature.

[0037] In other words, in the fourteenth aspect, it is possible to provide the same effect as that of the sixth aspect.

[0038] According to the fifteenth aspect, as in any one of the eleventh to the fourteenth aspect, the liquid filling means is provided in a rotary passage for rotating the container on the circumferential direction, a predetermined filling weight of the liquid is filled into the container while the rotary passage is rotating by a predetermined rotary angle range, and a rotating speed of the rotary passage is reduced according to the measurement temperature.

[0039] In other words, in the fifteeneth aspect, it is possible to provide the same effect as that of the seventh aspect.

[0040] These and other objects, the characteristics and the advantages of the present invention will become more apparent in the detailed description of the typical embodiments of the present invention which follow.

[0041] In the context of device or apparatus definitions herein, it will be understood that specification of process steps can imply the presence of a control unit programmed to operate the specified procedure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042]

Fig. 1 is a conceptual view showing a filling device for filling a beer barrel with beer according to the present invention.

Fig. 2 is a longitudinal sectional view of a filling section taken along a line I - I in Fig. 1.

Fig. 3 is a flow chart showing an operation program of a filling device of the present invention.

Fig. 4 is a view showing a map of the filling speed function.

Fig. 5 is a view showing a relationship between the beer filling speed and the time.

Fig. 6 is a view showing a map of the filling finish time and the rotary speed.

Fig. 7a is a view showing a map of the filling speed and the degree C1 of opening of the first control valve 26.

Fig. 7b is a view showing a map of the filling speed and the degree C2 of opening of the second control valve 57.

Fig. 7c is a view showing a map of the filling speed, the degree C1 of opening of the first control valve 26 and the degree C2 of opening of the second control valve 57.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0043] Referring to the accompanying drawings, an embodiment of the present invention will be explained below. Like reference characters are used to indicate like

parts in the following drawings. In order to facilitate understanding, the scale has been appropriately charged. In this connection, in the case of the following explanation, beer is filled into beer barrels. However, it should be noted that the above case is only an example and the present invention includes all cases in which a liquid is filled into containers.

[0044] Fig. 1 is a conceptual view showing a filling device for filling a beer barrel with beer according to the present invention. A filling device 10 as shown in Fig. 1 includes: a conveyance passage 11 such as a conveyer for conveying a plurality of barrels, for example, a plurality of beer barrels 40 in the direction of arrow A; and an annular rotary passage 20, which is arranged adjacent to the conveyance passage 11, for conveying the beer barrels 40 in the direction of arrow B.

[0045] In the rotary passage 20, a plurality of filling sections 21, for example, twenty filling sections 21 for filling beer into the beer barrels 40 are arranged at regular intervals in the circumferential direction. In Fig. 1, the filling sections 21 are provided respectively at positions corresponding to the beer barrels 40 located in the rotary passage 20.

[0046] Fig. 2 is a longitudinal sectional view of a filling section taken along a line I - I in Fig. 1. In Fig. 2, the beer barrel 40 is arranged on the rotary passage 20 in which a metal cap of the beer barrel 40 is directed downward. In an upper portion of the filling device 10, an air cylinder 51 having an extensible rod 52 is provided. At a forward end portion of the rod 52, a clamp handle 53, the configuration of which is a substantial "+", is attached. When the air cylinder 51 is operated to extend the rod 52, the beer barrel 40 is held between the clamp handle 53 and the rotary passage 20.

[0047] The filling section 21 includes: a filling head 23 capable of engaging a barrel aperture (not shown) of the beer barrel 40; and a liquid conveyance tube 22 extending from a beer storage tank (not shown) to the filling head 23. Beer in a beer storage tank (not shown) is filled from the barrel aperture into the beer barrel 40 through the liquid conveyance tube 22 and the filling head 23.

[0048] As shown in the drawing, in the liquid conveyance tube 22, a flow meter 25 for detecting a flow rate of beer flowing in the liquid conveyance tube 22 is arranged. Further, in the downstream of the flow meter 25 with respect to the flow of beer, a first control valve 26 for controlling the flow rate of beer is arranged. Between the first control valve 26 and the filling head 23, a temperature measurement section 24 for measuring a temperature of beer flowing into the liquid conveyance tube 22 is arranged. The temperature measurement section 24, the flow meter 25 and the first flow control valve 26 are electrically connected to a control unit 30 described later.

[0049] In this connection, the temperature measurement section 24 may be arranged at a position different from the position shown in Fig. 2. For example, the temperature measurement section 24 may be incorporated into the filling head 23. Further, the temperature meas-

urement section 24 may measure a temperature of beer in a beer storage tank (not shown).

[0050] Further, in Fig. 2, a supply tube 55 for supplying pre-stress gas into the beer barrel 40 before beer is filled into the beer barrel 40, and a discharge tube 56 for discharging the pre-stress gas from the beer barrel 40 are shown. The pre-stress gas is inert gas, for example, carbon dioxide or nitrogen. The pre-stress gas has a function of preventing carbon dioxide, which is dissolved in beer, from separating or foaming when filling beer into the beer barrel 40. In this connection, in the discharge tube 56, a second control valve 57 for controlling a flow rate of discharging pre-stress gas is arranged. This second control valve 57 is also electrically connected to the control unit 30. Although the details are not explained here, pre-stress gas supplied to the beer barrel 40 is discharged through the discharge tube 56 in accordance with the progress of the filling operation of beer.

