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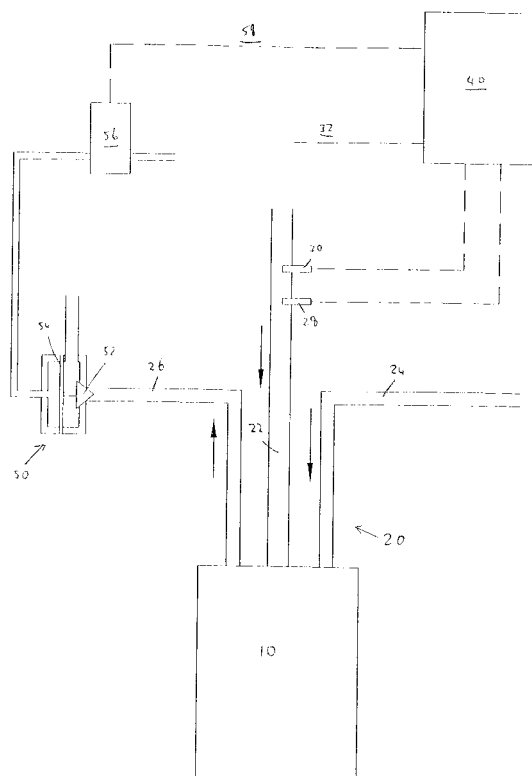
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(54) Method and apparatus for filling a container

(57) In an apparatus for filling a container (10) with a liquid, there is a supply line (22) for the liquid and a return line (26) for gas displaced from the container (10). A relief valve (50) is positioned to selectively prevent flow in the return line (26), and the pressure at which the relief valve (50) opens can be varied by a control means

(40). This allows the back pressure in the container (10) to be varied, and is of particular use when filling a container with a liquid containing dissolved gas, to avoid breakout of the gas. The invention also extends to a method of filling a container, in which a characteristic of the liquid is monitored and the back pressure varied in accordance with this characteristic.



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Description

[0001] The present invention relates to a method and apparatus for filling containers with liquids, more particularly liquids containing dissolved gas.

[0002] Many liquids for human consumption, such as beers or soft drinks, contain dissolved gas to provide effervescence or conditioning. Carbon dioxide is commonly used for this purpose, although other gases such as nitrogen can also be used.

[0003] When filling containers such as barrels with such liquids, it is very important to control the filling process so as to minimize the amounts of froth or foam generated by breakout of the gas (which occurs when the gas comes out of solution and bubbles up to the surface of the liquid). This froth or foam is commonly referred to as "fob" when it is formed from beer.

[0004] Barrels are normally filled with beer (or "racked") by means of a racking head. The head is mounted on the end of a racking tube, which can be moved to insert the head into a barrel. The racking tube includes a main beer supply line and a return line for displaced gas, fob and excess beer.

[0005] Unpasteurized beer is normally filled into casks. After filling, these are not pressurized; however, internal pressure is generated as the beer continues to ferment inside the cask. In contrast, pasteurized beers and lagers are normally supplied in kegs. These are internally pressurized after being filled, normally with carbon dioxide, by pressurized gas which is pumped through the keg valve. The pressure is held in the keg when the valve closes. Casks and kegs are generally well-known, and will not be described further here.

[0006] There are two common methods of controlling the flow of liquid. Firstly, the flow can be controlled by means of valves in the supply line, which can be partially opened. However, this method can be unsuitable for beer and some soft drinks, as the throttling effect produced by the partly open valve can in itself lead to the formation of fob.

[0007] Secondly, the container can be pressurized before filling takes place, to provide a back pressure. This requires that the racking tube also includes a line for the supply of pressurized gas. Pressurized gas is supplied into the barrel to provide a back pressure, and the container is then filled with liquid against this back pressure. The back pressure reduces the tendency of fob to form.

[0008] This method has found application in breweries, as it avoids the throttling problem which arises with beer. Traditionally, a spring-operated valve or a fixed-pressure pneumatic valve is placed in the return line. The valve opens at a set pressure to allow gas to be forced from the barrel by the beer.

