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[54] **DEVICE FOR DETERMINING THE COLLOIDAL STABILITY OF A LIQUID**

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[51] **Int. Cl.** **G01n 33/14**

[58] **Field of Search** .... 73/53; 356/201, 208; 23/253 R; 426/231, 330, 422; 312/236; 62/440, 457, 458

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[57] **ABSTRACT**

A control device for determining the colloidal stability of a fermented liquid such as beer. The device is characterised in that it comprises a refrigerating bath having a tank for containing refrigerating liquid, the bath being provided with electro-mechanical equipment for controlling the thermal conditioning of the fermented liquid contained in bottles placed in the tank. The bath cooperates with an apparatus of known type for measuring the turbidity of the fermented liquid by applying the "cold alcohol" method.

5 Claims, 5 Drawing Figures

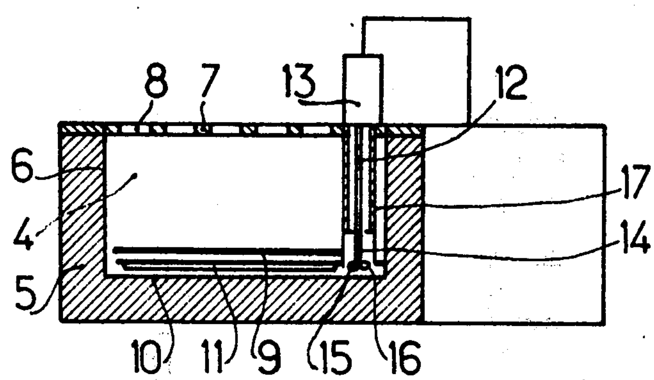

FIG.1

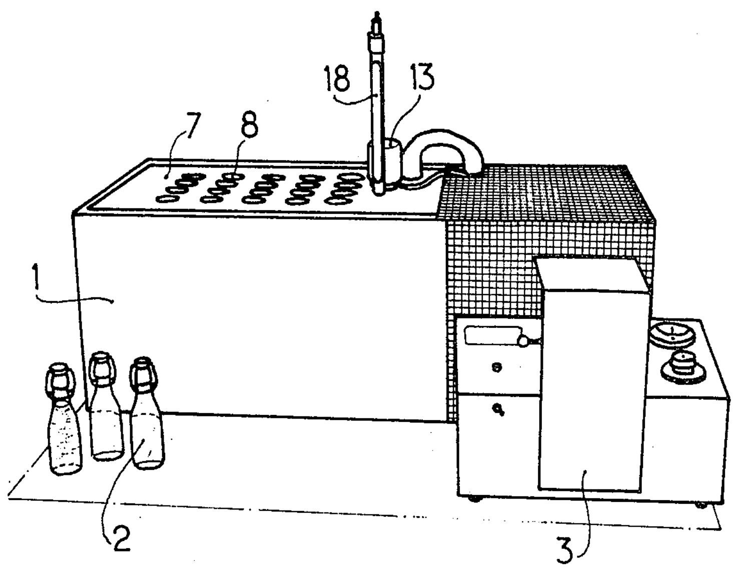

FIG.2

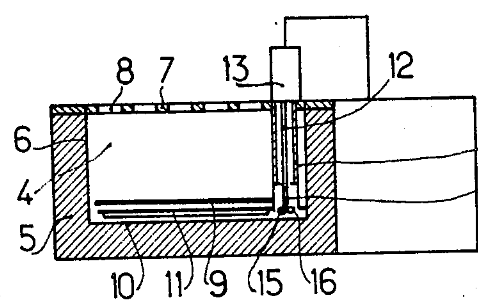

FIG.3

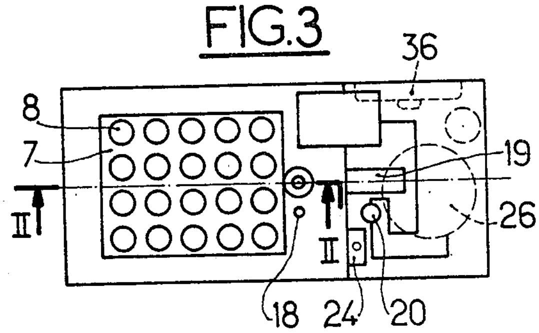

FIG.4

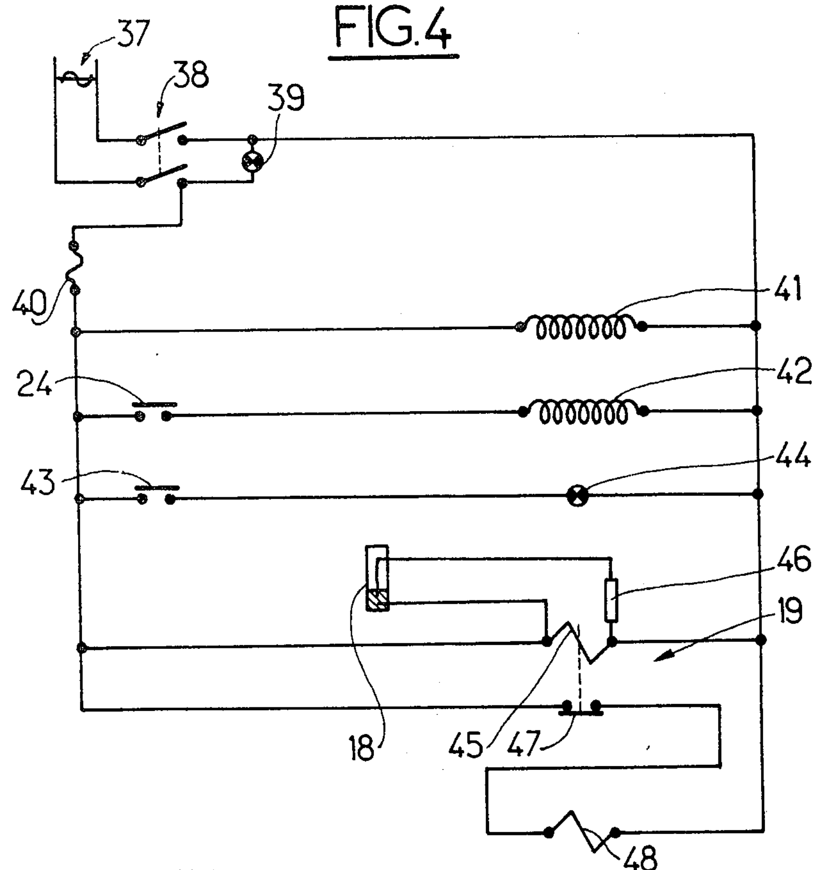
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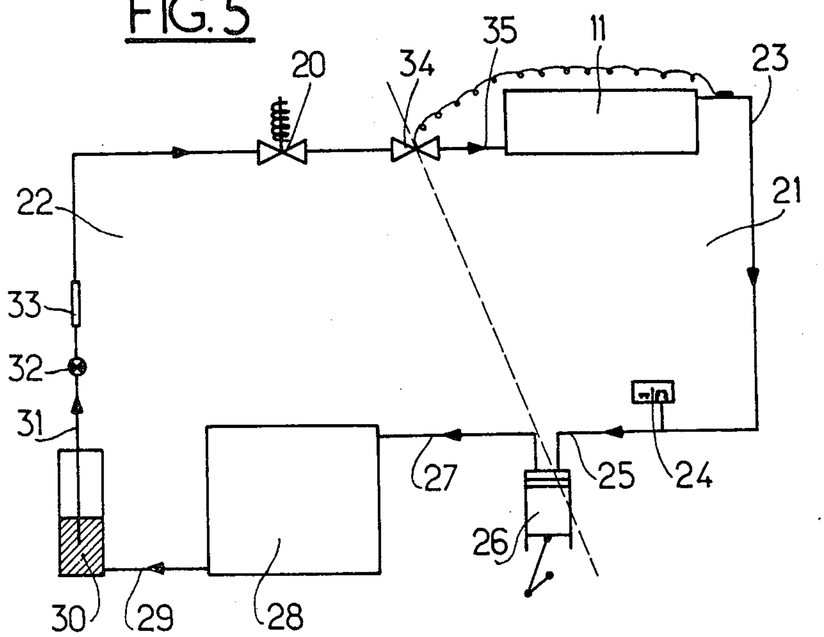
FIG.5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DEVICE FOR DETERMINING THE COLLOIDAL STABILITY OF A LIQUID

BACKGROUND OF THE INVENTION

This invention relates to a control device in particular for determing the colloidal stability of a fermented liquid such as beer.