[0051] Referring to Fig. 1 again, the beer barrels 40, which has been conveyed onto the conveyance passage 11, are further conveyed into the rotary passage 20 by a star wheel 13 and a guide 14 arranged on the upstream side with respect to conveyance direction A. While the beer barrel 40, which has been conveyed into the rotary passage 20, is being rotated by the rotary passage 20 in the direction of arrow B, beer is filled into the beer barrel 40 by one filling section 21.

[0052] In other words, while the rotary passage 20 is being rotated from a beer barrel injecting position at the upstream side star wheel 13 to a beer barrel ejecting position at the downstream side star wheel 15, a predetermined amount of beer is filled into the beer barrel 40. The beer barrel 40 filled with beer is returned to the conveyance passage 11 by the star wheel 15 and the guide 16 on the downstream side. Since the filling device is composed as described above, in a filling section 21a located between the star wheels 13 and 15, no beer barrels 40 are arranged.

[0053] In the filling device 10, a weight measuring means 17 is arranged on the conveyance passage 11 in the downstream of the downstream side star wheel 15. The weight measuring means 17 measures a total weight of the beer barrel 40 after beer has been filled into it.

[0054] As shown in the drawing, in the downstream of the weight measuring means 17, a branch conveyance passage 18 branches from the conveyance passage 11. Usually, the branch conveyance passage 18 is not operated. Only when a starting section 19 is set in motion, the branch conveyance passage 18 is operated. In the case where the total weight of the beer barrel 40, which has been measured by the weight measuring means 17, is lighter than the predetermined value Z2, the starting section 19 is started and the beer barrel 40 concerned is ejected from the conveyance passage 11 into the branch conveyance passage 18. That is, the branch conveyance passage 18 has a function as an ejection means for ejecting the beer barrel 40.

[0055] The weight measuring means 17 and the start-

ing section 19 are also electrically connected to the control unit 30. In this case, the control unit 30 is a digital computer, which controls the entire filling device 10. The control unit 30 includes a storage section 34 for storing predetermined various values, various measured value, maps and an operation program 100 described later.

[0056] Fig. 3 is a flow chart showing an operation program of a filling device according to the first embodiment of the present invention. Referring to Fig. 3, an operation of the filling device of the present invention will be explained below.

[0057] In step 101 of the operation program 100 shown in Fig. 3, a temperature θ of beer in the liquid conveyance tube 22 is measured with the temperature measurement section 24. Next, in step 102, the temperature θ of beer is compared with a predetermined temperature θ_0 in the control unit 30. In the case where it is judged that the beer temperature θ is not higher than the predetermined temperature θ_0 , the program proceeds to step 107.

[0058] On the other hand, in the case where it is judged that the beer temperature θ is higher than a predetermined value θ_0 , the program proceeds to step 103. A case in which the beer temperature θ exceeds the predetermined value θ_0 is caused when the filling device is stopped over a long period of time, for example, in summer. In step 103, the filling speed function $f(T)$, which is related to a filling speed V for filling beer into the beer barrel 40, is changed.

[0059] Fig. 4 is a view showing a map of the filling speed function. As shown in Fig. 4, a plurality of filling speed functions $f(T)$, which are different from each other according to the beer temperature θ , are previously stored in the storage section 34 of the control unit 30. These filling speed functions $f(T)$ are previously set in such a manner that the filling speed V can be reduced and the filling time can be prolonged as the beer temperature θ is raised. These filling speed functions $f(T)$ are previously found by experimentation, etc. In step 103, according to the measured beer temperature θ , the filling speed function $f(T)$ is selected. In the case where it is not necessary to change the filling speed function $f(T)$, the filling speed function, which has been previously set so as to be used for a normal condition, is used as it is. In this case, the normal condition is defined as a condition in which the beer temperature is relatively low, for example, the beer temperature is approximately 2°C.

[0060] Referring to Fig. 5 showing a relationship between the beer filling speed and the time, the filling speed function will be more specifically explained below. In Fig. 5, the axis of ordinates represents the filling speed of beer and the axis of abscissas represents the time. The curve X0 shown in Fig. 5 is a filling speed function of beer in a normal condition. The curve X1 is one example of the filling speed functions $f(T)$ which are changed from the normal condition.

[0061] First, referring to the curve X0, the filling speed in the normal condition of the filling device 10 will be explained below. When filling of beer is started at the time

0, the filling speed V is increased until the time becomes $TA0$ at a uniform acceleration. A section from the time 0 to the time $TA0$ is referred to as an initial filling section. After the time $TA0$, the beer filling speed V is further increased. At the time $TB0$, the beer filling speed V reaches the maximum filling speed $VA0$.

[0062] Next, beer is continuously filled at the maximum filling speed $VA0$ until the time becomes $TC0$. A section between the time $TB0$ and the time $TC0$ is referred to as the maximum filling speed section. After that, the beer filling speed V is reduced to zero at the filling finish time $TE0$. At the time $TE0$, a predetermined weight of beer is filled into the beer barrel 40.