[0009] While this method can reduce the amount of fob forming during filling, it is relatively crude. It only allows gas to be vented from the barrel above a certain pressure. If it desired to change the pressure at which

gas is vented (for example, because the barrels are to be filled with a different beer), then the valve must be adjusted.

[0010] Further, the back pressure in the barrel determines the speed at which the barrel can be filled, with a higher pressure leading to a lower speed. In a system with a constant back pressure, there is no allowance for short-term fluctuations in the supply pressure, or for the fact that it is usually preferable to start and finish the filling cycle with a relatively slow fill.

[0011] According to a first aspect of the invention, there is provided apparatus for filling a container with a liquid, comprising a supply line for the liquid, a return line for gas displaced from the container, a relief valve positioned to selectively prevent flow in the return line, and a control means for varying the pressure at which the relief valve opens.

[0012] The relief valve is designed to open when the pressure in the return line (the back pressure) reaches a certain amount. Providing a control means for varying this pressure allows the back pressure, and thus the rate at which liquid is supplied into the container, to be accurately controlled, thus reducing the risk of fob formation.

[0013] The valve can take any suitable form. However, it is preferred for the relief valve to be a diaphragm valve. It is further preferred for the pressure at which the relief valve opens to be varied by varying the pressure of fluid supplied to the diaphragm valve. Preferably, the fluid is supplied to the relief valve by a variable pressure regulator.

[0014] The control means can also take any suitable form. In a preferred form, the control means is a programmable logic controller unit.

[0015] In a preferred embodiment, a signal from a pressure sensor in the supply line is sent to the control means, the control means varying the pressure at which the relief valve opens in accordance with this signal. This allows the back pressure to "track" the pressure in the supply line, so that any fluctuations in the supply line pressure are mirrored by the back pressure. This keeps the rate of supply of liquid into the container substantially constant.

[0016] In another preferred embodiment, a signal from a temperature sensor in the supply line is sent to the control means, the control means varying the pressure at which the relief valve opens in accordance with this signal. The temperature of a liquid containing dissolved carbon dioxide gas can affect the gas breakout characteristics of the liquid, and sensing the temperature allows the back pressure to be varied to compensate for this.

[0017] In another preferred embodiment, a signal relating to the amount of dissolved gas in the liquid is sent to the control means, the control means varying the pressure at which the relief valve opens in accordance with this signal. If the liquid contains relatively little dissolved gas, then it can be supplied at a faster rate than

a liquid with a relatively high dissolved gas content without the risk of gas breakout. This feature allows the back pressure (and so the rate of supply) to be varied accordingly.

[0018] In a further preferred embodiment, a signal relating to the amount of liquid in the container is sent to the control means, the control means varying the pressure at which the relief valve opens in accordance with this signal. This is of particular use when filling barrels with beer, where it is desirable for the start and end of the filling process to be carried out a low fill speed, to avoid fob formation, but for the remainder of the process to be carried out at as high a fill speed as possible, to reduce the time it takes to fill a barrel. This feature allows the back pressure to be varied during the filling process, depending on the amount of liquid supplied.

[0019] It is also preferred for the apparatus to comprise a pressurized gas supply line, for supplying pressurized gas to the container. This can be used to provide an initial back pressure, and also allows the container to be checked for leaks before the filling process commences.

[0020] According to a second preferred aspect of the invention, there is provided a method of filling a container with a liquid containing dissolved gas, including the steps of establishing a back pressure in the container, supplying liquid into the container, monitoring at least one characteristic of the liquid, and varying the back pressure in accordance with the characteristic of the liquid to reduce breakout of the gas.

[0021] As has been described above, various characteristics of the liquid affect its propensity for gas breakout. By monitoring these characteristics and varying the back pressure in accordance with them, the chance of gas breakout is reduced.

[0022] In a preferred embodiment, the back pressure is varied by varying the pressure at which a relief valve, positioned to selectively prevent flow in a return line for gas displaced from the container, operates.

[0023] In one preferred form, the pressure of the liquid being supplied is monitored, and the back pressure is varied in accordance with the pressure of the liquid being supplied.

