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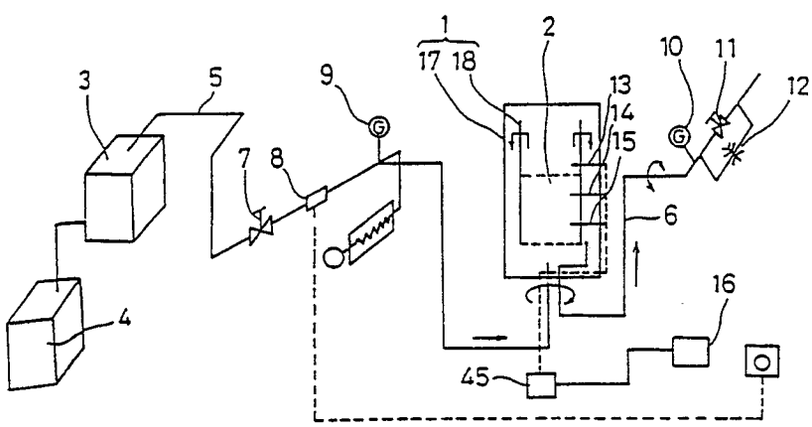
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(54) Method and apparatus for deodorization of cork.

(57) A method for deodorization of cork accomplished by applying steam distillation to remove substances originating offensive odor in the cork is disclosed. The method comprises a first step of putting the cork into a container, a second step of supplying steam generated in a steam generator to the container, and a third step of discharging the steam along with the substance originating the offensive odor from the container. An apparatus for deodorization of cork by this method is also disclosed.

FIG. 1



EP 0 395 010 A1

METHOD AND APPARATUS FOR DEODORIZATION OF CORK

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to removing offensive odors from cork. Specifically, the present invention relates to removing 2,4,6-trichloroanisole (TCA) which has a characteristic odor.

Description of the Background Art

Cork has unique characteristics. It is lightweight and has a high degree of resilience. Additionally, it has excellent gas and liquid sealing properties, and has stability against solvents such as alcohol. Furthermore, it is hygienic material which is food-safe and not harmful to human beings, and has no intrinsic odor.

Because of the above mentioned characteristics, cork has been widely utilized as stoppers for casings such as bottles filled with liquor such as wine, brandy or whiskey, or casings packed with various kinds of foods.

However, in spite of having no intrinsic odor, offensive odor is encountered on cork stoppers on rare occasions. This odor, when present deteriorates the quality of the contents of the bottles or casings sealed by the cork. Recently, by various studies, 2,4,6-trichloroanisol (TCA) has been identified as the substance which originates the offensive odor. TCA is considered as the substance produced by moulds from 2,4,6-trichlorophenol (TCP) which is utilized in agents conventionally used to spray to cork oak. Also, in "Journal of Agricultural and Food Chemistry", (1982) pages 359 to 362, presumption is given that 2,4,6-trichlorophenol and other related chlorinated compounds originate from chlorination of liquid-related substantce during the chlorinate bleaching used in the process of cork and that these compounds are later extracted into the liquor, such as wine. Similar consideration that clorinate agent is the source of the oder substance has been given in "Science des Aliments" (1984), pages 81 to 93. In the discussion, it has been pointed out that the 2,4,6-trichloroanisol is derived from pentachlorophenol or other chrorinated pesticides applied to the tree. Further consideration is given that cork material and corks stored in premises with atmosphere polluted by chloroanisoles may contaminate bottled wine aged in healthy cellars.

Methods for effective deodorization of cork have been studied, and the following methods have been attempted.

(1)Dry-heating deodorization

Cork is heated and dried at 80 °C for 6 to 8 hours, after which the offensive odor causing substances are substantially evaporated. However, TCA is specifically adsorbed by the macromolecular compounds which form cork such as cellulose, lignin and suberin, and it is difficult to remove TCA in the dried state. The boiling point of TCA is 240 °C at 738.2 mmHg, and 132 °C at 28 mmHg. Therefore, in order to evaporate TCA, a heating temperature must be applied which is higher than the boiling point of TCA. However, it is difficult to raise the internal temperature of cork without heating the surface excessively, which results in deterioration of cork's desirable characteristics. As such, heating is applied only to surface of cork, therefore TCA in the interior cannot be removed entirely.