In order to maintain the brightness of a fermented liquid, in particular of beer, at the correct level for as long as possible when under the care of the consumer, that is to say in order to ensure its colloidal stability, it is necessary to subject the beer to a stabilisation treatment. A number of factors are known which exert an unfavourable influence upon the colloidal stability of beer; the principle ones are the dissolved oxygen originating from the principle fermentation and the presence of heavy metals such as Cu^{2+}, Fe^{2+}, Sn^{2+}. These factors result in the premature appearance of cloudiness.

In order to predict the actual colloidal stability of beer, attempts have been made to develop relatively rapid control methods.

A first method consists of estimating separately the two forerunners of cloudiness, that is certain proteins and the tannoids, the equilibrium of which has a decisive influence upon the stability of beer. A diffusoabsorptiometer recorder has been developed, by means of which two determinations can be carried out: firstly, the sensitivity to tannin which characterises the proteins kown as sensitive proteins; secondly, the concentration of tannoids, which constitute a large fraction of the condensed polyphenols. Nevertheless, due to its cost and its complexity, this apparatus can only be used in the laboratory and cannot be put into operation on an industrial scale.

A second method consists of exaggerating the conservation conditions, in order to accelerate the formation of turbidity. Thus, the stabilised beers are subjected to a 60° Celsius temperature for a period of seven days, then to a temperature of zero degrees Celsius for 24 hours, and standard beers to a temperature of 40° Celsius for 7 days, followed by maintenance at zero degrees Celsius for 24 hours. The principle disadvantage of this method is that it takes 8 days. The control operation has often not been completed when the beer has already left the brewery.

A third method, known as the "cold alcohol" method, was developed for rapidly measuring the evolution of turbidity in the beer at a given temperature. The cold turbidity is the first manifestation of instability in the beer. It results from associations by hydrogen bonds between the hydroxyl groups of certain polyphenols and the peptide groups of certain proteins. The principle of the test consists of adding a suitable alcohol which, acting in the manner of a polyphenol, drives out the molecules of protein solvation water and causes a reduction of solubility; the lower the temperature of the beer, the higher this reduction in solubility. The response speed of this test is especially favourable, since a period of only 40 minutes at less than 8° Celsius is required to enable a judgement to be made of the tendency of the beer investigated to become colloidally clouded. The effectiveness of this measuring principle, which is both simple and rapid, has aroused a great deal of interest among breweries.

The present invention has the object of overcoming the disadvantages of the first two methods and proposes to provide a simple and robust control device, enabling the "cold alcohol" test to be carried out and which is adapted as well as is possible to all the conditions of use at the works, at a relatively modest initial cost.

SUMMARY OF THE INVENTION

According to the invention there is provided a control device for determining the colloidal stability of a fermented liquid such as beer, comprising a refrigerating bath for containing a refrigerating liquid, electromechanical means for the thermal conditioning of the fermented liquid, and means for measuring the turbidity of the fermented liquid by applying the "cold alcohol" method.

The device is ideally suitable for tank beer controls of beer filtered after treatment, intended for improving the colloidal stability. This control may thus be carried out systematically on each tank thus making it possible, where applicable, to remedy rapidly a treatment defect, since the time necessary for obtaining the result of the test is only 1 hour. Thus, it is possible to limit the "accidents" resulting from an error in treating the finished product; many brewers have not yet succeeded in preventing such "accidents."

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention will now be described by way of an example, with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of a device according to the invention permitting the "cold alcohol" method to be applied for determining the colloidal stability of a fermented liquid under test;

FIG. 2 is a diagrammatic view in elevation of a chilling tank of the device, being a section along line II—II of FIG. 3;

FIG. 3 is a diagrammatic view in plan of the chilling tank, with a motor hood removed;

FIG. 4 is an electrical circuit diagram for the chilling tank; and

FIG. 5 is a refrigeration circuit diagram for the tank.

DESCRIPTION OF PREFERRED EMBODIMENT

Reference is now made to FIG. 1. The assembly which makes possible the application of the "cold alcohol" method used for the determination of the colloidal stability of beer, comprises a refrigerating or chilling bath 1, in which simple bottles 2 are arranged in order to impart a certain given temperature to the beer contained in the bottles 2, to which an alcohol has been added. The amplitude of variation of this temperature must not exceed one tenth of one degree Celsius up or down. Observance of this condition is essential for an accurate measurement of turbidity, since the solubility of the turbidity when cold is characterised by the very high thermal gradient of the order of 1.5 units of formazine per degree. After ensuring that the temperature and the time have been reached, the bottles 2 are removed individually and are placed in an apparatus 3 enabling the turbidity to be measured; the apparatus 3 in question is of known type and is currently in use.