[0063] In step 103, in the case where a filling speed function $f(T)$ is selected, the filling speed function in the normal state is shifted in the direction of the X-axis as shown, for example, by the curve $X1$. An area surrounded by the curves $X0$, $X1$ and the X-axis corresponds to a filling weight of beer to be filled into the beer barrel 40. It should be noted that this area is not changed even when the filling speed function is changed. In other words, the filling speed function $f(T)$ on the map shown in Fig. 4 is determined in such a manner that the beer filling weight can not be changed. As long as the beer filling weight is compensated, the filling speed function, in which the filling time is prolonged, may be selected without changing the maximum filling speed.

[0064] As shown in the drawing, the time $TA1$, at which the initial filling section is finished on the curve $X1$, is longer than the time $TA0$ described before. Further, the filling finish time $TE1$ on the curve $X1$ is longer than the time $TE0$ on the curve $X0$.

[0065] In the initial filling section of the curve $X1$, the filling speed V is increased at a uniform acceleration in the same manner as that of the curve $X0$. In the initial filling section of the curve $X1$, a gradient β of the filling speed V is set to be lower than a gradient α of the initial filling section of the curve $X0$. Further, as can be seen from Fig. 5, the maximum filling speed $VA1$ on the curve $X1$ is lower than the maximum filling speed $VA0$ on the curve $X0$.

[0066] As described above, in the present invention, in the case where the beer temperature θ is relatively high, the filling time is lengthened and the filling speed is lowered. Due to this, the filling weight of beer filled into the beer barrel 40 can be compensated.

[0067] When the filling speed function $f(T)$ is selected according to the beer temperature θ in step 103 shown in Fig. 3, the filling speed V is reduced and the filling finish time TE is prolonged as compared with the case of the normal condition. However, the filling weight of beer filled into the beer barrel 40 is not changed.

[0068] Next, in step 104, the filling finish time TE is calculated from the filling speed function $f(T)$ selected according to the beer temperature θ . The filling finish time TE is a time, which is longer of the two times at which the filling speed V is zero in the selected filling speed function. The filling finish time TE may be calculated from

the selected filling speed function $f(T)$. Alternatively, the filling finish time TE may be selected from a map (not shown) previously stored in the storage section 34 with respect to the filling finish time TE .

[0069] Next, in step 105, it is judged whether or not the filling finish time TE is longer than the predetermined value $T0$. As described above, a filling operation for filling a predetermined filling weight of beer into the beer barrel 40 is conducted while the beer barrel 40 is being conveyed in the arrowed direction B on the rotary passage 20 from the upstream side star wheel 13 to the downstream side star wheel 15. The predetermined value $T0$ substantially agrees with a period of time needed for rotating the rotary passage 20 from the upstream side star wheel 13 to the downstream side star wheel 15.

[0070] In the case where the filling finish time TE is longer than the predetermined value $T0$, the program proceeds to step 106. In step 106, the rotating speed Q of the rotary passage 20 is changed in such a manner that a period of time needed for the rotary passage 20 to be rotated from the upstream side star wheel 13 to the downstream side star wheel 15 can be longer than the filling finish time TE .

[0071] This rotating speed Q may be decided from the map (shown in Fig. 6) showing a relationship between the filling finish time TE and the rotating speed Q of the rotary passage 20 previously found by experiments etc. Due to the foregoing, before the rotary passage 20 rotates from the upstream side star wheel 13 and arrives to the downstream side star wheel 15, a predetermined filling weight of beer can be filled into the beer barrel 40.

[0072] Next, in step 107, the empty beer barrel 40 is moved by the upstream side star wheel 13 and the guide 14 from the conveyance passage 11 to the rotary passage 20 and then held by the corresponding filling section 21 as described before. While the empty beer barrel 40 is being rotated together with the rotary passage 20, a predetermined filling weight of beer is filled into the beer barrel 40 from the filling head 23 of the filling section 21.

[0073] Beer is filled into the beer barrel 40 according to the filling speed function in the case of the normal condition or according to the filling speed function $f(T)$ changed in step 103. As described before referring to Fig. 5, the filling speed V of beer is changed by the time according to the filling speed function. The filling speed V of beer is changed mainly by adjusting a degree of opening of the first control valve 26 provided in the liquid conveyance pipe 22.

[0074] As shown in Fig. 7a, in the storage section 34 of the control unit 30, a map showing a relationship between the filling speed V and the degree $C1$ of opening of the first control valve 26 is stored. In this map, as the required filling speed V is reduced, the degree $C1$ of opening of the first control valve 26 is also reduced. According to this map, the degree $C1$ of opening of the first control valve 26 is set at a degree of opening corresponding to the required filling speed V . When the above setting is conducted for each time unit, the most appropriate fill-

ing speed V can be easily changed according to the filling speed function.

[0075] As described before, when the beer temperature is raised, carbonic dioxide dissolved in the beer easily separates from the beer and foams. On the contrary, in the present invention, the beer filling speed is lowered according to the beer temperature, so that foaming of beer can be suppressed at the time of filling the beer. Accordingly, in the present invention, it is not necessary to set the pressure of pre-stress gas in the beer barrel 40 at a high value so as to suppress foaming of beer. In other words, in the present invention, it is possible to suppress beer from foaming without using a large volume of pre-stress gas, that is, inert gas.