(2)Repetition heating deodorization

Cork is heated at 80 °C for 6 hours, and is then left at room temperatures for about a month. TCA can removed by repeating this treatment many times. However, this method requires a long periods of treatment until the TCA is entirely removed, therefore, production efficiency is low. (2 or 3 repetitions of the above treatment is insufficient for entirely removing TCA).

(3)Citric acid deodorization

Cork is deodorized by being soaked in a 3 vol% solution of citric acid for 3 to 5 min. However, the effects of this deodorization technique are retained only for a short period. That is because, as cork resists absorption of liquids, the citric acid solution cannot reach the cork internal. Therefore, the deodorizing treatment affects only the cork surface, untreated TCA within the cork is moved to the cork surface with the elapse of time, thus the offensive odor re-occurs.

(4)Oxidant bath deodorization

Cork is deodorized and sterilized by soaking in a 1 vol% solution of hydroperoxide (H_2O_2). However similar problems are caused as in the case of citric acid deodorization.

(5)Alcohol steam deodorization

Cork is left and deodorized in alcohol atmosphere at 18 to 24 °C for a month. However, this method encounters the same problems as methods (3) and (4).

(6)Hot water washing

Cork in the grain state is washed in hot water at a temperature of 60 °C. The treatment needs to be repeated 2 times. But, as TCA has a relatively strong affinity for cork, it is moved to and retained in the internal portions of the cork. According to this method, therefore, the deodorizing effect is still insufficient because the treatment affects only the cork surface.

(7)Soxhlet extraction

TCA in the cork is extracted by Soxhlet extractor at 45 °C for 24 hours with n-pentane. By this method, TCA is entirely removed from both the surface and internal areas of the cork. However, the equipment is very expensive and production costs become very high. Furthermore, a certain degree of safety risk is encountered with this method.

(8)Dispersion

It has been considered to simply grind the cork into grains having a certain diameter, and then forming it back into the desired form by pressing with adhesives. However, TCA is merely disperse in each grain, high improvement cannot be expected from this approach.

(9) Sterilization with Iradiation

"Deutsche Lebensmittel-Rundschau" (1984) Pages 204-207, is directed to sterilization with irradiation. It has been discussed that the mechanism of formation of cork taint in wines. There has been proposed to use irradiation process for preventing michtobial conversion from TCP to TCA and thus achieving prevention of cork taint. However, this method cannot remove TCA residing within internal structure of the cork

(10) Sterilization with Ozone

German Patent First Publication No. 34 05 422 discusses that cork is sterilized with ozoned water or ozonized silicone emulsion, in which the ozonized concn. being Pl mg/ℓ at a temperature lower than 30°C.

However, this method encounters the same problems as method (3) and (4).

SUMMARY OF THE INVENTION

It is therefore, the principal object of the present invention to provide a method for deodorizing cork by removing substance causing offensive odors, principally TCA from the cork internal.

It is another object of the present invention to provide a method for deodorization of cork without deteriorating cork's unique characteristics.

It is a further object of the present invention to provide an apparatus for simply and inexpensively deodorizing the cork.

According to one aspect of the invention, a method for deodorization of cork comprises the step of applying steam distillation to the cork to remove a substance originating offensive odor in the cork, temperature and pressure of steam for deodorization treatment is so selected as to penerate steam molecule into internal structure of cork.

According to another aspect of the invention, a method for removing a substance originating offensive odor in the cork comprising the steps of:
a first step of putting the cork into a container,
a second step of supplying steam to the container for generating steam flow at a given temperature and a given pressure, the temperature and pressure being selected for penetrating steam molecule into internal structure of cork and promoting steam distillation within the internal structure of cork,
a third step of discharging the steam past the cork and containing the substance originating offensive odor, from the container.