The main problem consists of ensuring that all the samples of beer to be tested are at the same predetermined temperature. It is of course necessary for the forming of the turbidity to be fairly sensitive, so that it can be evaluated in a precise manner and, at the same time, the turbidity value must come within the measuring range of the control apparatus 3. In addition, the operating temperature for the test must be sufficiently low to accentuate the formation of turbidity.

Reference is now also made to FIGS. 2 and 3. The chilling bath 1 comprises a tank 4 clad in thermal insulating material 5. The tank 4 is closed at its upper part 6 by a removable grating 7 having holes 8 of identical diameters. The holes 8 are equidistant from one another both along their longitudinal axis and along their transverse axis. The bottles 2, containing the beer to be tested, are disposed through the holes 8. The plurality of holes 8 enables a number of samples to be tested simultaneously, which is a very great advantage on an industrial scale. As a result of the identical centre-to-centre spacings, the bottles 2 occupy a predetermined position and identical circulation passages for the refrigerating liquid result. The bottles 2 are thus uniformly chilled. It is important that the level of the chilling liquid shall be at the same height as the level of the volume of liquid to be tested, which is contained in the bottles 2 immersed in said chilling liquid.

The bottles 2 rest upon a double bottom 9, situated at a certain distance above the bottom 10 of the tank 4. In the free space between the double bottom 9 and the bottom 10, there is housed an evaporator plate 11 which gives to the chilling liquid contained in the tank 4 the desired temperature. To ensure uniformity of temperature in the bath, it is necessary to ensure uniform circulation of the chilling liquid contained in the tank 4. For this purpose, a stirrer 12 is immersed vertically in the liquid; the stirrer is driven at its top end by a motor 13. The immersed end 14 of the stirrer 12 is provided with a suction and delivery propellor 15. The shape, angle and number of the blades 16 are of course predetermined.

The propellor 15 revolves in a metal duct 17 forming a chimney, the diameter and the height of which have been carefully selected. The stirrer 12 operates continuously. The chilling liquid is sucked by the propellor 15, ascends in the metal duct 17 and is thrown out at the top into the mass of chilling liquid. For this purpose, the metal duct 17 comprises at its top end at least one orifice for the discharge of the liquid sucked by the propellor 15.

The temperature of the chilling liquid is controlled by a thermometer 18 with electrical contacts; the thermometer 18 actuates a relay 19 which connects an electrical supply to an electrically operated valve 20 mounted in the refrigeration unit.

To illustrate this assembly, reference is now made to FIG. 5 which shows the circuit of the refrigeration unit. The circuit is divided into a low pressure circuit 21 and a high pressure circuit 22. The low pressure circuit 21 comprises all the plant from the needle of a pressure reducing valve 34 to the suction valve of a compressor 26, i.e. duct 35, evaporator plate 11, duct 23, pressure controller 24 and duct 25. The high pressure circuit 22 comprises all the plant from the delivery valve of the compressor 26 to the needle of the pressure reducing valve 34, i.e. duct 27, condensor 28, duct 29, storage bottle 30, duct 31, indicator 32, filter 33 and valve 20. The assembly comprises of course a cooling fan 36.

Reference is now made to FIG. 4 which shows the electrical diagram for controlling the temperature of the chilling bath 1.

The electrical circuit is supplied from mains 37 by a double interrupter switch 38. A visual supply indicator 39, connected across the output terminals of the switch 38, indicates that the supply voltage is available at these terminals; from these terminals there branch in parallel, after the incorporation of a protecting fuse 40, a number of circuits as follows: an electrical circuit 41 for the electric motor of the stirrer 13, followed by an electrical circuit 42 for the electrical motor of the compressor; the pressure controller 24, is mounted in series in the latter circuit.

Another branch comprises in series a tank level switch 43 and a low level visual indicator 44.