[0076] When the beer barrel 40 is filled with the predetermined weight of beer in this way and is moved to the proximity of the downstream side star wheel 15, the beer barrel 40 is returned from the rotary passage 20 to the conveyance passage 11 by the downstream side star wheel 15 and the guide 16. Next, the total weight Z, in which the weight of the beer barrel 40 itself and the filling weight of beer are totaled, is measured by the weight measuring means 17 (step 108).

[0077] Next, in step 109, it is judged whether or not the total weight Z is lighter than the after-filling beer barrel reference total weight Z2. In this case, the after-filling beer barrel reference total weight Z2 is a predetermined value previously stored in the storage section 34 of the control unit 30. This after-filling beer barrel reference total weight Z2 is a value obtained by adding the beer filling weight to the maximum value of the empty beer barrel weight previously determined by a statistical method.

[0078] In the case where it is judged that the weight Z is lighter than the after-filling beer barrel reference total weight Z2, it can be determined that the after-filling beer barrel 40 is not sufficiently filled with beer. In this case, a signal is transmitted from the control unit 30 to the starting section 19, so that the branch conveyance passage 18 is started. Due to the foregoing, the after-filling beer barrel 40 is moved from the conveyance passage 11 to the branch conveyance passage 18 and ejected from the filling device 10 (step 110). In this way, the after-filling beer barrel 40, which is not sufficiently filled with beer, can be prevented from being delivered to the market.

[0079] On the other hand, in the case where it is judged that the total weight Z is not lighter than the after-filling beer barrel reference total weight Z2, it can be determined that the beer barrel is not insufficiently filled with beer. In this case, the starting section 19 is not operated and the after-filling beer barrel 40 concerned is moved on the conveyance passage 11 to the next step as it is. In this way, the operation program 100 shown in Fig. 3 is finished.

[0080] As explained before referring to Fig. 5, in the present invention, it is preferable that the gradient of the filling speed V in the initial filling section is reduced to, for example or gradient β . In general, when beer collides on an inner face of the beer barrel 40, the beer tends to

sparkle. In particular, the beer easily collides with the inside of the barrel right after the start of the filling of beer. Accordingly, by reducing the gradient of the filling speed V in the initial filling section, it is possible to suppress beer from foaming in the initial filling section.

[0081] It is known that in the case where beer foams in the initial filling section, when the beer is continuously filled as it is, foaming continuously occurs. Therefore, if the foaming action caused in the initial filling section can be suppressed, it is possible to suppress a continuously foaming action of the beer which is caused by the foaming action in the initial filling section. Accordingly, it is especially preferable to suppress foaming in the initial filling section by reducing the gradient of the filling speed V in the initial filling section. Due to the foregoing, foaming of beer can be effectively suppressed at the time of filling beer.

[0082] In this connection, the filling speed V can be also changed by adjusting the second control valve 57 provided in the discharging pipe line 56. Fig. 7b is a view similar to Fig. 7a, showing a map of the filling speed and the degree C2 of opening of the second control valve 57. On this map, as the filling speed V is decreased, the degree C2 of opening of the second control valve 57 is also decreased. In the case where the degree C2 of opening of the second control valve 57 is decreased, a volume of pre-stress gas in the empty beer barrel 40 discharged through the discharge pipe line 56 is reduced. Therefore, pressure of pre-stress gas in the beer barrel 40 can be maintained relatively high.

[0083] As a result, it is difficult for beer to flow into the beer barrel 40 from the filling head 23. Accordingly, by reducing the degree C2 of opening of the second control valve 57, the filling speed V of beer can be finally reduced. In the same manner as that described above, when this map is used, the most appropriate filling speed V can be easily changed according to the filling speed function.

[0084] In the case of Fig. 7b, a volume of pre-stress gas, that is inert gas to be used is increased, which is not economical. Therefore, it is preferable that the filling speed V is changed by adjusting both the degree C1 of opening of the first control valve 26 and the degree C2 of opening of the second control valve 57. In this case, the map shown in Fig. 7c is used which shows a relation among the filling speed V, the degree C1 of opening of the first control valve 26 and the degree C2 of opening of the second control valve 57.

[0085] In this case, by adjusting the degree of opening of the second control valve 57, it is possible to help a reduction of the filling speed V. When this case is compared with a case in which the filling speed V is controlled only by adjusting the second control valve 57, since a volume of pre-stress gas to be used is decreased, this case is advantageous from the economical viewpoint. Further, by adjusting both the first control valve 26 and the second control valve 57, the filling speed V can be quickly changed.

[0086] In this connection, in Fig. 5, the filling speed in

the initial filling section is changed at a uniform acceleration. However, even in the case where the filling speed V in the initial filling section is changed in the form of a step or a curve, as long as the filling speed V is lower than the filling speed V under normal conditions, it is included in the scope of the present invention.