The substance originating offensive odor may be 2,4,6-trichloroanisole, which may be precursor of 2,4,6-trichloroanisole.

The method further comprises the steps of:
cutting the cork into pieces having a predetermined size,
pre-heating the cut cork to a certain temperature, and
maintaining the temperature and the pressure during deodorizaion.

In such case, the steam temperature is at least 100 °C; the system pressure is at least 760 mmHg. In the preferred embodiment, the second step further comprises supplying the steam for the cork from the bottom of the container. The second step may further comprise agitating the container. In such case, the agitating step is comprised of rotating and/or oscillating the container. The agitating step may comprise of stirring the cork in the container.

The method may further comprise a step of cooling the cork in the container. The cooling step is may includes the steps of:
generating a hot atmosphere,
supplying the hot atmosphere to the interior of the container while maintaining rotation and oscillation of the container.

Preferably, supplying atmosphere is performed after natural cooling and at a timing where cooling efficiency by natural cooling is lowered.

According to a further aspect of the invention, an apparatus for deodorization of cork by steam distillation comprises:
means for generating a flow of stream at a given temperature and a given pressure which are selected for causing steam distillation within the internal structure of the cork to remove a substance originating offensive odor, contained in the cork.

According to a still further aspect of the invention; an apparatus for deodorization of cork comprises:
first means for containing the cork,
second means for supplying steam from a steam generator for forming a steam flow from an inlet to an outlet of the first means, the steam in the steam flow being maintained at a given temperature and a given pressure selected for removing a substance causing offensive odor from the cork,
third means for discharging the steam along with the substance causing offensive odor through the outlet of the first means.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more clearly from the preferred embodiments described herebelow and from the appended drawings which illustrate the detailed composition of the embodiments,

which, however, should not be taken to limit the invention but are for explanation and understanding only.

In the drawings:

Fig. 1 is a block diagram showing a method for removing offensive odor substances according to the present invention;

Fig. 2 is a sectional view of an apparatus for deodorization of cork according to the present invention;

Fig. 3 is a graph showing the relationship between penetration of steam and the temperature and pressure of the steam; and

Fig. 4 is a graph showing relationship between total amount of supplied steam and TCA removal ratio.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is accomplished by utilizing conventional steam distillation.

As is well known, the cork has a water resistive property to prevent water molecule from penetrating into the internal structure thereof. Therefore, though it is known that TCA on the surface of the cork surface can be washed out by water, internally contained TCA cannot be removed by water. To this point, it has been known that TCA has a characteristic which is that it can volatirized with steam. Additionally, it has relatively low boiling point at 28 mmHg. Therefore, if treating temperatures are controlled at the level at which the partial pressure of TCA becomes 28 mmHg, TCA can be evaporated at relatively low temperatures. Taking the factors mentioned above into consideration, the inventors became aware that steam distillation may be effectively utilized for the deodorization of cork. Previously, steam distillation had never been applied for cork deodorization. In various attempts made by the inventors, it comes to known to the inventors that steam temperature and pressure is very important factor for enabling steam distillation. Particularly, according to the invention, the steam is enabled to penerate into the internal structure of the cork for heating the internal structure so that steam distillation is caused within the internal structure for removing TCA residing inside of the cork.

It is considered that molecule of steam can be excited for increasing mobility under given temperature. Such increased mobility of steam molecule is enabled to successfully penetrate into the internal structure of the cork. The steam molecule penetrated into the internal structure of cork heats the inside of cork to the temperature at which steam distillation is internally caused. By this, TCA contained in the internal structure of the cork can be evaporated.

Any kind of cork may be used and is not limited by the field of use to which it is put nor by its form. For example, cork for bottle capping, wine bottle stoppers or crown disks, for architectural use, vibration proofing or heat insulator materials may all benefit from treatment according to the present invention.