[0024] In another preferred form, the temperature of the liquid being supplied is monitored, and the back pressure is varied in accordance with the temperature of the liquid being supplied.

[0025] In a further preferred form, the amount of gas dissolved in the liquid being supplied is monitored, and the back pressure is varied in accordance with the amount of gas dissolved in the liquid being supplied.

[0026] In a further preferred form, the amount of liquid supplied is monitored, and the back pressure is varied in accordance with the amount of liquid supplied.

[0027] These preferred forms have the advantages discussed above.

[0028] A preferred embodiment of the invention will now be described by way of example only and with ref-

erence to the accompanying drawing, which shows schematically a container 10, a racking tube 20 and a control system.

[0029] As can be seen from the Figure, the racking tube 20 has a supply line 22 for a liquid such as beer, a pressurized gas inlet 24, and an outlet or return line 26 for gas, froth and excess liquid. Although not shown, the racking tube 20 is provided with a seal to allow it to seal against an opening in the container 10, with the head of the racking tube projecting into the container.

[0030] Provided in the supply line 22 are a pressure transducer 28, for measuring the instantaneous pressure in the liquid being filled, and a temperature probe 30, for measuring its temperature. Signals from these are sent to a programmable logic controller unit (or PLC) 40. The PLC 40 is also supplied with a signal 32 regarding the content of dissolved gas in the liquid being filled.

[0031] The pressurized gas inlet 24 is provided to allow the container 10 to be internally pressurized. When barrels are being filled, the first stage in the filling process is to pressurize the barrel, to check for leaks. This is particularly important for casks, as the washing process routinely carried out before filling requires the removal of a stopper (known as a keystone) from one of the faces of the cask. The pressurization allows an automatic check that the keystone has been replaced. Any suitable pressurized gas can be used.

[0032] The return line 26 fulfills the same purpose as the return line of the known filling apparatus, in that it allows gas, froth and any excess liquid to be transported from the container 10. However, flow in the return line 26 is regulated by a diaphragm valve 50, rather than a spring-operated valve or similar as in the prior art.

[0033] The diaphragm valve 50 includes a part 52 which can be moved to block flow in the return line 26. This part is connected to one side of a diaphragm 54, and a pressure source 56 is connected to the other side of the diaphragm. When the pressure in the return line 26 is less than the pressure supplied by the source 56, the part 52 blocks flow in the return line 26. When the pressure in the return line 26 is greater than the pressure supplied by the source 56, then the part 52 moves to allow flow in the return line 26.

[0034] The pressure source is, in the preferred embodiment, a variable pressure regulator 56. The pressure supplied by the variable pressure regulator 56 can be varied, and is controlled by the PLC 40 by means of a signal, schematically indicated at 58. This allows the pressure below which flow in the return line 26 (the back pressure) is prevented to be controlled, depending on the data received by the PLC 40.

[0035] In addition, a conductivity probe (not shown) or a similar sensor can be provided in the return line. The probe is activated by the presence of liquid in the return line, but is not activated by gas or froth. Activation of the probe signals that the container is full. Other means of determining that the container is full, such as monitoring of the amount of liquid supplied to the con-

tainer, can also be used.

[0036] A normal process for filling a cask with beer will now be described by way of example only.

[0037] Firstly, as mentioned above, pressurized gas is supplied into the cask, to check it for leaks and to ensure that the keystone has been replaced. A pressure of around 15 psi (103 kPa) is normally used for this, and so the pressure supplied to the diaphragm valve by the variable pressure regulator is set by the PLC to be at least this great.

[0038] As mentioned above, the rate at which beer can be filled into the cask is determined by the back pressure. Since it is normally desirable for the initial part of the filling cycle (at least until the level of beer is above the racking head) to be carried out at a low fill rate, the back pressure should at first be reasonably high, at around 10 psi (69 kPa). However, it does not need to be as high as the pressure used in the initial pressurization step, and so it is necessary to reduce the back pressure.