[0087] As described before, in the present invention, in the case where the beer temperature is relatively low, for example, about 2°C, the case is referred as a general condition. When the beer temperature is higher than the temperature of the general condition, the filling speed function, which is on the high temperature side of the normal condition, is selected. However, a case in which the beer temperature is relatively high, for example about 10°C, is set as the general condition, and in the case where the beer temperature is lower than that in the general condition, the filling speed function on the low temperature side with respect to the normal condition may be selected according to the beer temperature. In the case where the beer temperature is higher than that in the general condition, the filling speed function on the high temperature side with respect to the general condition may be selected according to the beer temperature. It is obvious that the these two cases are included in the scope of the present invention.

[0088] The present invention is explained above by referring to the typical embodiments. However, it should be noted that various changes, omissions and additions can be made by those skilled in the art without departing from the scope of the present invention.

Claims

1. A filling method for filling a liquid into a container comprising the steps of:

measuring a temperature of the liquid by a temperature measurement means;
increasing or decreasing a filling time of the liquid per a unit of filling weight according to a measurement temperature of the liquid measured by the temperature measurement means;
and
filling the liquid by a predetermined filling weight by a liquid filling means into a container during the filling time that was increased or decreased before.

2. A filling method for filling a liquid into a container comprising the steps of:

measuring a temperature of the liquid by a temperature measurement means;
increasing or decreasing a filling speed of the liquid according to a measurement temperature of the liquid measured by the temperature measurement means; and

filling the liquid by a predetermined filling weight by a liquid filling means into a container at the filling speed that was increased or decreased before.

3. A filling method for filling a liquid into a container comprising the steps of:

measuring a temperature of the liquid by a temperature measurement means;
decreasing a filling speed of the liquid according to a measurement temperature of the liquid measured by the temperature measurement means; and
filling the liquid by a predetermined filling weight by a liquid filling means into a container at the filling speed that was decreased before.

4. A filling method for filling a liquid into a container according to claim 3, wherein the filling speed of filling the liquid is decreased by a liquid control valve arranged in a supply pipe line for supplying the liquid to the liquid filling means.

5. A filling method for filling a liquid into a container according to claim 3 or 4, wherein an exhaust control valve, which is arranged in an exhaust pipe line for exhausting pre-stress gas previously pressurized in the container, reduces the filling speed of the liquid by reducing an exhausting speed of the pre-stress gas in the container at the time of filling the liquid into the container by the liquid filling means.

6. A filling method for filling a liquid into a container according to any one of claims 3 to 5, wherein the filling speed is decreased in such a manner that a gradient of the filling speed right after the start of filling the liquid can be reduced according to the measurement temperature.

7. A filling method for filling a liquid into a container according to any one of claims 3 to 6, wherein the liquid filling means is provided on a rotary passage for rotating the container in the circumferential direction, a predetermined filling weight of the liquid is filled into the container while the rotary passage is rotating by a predetermined rotary angle range, and a rotating speed of the rotary passage is reduced according to the measurement temperature.

8. A container filled by the filling method described in any one of claims 1 to 7.

9. A filling device for filling a container with a liquid comprising:

a liquid filling means for filling a predetermined filling weight of the liquid into the container; and

a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein

a filling time of filling the liquid per a unit of filling weight is increased or decreased according to a measurement temperature of the liquid measured by the temperature measurement means.

10. A filling device for filling a container with a liquid comprising:

a liquid filling means for filling a predetermined filling weight of the liquid into the container; and a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein

a filling speed of filling the liquid filled by the liquid filling means is increased or decreased according to a measurement temperature of the liquid measured by the temperature measurement means.

11. A filling device for filling a container with a liquid comprising:

a liquid filling means for filling a predetermined filling weight of the liquid into the container; and a temperature measurement means for measuring a temperature of the liquid filled by the liquid filling means, wherein

a filling speed of filling the liquid filled by the liquid filling means is decreased according to the measurement temperature in the case where the measurement temperature of the liquid measured by the temperature measurement means is higher than a predetermined value.

12. A filling device for filling a container with a liquid according to claim 11, wherein the filling speed of filling the liquid is decreased by a liquid control valve arranged in a supply pipe line for supplying the liquid to the liquid filling means.

13. A filling device for filling a container with a liquid according to claim 11 or 12, further comprising an exhaust control valve arranged in an exhaust pipe line for exhausting pre-stress gas previously pressurized in the container, wherein an exhaust control valve reduces the filling speed of the liquid by reducing an exhausting speed of the pre-stress gas in the container at the time of filling the liquid into the container by the liquid filling means.

14. A filling device for filling a container with a liquid according to any one of claims 11 to 13, wherein the filling speed is decreased in such a manner that a gradient of the filling speed right after the start of

filling the liquid can be reduced according to the measurement temperature.

15. A filling device for filling a liquid into a container according to any one of claims 11 to 14, wherein the liquid filling means is provided on a rotary passage for rotating the container in the circumferential direction, a predetermined filling weight of the liquid is filled into the container while the rotary passage is rotating in a predetermined rotary angle range, and a rotating speed of the rotary passage is reduced according to the measurement temperature.