The shape of the first means is not limited specifically, but for effective steam utilization, a longitudinal shape the container of which is formed with a diameter smaller than its height is most preferred.

Any state of cork is acceptable, but for enhancing the removal efficiency by homogenizing steam and cork, maintaining the cork in an agitated state while supplying steam to the first means is preferable. For agitating, to move the container per se (e.g., oscillating or rolling) or to locate agitating means in the container of the first means to stir the inner materials are both acceptable.

In general, the steam temperature should be at least 100 °, and, the pressure at least 760 mmHg, and the amount of fluid at least 0.1 liter against 1 liter of cork. When the steam temperature is lower than 100 °C, partial pressure cannot be high enough to cause steam distillation within the internal organization of the cork. Also at the temperature lower than 100 °C, penetration of steam molecule into the internal structure of cork may not be sufficient. On the other hand, when the steam temperature is higher than 130 °C, difficulty is encountered in controlling temperature during cooling process. That is at high steam temperature, significant amount of steam can be penetrated within the internal structure. The steam penetrated within the internal structure of the cork may lead shrinking of the cork when it is subjected atomospheric temperature which may results in rapid cooling. Siginificant magnitude of shrinkin of cork may degradation of the property of cork. Therefore, the temperature has to be maintained to be lower than or equal to 130 °C.

Cork size is not limited specifically, but a smaller size is preferred because TCA movement from within the cork to its surface becomes easier. This results effective removal of TCA.

It should be appreciated that the treatment temperature, the system pressure, container configuration cork amount to be treated and other conditions for steam distillation treatment can be selected according to required efficiency and degree of removal of TCA.

According to the above identified steam distillation, the partial pressure of TCA can be reduced by the

partial pressure of steam, then the boiling point of TCA can be lowered at around atmospheric pressure. Therefore, deterioration of cork can be avoided and deodorization of cork (removal of TCA) can be accomplished sufficiently.

A method for removing offensive odor in the cork according to the present invention is described in detail referring to the appended Figures which show the processing system for TCA removal.

Referring now to **Fig. 1**, a block diagram showing the method for removing offensive odor according to the present invention is shown. A given amount of cork **2** cut to a predetermined size is put into a treating container **1**. Purified water provided from a purified water generator **4** is supplied to a steam generator **3**. Then, after steam is generated in the generator 3, it is supplied to the container 1 via a steam supply pipe **5**. Steam distillation of the cork **2** is performed in the container **1**, then steam is discharged from the container **1** through a steam discharge pipe **6** out of the system. Steam feeding is controlled by a supply valve **7**, a flow meter **8**, pressure meters **9**, and **10**, a discharge valve **11**, and a flow control valve **12**. Temperature sensors **13**, **14** and **15** are installed in the upper, middle and lower ports of container **1**, respectively. The temperature in the container **1** is monitored through these sensors by a monitor system **16**, then temperature is controlled at the constant predetermined level.

The container **1** has an outer container **17** and an inner container **18** spaced from the outer container **17** at a constant interval as shown in **Fig. 2**. It may be formed as a cylinder. In this way, the container **1** is formed as a pressure proof container having a double-walled structure. This structure enables steam to be introduced into the space between the outer and the inner wall after it goes through the cork **2**. Therefore, steam in the space through which the steam past the cork flows, serves for maintaining the container temperature at the desired treatment temperature and thus for reducing the heat loss in the steam

Referring now to **Fig. 2**, when amounts of cork **2** are put into the inner container **18** by opening a lid **19**, they pile on a bottom plate **20**. Steam is sprayed into the interior of the container **1** through a plurality of steam pores **21** penetrating the bottom plate **20**, and runs through the piled cork **2** from bottom to top.