[0039] This reduction is achieved by reducing the pressure supplied to the diaphragm valve by the variable pressure regulator. As the pressure supplied to the diaphragm falls below the pressure inside the cask (which was initially pressurized to around 15 psi (103 kPa)), the diaphragm is moved by the pressure in the return pipe, allowing gas to flow from the cask. When the outflow of gas from the cask brings the pressure in the cask below the pressure supplied by the variable pressure regulator, the diaphragm moves back to block flow in the return line, and provide a back pressure in the cask.

[0040] Beer is then supplied into the cask against the back pressure, until the level of beer is above the racking head. This can be measured by a sensor on the racking head, or the amount of beer supplied into the cask can be measured. Once the level of beer is above the racking head, the rate at which beer is supplied can be increased without increasing the chance of formation of fob.

[0041] Accordingly, the pressure supplied to the diaphragm valve by the variable pressure regulator is again reduced, to allow gas to flow from the cask and thus reduce the back pressure. With the back pressure reduced, the rate at which beer is supplied increases, and the cask is filled relatively quickly.

[0042] It is also preferable for the last part of the filling cycle to be carried out relatively slowly. Thus, the pressure supplied to the pressure regulator is increased once the beer level in the cask has reached the appropriate level (which can again be detected by a sensor on the racking head or by monitoring the volume of beer supplied). The supply of beer into the cask will tend to compress the gas in the cask, and so increase the back pressure until the desired level is reached; alternatively, pressurized gas can be supplied through the line in the racking head.

[0043] Once the cask is sensed as being full, the supply of beer is stopped. The racking head can then be

removed from the cask, which can then be stoppered.

[0044] The filling process for a keg is generally similar. However, as a last step, pressurized gas is supplied into the keg through the keg valve, to place the keg under internal pressure.

[0045] If the back pressure could not be varied, then it would have to be set at the higher value (corresponding to the low fill rate at the start and end of the filling cycle), to prevent fob formation. The ability to vary the back pressure, and thus the rate at which beer can be supplied into the barrel, allows the barrel to be filled more quickly.

[0046] Further, the provision of the variable pressure regulator, controlled by the control means, allows fine adjustment of the back pressure, and in particular allows the back pressure to be selected according to the particular characteristics of the liquid being filled. For example, in a beer with a low dissolved gas content, there is less tendency for the gas to breakout and form fob. Thus, the back pressure can be reduced, allowing for a faster fill rate. For a beer with a higher dissolved gas content, and so a higher tendency for gas breakout, the back pressure can be increased.

[0047] In addition, the provision of sensors in the supply line allow the back pressure to be constantly adjusted to provide optimum filling characteristics. The drive pressure forcing beer into the container is equal to the available pressure in the supply line minus the back pressure. If the pressure in the supply line drops, then the drive pressure will also drop, leading to a reduced flow. However, if the supply line pressure is monitored, any slight fluctuations in the supply line pressure can be matched by variations in the back pressure in order to keep the drive pressure constant. Thus, the beer can always be supplied at the optimum drive pressure. Similarly, as the temperature of the liquid can affect its gas breakout characteristics, this is also monitored, and the back pressure can be varied accordingly.

[0048] Although the above description has been in the context of filling a barrel with beer, it will be appreciated that the use of variable back pressure can be applied to any container being filled with a liquid. Further, although only certain characteristics of the liquid being filled have been discussed, the skilled person will appreciate that other relevant characteristics may also be monitored.

Claims

1. Apparatus for filling a container (10) with a liquid, comprising:

a supply line (22) for the liquid;
a return line (26) for gas displaced from the container (10);
a relief valve (50) positioned to selectively prevent flow in the return line (26); and
a control means (40) for varying the pressure

at which the relief valve (50) opens.

2. Apparatus as claimed in claim 1, wherein the relief valve (50) is a diaphragm valve.

3. Apparatus as claimed in claim 2, wherein the pressure at which the valve (50) opens is varied by varying the pressure of fluid supplied to the diaphragm valve.

4. Apparatus as claimed in claim 3, wherein fluid is supplied to the relief valve (40) by a variable pressure regulator (56).