Another circuit comprises the winding or coil 45 of the relay assembly 19, known by the name of EPSL; the terminals of the relay are shunted by a circuit branch composed of the contacts of the mercury thermometer 18 and of a ballast circuit 46 which is intended, when the shunt circuit is closed, to tap a large proportion of the supply current from the coil 45. This coil controls the opening or closing, through the contacts 47, of the relay 19; a final branch comprises the supply circuit 48 to the electrically operated valve 20.

The method of functioning of the chilling bath 1 is as follows: initially, the mercury thermometer 18 operates and itself actuates the relay 19. The relay 19 closes the electrical contact of the electrically operated valve 20 mounted in the high pressure circuit 22 to allow the inflow of refrigerating fluid to the evaporator plate 11. The low pressure increases and the pressure controller 24 switches on the compressor 26. When the desired temperature has been reached, the mercury thermometer 18 cuts the supply to the relay 19 and the electrically operated valve 20 is no longer supplied electrically. There is no further flow of refrigerating fluid. The compressor 26 empties the plate evaporator 11, the low pressure falls and the pressure controller 24 cuts the electrical supply to the compressor 26. The method of operation is cyclical.

We claim:

1. A device for determining the colloidal stability of a fermented liquid such as beer, comprising a refrigerating bath containing a chilling liquid for imparting a precisely controlled temperature to said fermented liquid and means for measuring the turbidity of the fermented liquid by the "cold alcohol" method at said controlled temperature, said refrigerating bath comprising a tank clad in thermal insulating material and containing said chilling liquid, a removable grating provided at the upper part of said tank, said grating having holes of identical diameters to receive bottles and arranged at equidistant centres, whereby a plurality of bottles, filled with the liquid to be tested, occupy predetermined positions when placed in the tank according to the arrangement of the holes of the grating, thereby producing identical circulating passages for the chilling liquid between the bottles so as to cool the bottles uniformly, a double bottom disposed at a certain distance from the bottom of the tank, the double bottom serving as a support for the bottles received in said holes in said grating, the position of the double bottom relative to the level of the chilling liquid in the tank being predetermined so that the level of the chilling liquid is in the same horizontal plane as the level of the volume of liquid to be tested contained in the bottles immersed vertically in said chilling liquid and held in place by the grating, a motor-driven stirrer mounted in

the refrigerating bath for circulating the chilling liquid in the tank, a refrigerating assembly, and a plate evaporator disposed in the tank between the bottom of said tank and the double bottom, and connected to said refrigerating assembly.

2. A device according to claim **1,** in which said stirrer comprises a sucking and delivering propellor provided at the immersed end of a motor driven shaft, and a vertical duct forming a chimney wherein said propellor revolves and having at its upper part at least one orifice for discharging overflow of the chilling liquid drawn up inside the duct by the propellor, whereby a uniform circulation of the chilling liquid is created thus ensuring the homogeneity of the temperature of the liquid in the tank.

3. A device according to claim **1,** wherein said refrigerating assembly comprises an electrically operated valve connected to said evaporator plate, a relay connected to said valve, a contact thermometer controlling the temperature of the chilling liquid and actuating said relay, and a refrigeration circuit comprising in series said valve and said plate evaporator.

4. A device according to claim **3,** wherein said thermometer is a mercury thermometer with contacts positioned to control the temperature of the chilling liquid to within ±0.1°C of a predetermined temperature.

5. A device for determining the colloidal stability of a fermented liquid such as beer, comprising a refrigerating bath containing a chilling liquid for imparting a precisely controlled temperature to said fermented liquid and means for measuring the turbidity of the fermented liquid by the "cold alcohol" method at said controlled temperature, said refrigerating bath comprising a tank clad in thermal insulating material and containing said chilling liquid, a removable grating provided at the upper part of said tank, said grating having holes of identical diameters to receive bottles and arranged at equidistant centres, whereby a plurality of bottles, filled with the liquid to be tested, occupy predetermined positions when placed in the tank according to the arrangement of the holes of the grating, thereby producing identical circulating passages for the chilling liquid between the bottles so as to cool the bottles uniformly, means supporting said bottles spaced from the bottom of said tank to provide liquid circulating space below said bottles received in said holes in said grating, refrigerating means for cooling said chilling liquid, means for sensing the temperature of said chilling liquid and controlling the cooling of said liquid by said refrigerating means to maintain said chilling liquid at a predetermined temperature, and means for circulating the chilling liquid in the tank through the circulating passages between the bottles and below the bottles.

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