A steam inlet pipe **22** is connected to the center port of the container's bottom and extends from the lower end of the outer container **17** of the container **1** to the outside of the container. The lower edge of the inlet pipe **22** is connected to the steam supply pipe **5** via a first rotary joint **23**. Steam fluid supplied from the supply pipe **5** is supplied to the inlet pipe **22**, to the inner container **18** via the steam spraying pores **21** in the bottom plate **20** of the container **1**. Then, steam supplied into the inner container **18** rises through the cork **2** concurrently heating it, and is discharged from steam discharging pores **24** which penetrate the upper side wall(s) of the inner container **18** into the space **25** between the outer container **17** and the inner container **18**, an outlet pipe **26** coaxially arranged surrounding the outside of the steam inlet pipe **22**. Then it is discharged from the steam discharge pipe **6** connected to the outlet pipe **26** via a second rotary joint **27**. Pressure and flow of steam can be controlled at a constant level by the discharge valve **11** and the flow control valve **12**.

In order to homogenize sprayed steam and the cork **2**, agitating the material in the container **1** is effective. A central shaft **28** for rotation is located surrounding the outlet pipe **26**, and is rotatably supported by a bottom portion **30a** of an oscillating frame **30** formed in U-shape via a bearing **29**. The container **1** can be rotated against the central shaft by a rotation drive device **31** installed on the bottom portion **30a** of the oscillating frame **30** composed of a motor, rotation gear, translation gear or so forth. Additionally, the container **1** can be oscillated by the oscillating frame **30**. Then, by rotating with oscillation, the cork **2** and steam in the container **1** can be agitated sufficiently. A pair of supporting shafts **32**, and **33** are installed to an outer surface of an upper end of side portions **30b** of the oscillating frame **30**. These shafts **32**, **33** are oscillatably supported by a pair of fixed frames **36**, **37** via bearings **34**, **35** to be oscillated by an oscillation drive device **38**.

The oscillation drive device **38** is composed of a worm wheel **39** installed on the supporting shaft **33** and a motor **42** which rotatably operates a worm gear **40** via belt **41**, where the worm gear **40** is engaged to gear teeth of the worm wheel **39**. When the motor **42** is rotated in one direction, the worm gear **40** and the worm wheel **39** are rotated in order. This rotation slowly oscillates the oscillating frame **30** in one direction. On the other hand, when the motor **42** is rotated in the other direction, it slowly rotates the oscillating frame **30** in the other direction. In this way, the oscillating frame **30** is oscillated.

In order to supplying steam regardless of oscillation of the oscillating frame **30**, the steam supply pipe **5** is located through the center portion of the supporting shaft **33**, connected to the oscillating frame **30** via a third rotary joint **43**, and further connected to the container **1** via the first rotary joint **23**. The steam discharge pipe **6** is located through the center portion of the other supporting shaft **32**, connected to the oscillating frame **30** via a forth rotary joint **44**, and further connected to the container **1** via the second rotary joint **27**.

A slip ring **45** is mounted on the edge of the central shaft **28** of the container **1**. Signals, obtained from

temperature sensors **13**, **14** and **15**, connected to the outside portion of the oscillating frame **30** via the slip ring **45**, are input to a monitoring device **16** which is connected to the slip ring **45** (as shown in **Fig. 1**) allowing the temperature in the container to be effectively monitored.

Circular frames **46** are mounted on the top of the side portion **30b** of the oscillating frame **30**. Rollers **47** are installed in the inner surface of the radial frames **46** to rotate the container **1** smoothly by supporting the outer surface of the upper port of the container **1**.

In the shown embodiment, rotation speed of the container is preferably determined at, at least, 10 rpm, and the incline angle is preferably determined as at least ± 60°, though they depend on conditions such as the processing amount and cork size. The inclination angle range of the container is not strictly limited to ± 60° but can be selected in any way. In general, the inclination angle of the container may be determined according to the degree of filling of the cork within the interior space of the container. Namely, the inclination angle is so selected that the cork can be distributed over entire area of the steam path so that steam cannot escape without contacting with cork. Similarly, in case of rolling or agitation, care should be given so that blow off of the steam may not be caused. Therefore, driving speed in rolling and agitation may be determined according to the amount of the cork filled in the container.