Fig.1

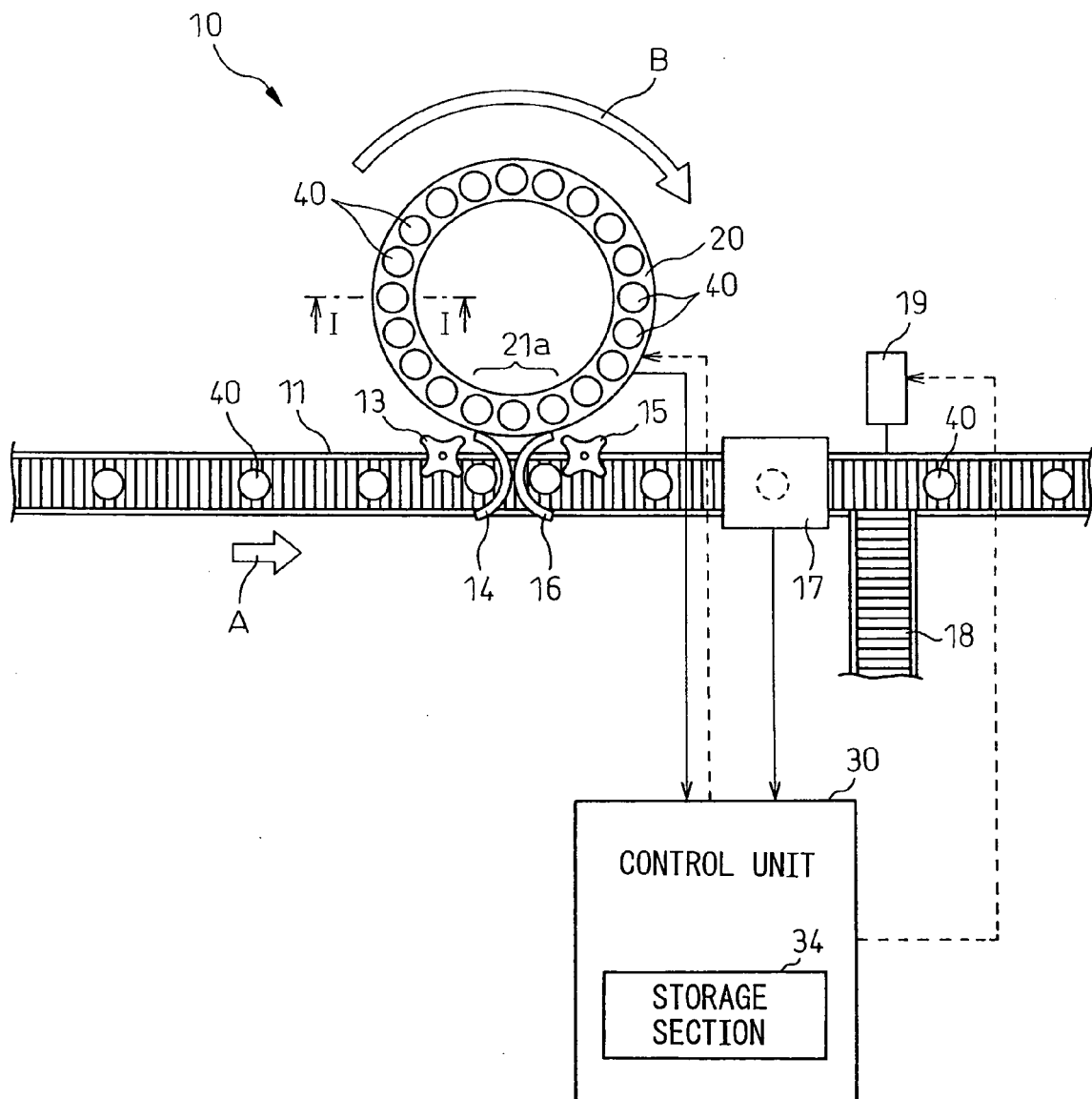


Fig.2

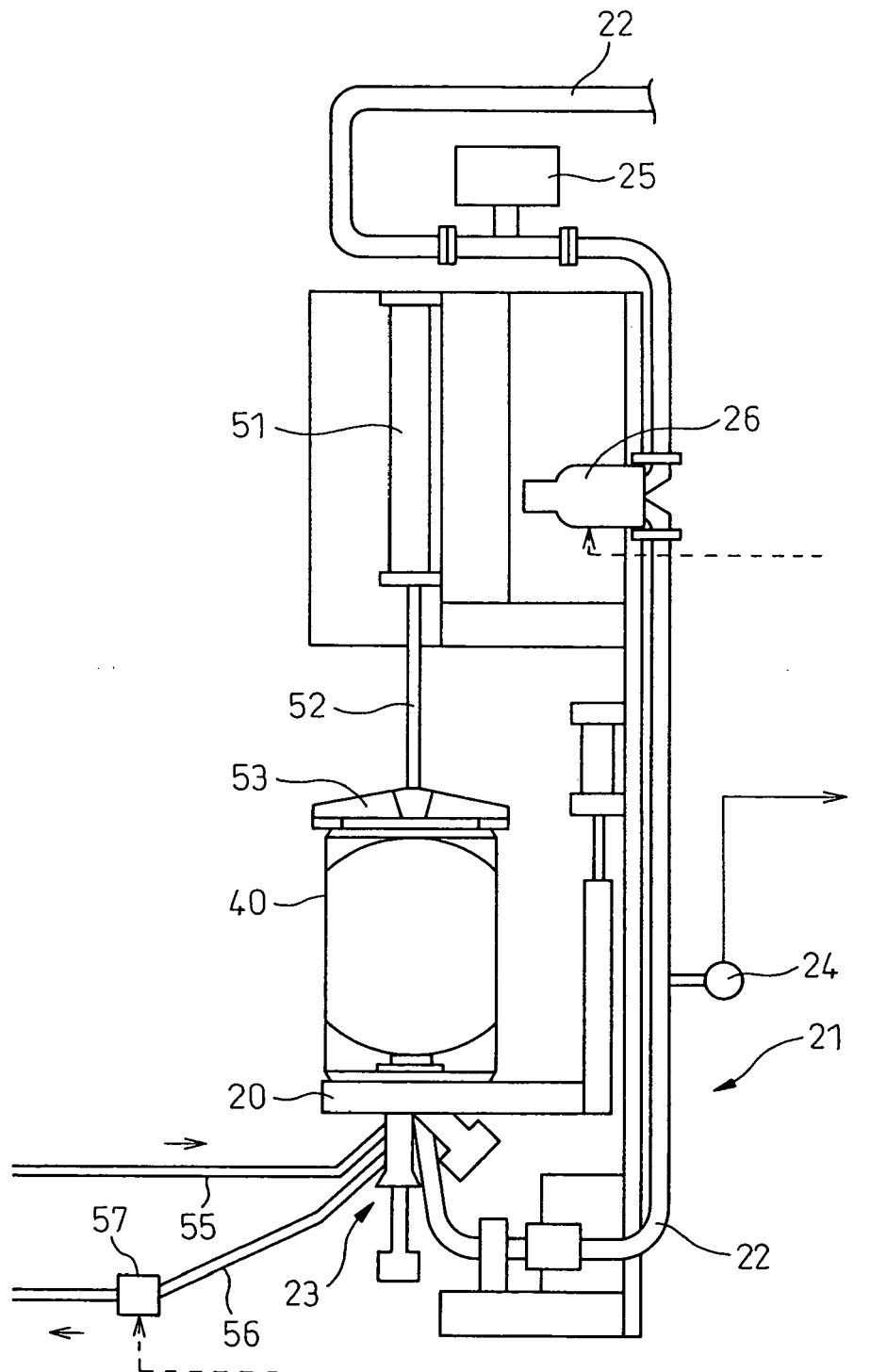


Fig.3

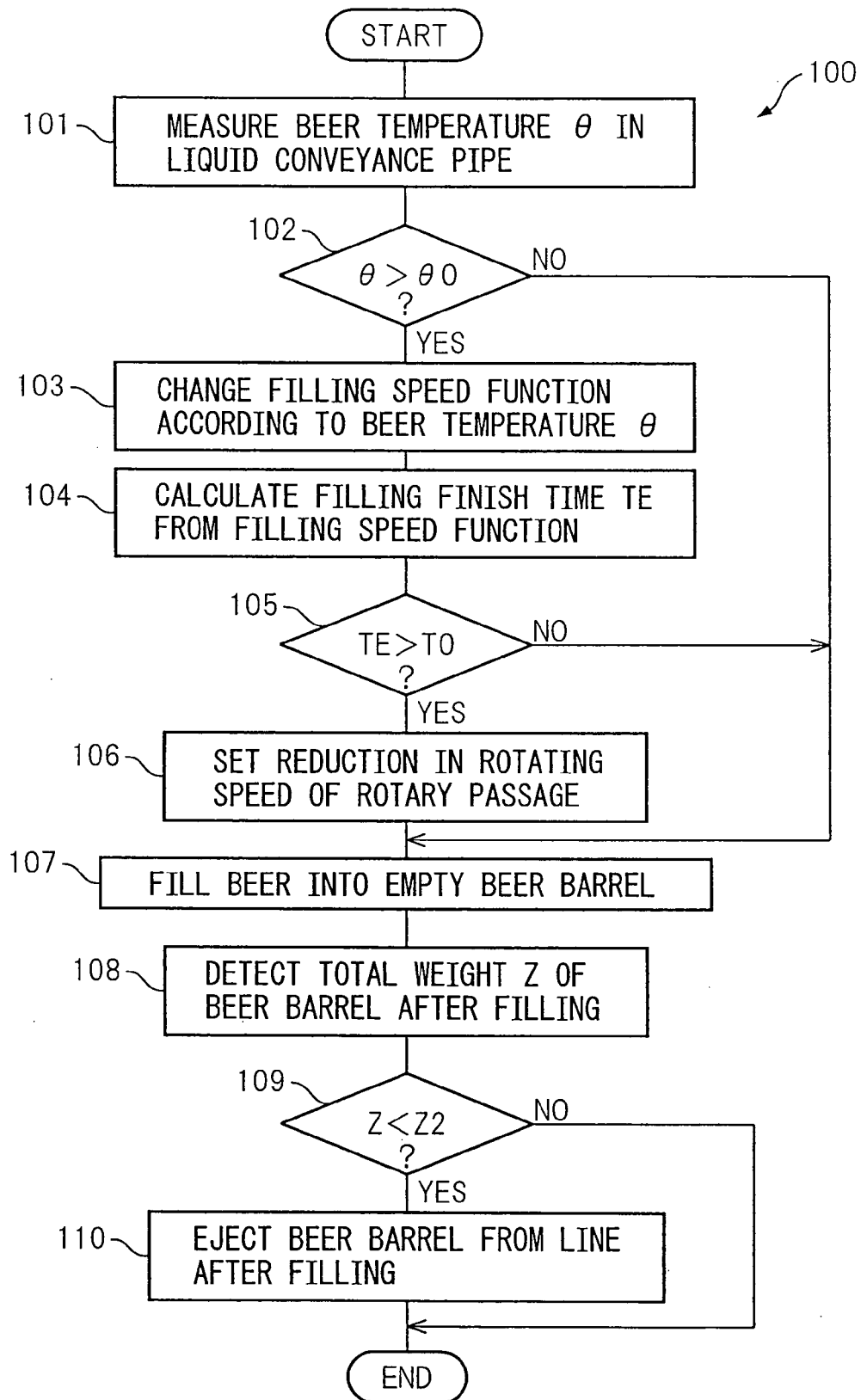


Fig. 4

TEMPERATURE	FILLING SPEED FUNCTION
LOW ↓ HIGH θ_1 ⋮ θ_n	HIGH ↑ LOW $V_1=f_1(T)$ ⋮ $V_n=f_n(T)$

Fig. 5

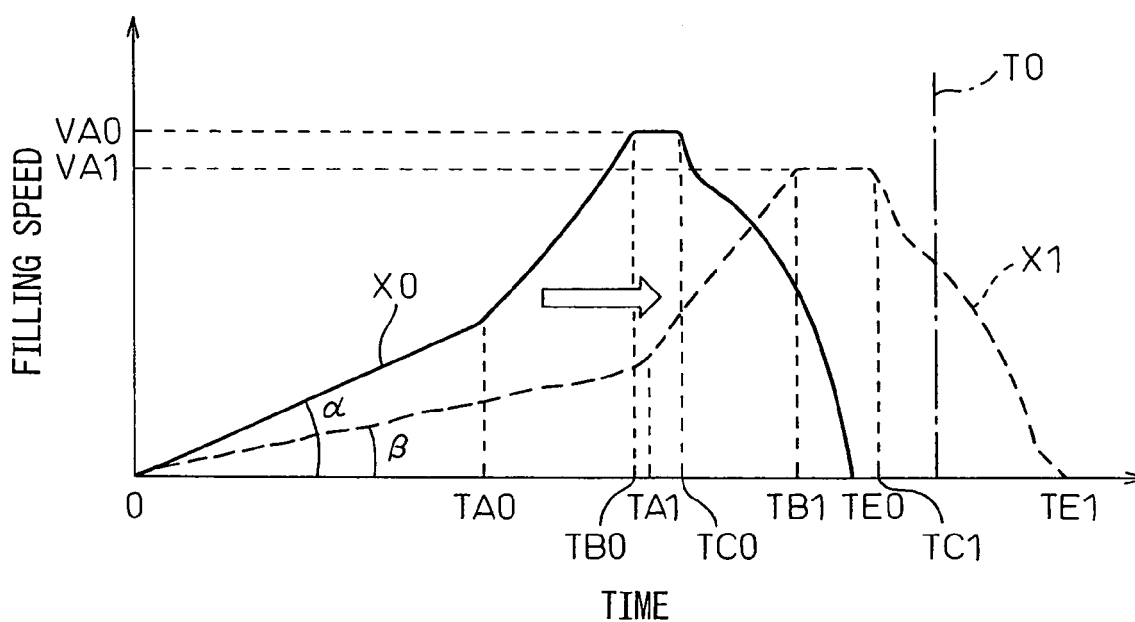


Fig.6

FILLING FINISH TIME	ROTATING SPEED
TE_1 $\vdots$ $\vdots$ $\vdots$ TE_n	Q_1 $\vdots$ $\vdots$ $\vdots$ Q_n

Fig.7a

FILLING SPEED	DEGREE OF OPENING OF FIRST CONTROL VALVE
V_1 ⋮ V_n	$C1_1$ ⋮ $C1_n$

Fig.7b

FILLING SPEED	DEGREE OF OPENING OF SECOND CONTROL VALVE
V_1 ⋮ V_n	$C2_1$ ⋮ $C2_n$

Fig.7c

FILLING SPEED	(DEGREE OF OPENING OF FIRST CONTROL VALVE, DEGREE OF OPENING OF SECOND CONTROL VALVE)
V_1 ⋮ V_n	$(C1_1, C2_1)$ ⋮ $(C1_n, C2_n)$



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 25 3779

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 095 897 A (GIMSON ENGINEERING LTD [GB]) 2 May 2001 (2001-05-02) * paragraphs [0003], [0007], [0010], [0015] - [0018], [0024]; figure * -----	1-4,8-12	INV. B67C3/30
			TECHNICAL FIELDS SEARCHED (IPC)
			B67C B65B G01G G01F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 January 2008	Examiner Müller, Claus
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

4

EPO FORM 1503 03.02 (P04C01)



European Patent
Office

Application Number

EP 07 25 3779

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 07 25 3779

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7 and 9-15

Device and method of filling a barrel

2. claim: 8

A container to be filled

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2583744 A [0007] [0007] [0008]