5. Apparatus as claimed in any preceding claim, wherein the control means (40) is a programmable logic controller unit.

6. Apparatus as claimed in any preceding claim, wherein a signal from a pressure sensor (28) in the supply line (22) is sent to the control means (40), the control means varying the pressure at which the relief valve (50) opens in accordance with this signal.

7. Apparatus as claimed in any preceding claim, wherein a signal from a temperature sensor (30) in the supply line (22) is sent to the control means (40), the control means varying the pressure at which the relief valve (50) opens in accordance with this signal.

8. Apparatus as claimed in any preceding claim, wherein a signal relating to the amount of dissolved gas in the liquid is sent to the control means (40), the control means varying the pressure at which the relief valve (50) opens in accordance with this signal.

9. Apparatus as claimed in any preceding claim, wherein a signal relating to the amount of liquid in the container (10) is sent to the control means (40), the control means varying the pressure at which the relief valve (50) opens in accordance with this signal.

10. Apparatus as claimed in any preceding claim, additionally comprising a pressurized gas supply line (24), for supplying pressurized gas to the container (10).

11. A method of filling a container (10) with a liquid containing dissolved gas, including the steps of:

establishing a back pressure in the container (10);
supplying liquid into the container;
monitoring at least one characteristic of the liq-

uid; and

varying the back pressure in accordance with the characteristic of the liquid to reduce break-out of gas.

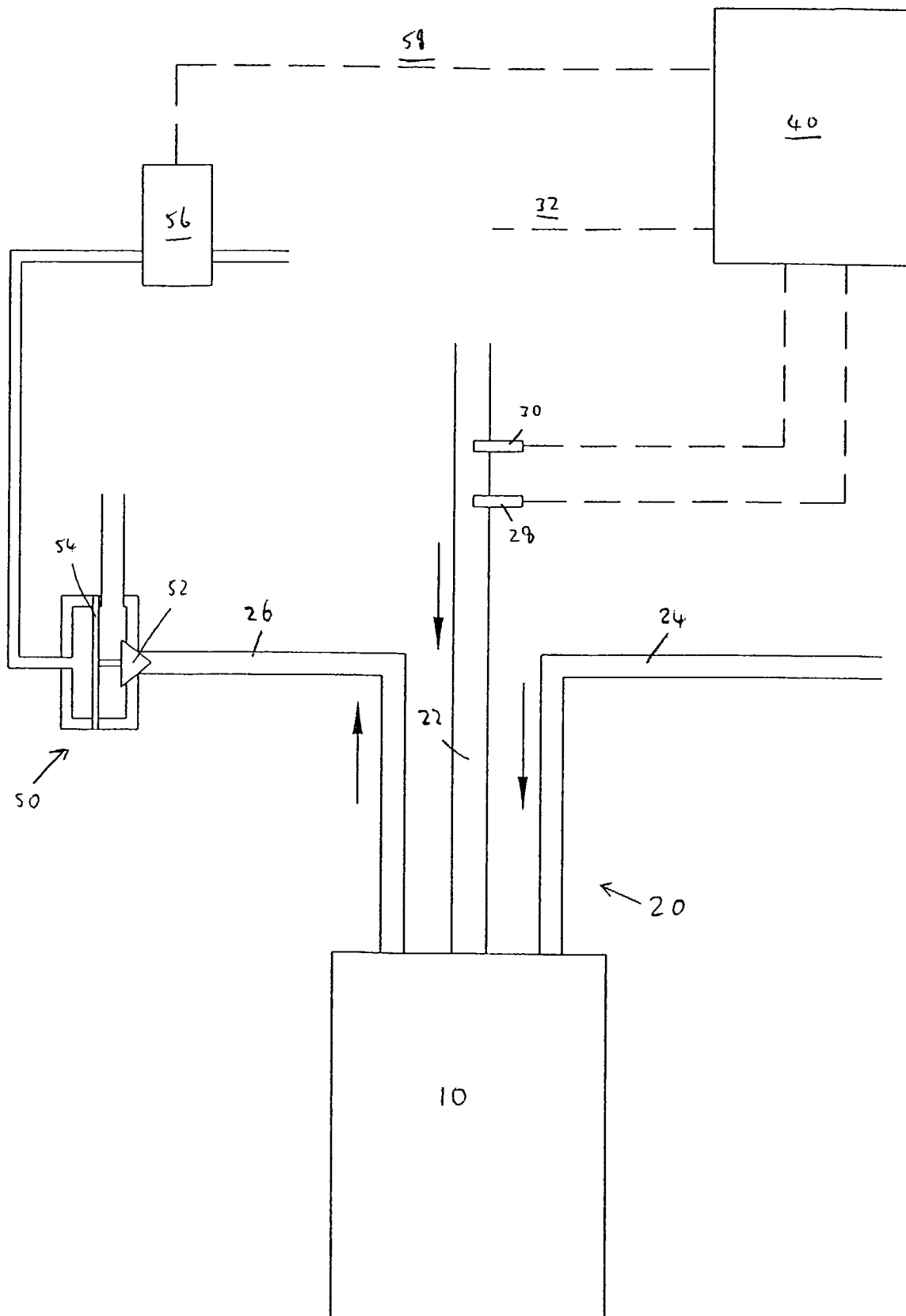
12. A method as claimed in claim 11, wherein the back pressure is varied by varying the pressure at which a relief valve (50), positioned to selectively prevent flow in a return line (26) for gas displaced from the container (10), operates.