Further to say, there is no problem processing by steam distillation in a stationary environment (not rotated or oscillated).

In order to avoid physically changing the cork, for example, shrinking, it may be preferable to cool the cork with maintaining the same within the container 1, slowly. Because cork volume becomes smaller (shrunken) when it subject substantially low temperature after penetration of steam of relatively high temperature. Particularly, since the temperature of the internal structure of cork cannot be cooled as that on the surface, relatively long period is required for satisfactorily cool the internal structure of the cork. This means that if they are removed from the container immediately to subject atmosphere, substantial magnitude of shrinking may be caused in the cork to make it stiff to degrade cork property. On the other hand, allowing natural cooling takes a very long time. Therefore, supplying a hot atmosphere to the container by way of cooling may be effective. Here, rotation and oscillation of the container **1** are continued while cooling. During natual cooling, it has been observed that cooling efficiency is siugnificantly droped at a certain temperature. In order to accelerate cooling, the hot atmosphere is generated in a hot atmosphere generator (not shown in the Figures), and is supplied to the container **1** by controlling the valve **7** located on the steam inlet side. As the cork **2** is wetted by steam, hot atmosphere supplied to the container **1** can take latent heat from the surface of the cork **2** when steam is evaporated. This increases the cooling speed. The results of cooling tests on cork are shown in the following **Table 1**.

Table 1

Repetition	1	2	3	4	5
Cooling periods(min.)	47	48	47	50	46
Volume ratio(%)	111.4	98.0	95.0	96.4	104.7

$$\text{Volume ratio(\%)}: \frac{\text{dried weight after treatment}}{\text{dried weight before treatment}}$$

Materials are shrunken when this value becomes over 100.

Treatment indicates steam distillation.

Test conditions

Flow amount of steam : 280 l/hr.

Period of treatment : 64 min.

Pressure (cage pressure): 1 kg/cm.

As shown in **Table 1**, shrinking of the cork was prevented.

EXAMPLE

In order to demonstrate the advantages accomplished by the present invention, experiments were performed. In the experiments, natural cork of the size 10 cm x 10 cm x 5 cm is heated in an autoclave for

60 minutes at respective temperatures of 100 °C, 110 °C, 120 °C and 130 °C. The pressures at respective temperatures are shown in the following Table 2.

TABLE 2

Temperature (°)C	Pressure (Kg/cm^2)
100	1.033
110	1.461
120	2.055
130	2,754

For checking depth or degree of penetration of steam into the internal structure of the cork, the cork piece samples were cut by a knife and dimension from the cork surface was measured. The result of measurement is shown in the following **Table 3** and **Fig. 3**.

Table 3

Temperature (°)C	Penetration Magnitude (mm)
100	0.5
110	5.0
120	10.0
130	20.0

As can be seen from the foregoing **Table 3** and **Fig. 3**, the penetration degree is exponentially increased according to rising of the steam temperature.

EXAMPLE 2

Cork capping plug recognized as corked was crushed by a known cork crushing machine into a grain size ordinarily used for forming compressed cork, for forming sample cork pieces. 4g of the sample cork pieces were put in a gauze bag (15 cm x 20 cm). The sample cork containing bag is put in the mid portion of the cork burden in the container **1**. Deodorization treatment was performed utilizing the apparatus of **Fig. 2**. In the treatment, the container 1 was rolled with sccessive variation of inclination angle. The steam was flown through the container **1** across the cork in a flow rate of 20 liter/hour and 40 liter/hour. The deordorization treatment was performed for 30 minutes, 60 minutes and 90 minutes after reaching predetermined condition, i.e. temperature in the container was 120 °C and pressure was 1 Kg/cm^2. After treatment, residual TAC amount was checked. Check of residual TCA was performed by slicing the sample cork, extracting TCA from slices by n-pentane, and measured by gascromatograph. The result of measurement is shown in **Table 4** and **Fig. 4**.