13. A method as claimed in claim 11 or claim 12, wherein the pressure of the liquid being supplied is monitored, and the back pressure is varied in accordance with the pressure of the liquid being supplied.

14. A method as claimed in any of claims 11 to 13, wherein the temperature of the liquid being supplied is monitored, and the back pressure is varied in accordance with the temperature of the liquid being supplied.

15. A method as claimed in any of claims 11 to 14, wherein the amount of gas dissolved in the liquid being supplied is monitored, and the back pressure is varied in accordance with the amount of gas dissolved in the liquid being supplied.

16. A method as claimed in any of claims 11 to 15, wherein the amount of liquid supplied is monitored, and the back pressure is varied in accordance with the amount of liquid supplied.





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 9434

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 949 764 A (CLUESSE RATH LUDWIG) 21 August 1990 (1990-08-21) * column 4, line 41 - line 53 * * column 8, line 22 - line 31; figure 1 * ---	1,6, 10-13	B67C3/12 B67C3/32
X	US 3 167 098 A (HAYDEN E.L. ET AL) 26 January 1965 (1965-01-26) * column 2, line 36 - line 42 * * column 4, line 21 - line 36 * * column 4, line 54 - line 69; figure 1 * ---	1,2, 11-13	
X	GB 1 574 735 A (GKN SANKEY LTD) 10 September 1980 (1980-09-10) * page 3, line 1 - line 10 * * page 3, line 81 - line 84; figure 1 * ---	1 11	
A	DE 297 18 062 U (TILL GEA GMBH & CO) 20 May 1998 (1998-05-20) * page 11, line 1 - line 9; figure 3 * -----	1,11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B67C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17 January 2001	Examiner Wartenhorst, F
CATEGORY OF CITED DOCUMENTS 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 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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 30 9434

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-01-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4949764 A	21-08-1990	DE 3717256 A	01-12-1988
		AT 62210 T	15-04-1991
		BR 8802490 A	20-12-1988
		DE 3862237 D	08-05-1991
		EP 0291971 A	23-11-1988
		JP 1037397 A	08-02-1989
		US 4976295 A	11-12-1990
US 3167098 A	26-01-1965	NONE	
GB 1574735 A	10-09-1980	NONE	
DE 29718062 U	20-05-1998	DE 19741254 A	05-11-1998
		BR 9809432 A	13-06-2000
		DE 19720170 A	05-11-1998
		DE 29712148 U	11-09-1997
		WO 9849088 A	05-11-1998
		WO 9849089 A	05-11-1998
		EP 0979206 A	16-02-2000
		EP 0979207 A	16-02-2000