Table 4

	Steam Flow Rate (20 l/hr)		Steam Flow Rate (40 l/hr)	
	25,25,18,22,24,28 19,30,32,32		5,4,6,6,5,6,8,6,5	
		(ng/g)		(ng/g)
30 min	Average Standard Error CV(%) Removal	25.5 4.99 22.8% 89.7%	Average Standard Error CV(%) Removal	5.3 1.77 33.4% 97.8%
	7,8,8,11,9,13,12,13,13,12		1.5,1.3,1.6,2.8,2.8 1.6,1.7,2.7,1.5,3.0	
		(ng/g)		(ng/g)
60 min	Average Standard Error CV(%) Removal	10.5 2.51 23.9% 95.7	Average Standard Error CV(%) Removal	2.1 0.68 32.4% 99.1
	7,9,8,7,8,8,10,7,9,10			
		(ng/g)		
90 min	Average Standard Error CV(%) Removal	8.3 1.16 14.0% 96.6	Average Removal	ND 100%

As can be appreciated, the present invention is successful in achieving the object and advantages sought therefor.

While the present invention has been disclosed in terms of the preferred embodiment in order to facilitate better understanding of the invention, it should be appreciated that the invention can be embodied in various ways without departing from the principle of the invention. Therefore, the invention should be understood to include all possible embodiments and modifications to the shown embodiments which can be embodied without departing from the principle of the invention set out in the appended claims.

Claims

1. A method for deodorization of cork comprising the step of applying steam distillation to said cork to remove a substance originating offensive odor in said cork, temperature and pressure of steam for deodorization treatment is so selected as to penerate steam molecule into internal structure of cork.

2. A method for removing an substance originating offensive odor in said cork comprising the steps of:
a first step of putting said cork into a container,
a second step of supplying steam to said container for generating steam flow at a given temperature and a given pressure, said temperature and pressure being selected for penetrating steam molecule into internal structure of cork and promoting steam distillation within the internal structure of cork,
a third step of discharging said steam past the cork and containing the substance originating offensive odor, from said container.

3. The method for deodorization of cork as set forth in claim 1 or 2, wherein said substance originating offensive odor is 2,4,6-trichloroanisole.

4. The method for deodorization of cork as set forth in claim 1 or 2, wherein said substance originating offensive odor is 2,4,6-trichlorophenol, which is precursor of 2,4,6-trichloroanisole.

5. The method for deodorization of cork as set forth in claim 2, which further comprises the steps of:
cutting said cork into pieces having a predetermined size,
pre-heating said cut cork to a certain temperature, and

maintaining said temperature and said pressure during deodorizaion.

6. The method for deodorization of cork as set forth in claim 5, wherein said temperature is at least 100 °C.

7. The method for deodorization of cork as set forth in claim 5, wherein said pressure is at least 760 mmHg.

8. The method for deodorization of cork as set forth in claim 2, wherein said second step further comprises agitating said container.

9. The method for deodorization of cork as set forth in claim 8, wherein said agitating step is comprised of rotating and/or oscillating said container.

10. The method for deodorization of cork as set forth in claim 8, wherein said agitating step is comprised of stirring said cork in said container.

11. The method for deodorization of cork as set forth in claim 2, which further comprises a step of cooling said cork in said container.

12. The method for deodorization of cork as set forth in claim 11, wherein said cooling step is comprises the steps of:
maintaining said cork within said container with stopping steam supply and thus subject natural cooling,
generating a hot atmosphere,
supplying said hot atmosphere to the interior of said container after cooling efficiency by natuaral cooling is lowered.

13. An apparatus for deodorization of cork by steam distillation comprising:
means for generating a flow of stream at a given temperature and a given pressure which are selected for causing steam distillation within the internal structure of said cork to remove a substance originating offensive odor, contained in said cork.

14. An apparatus for deodorization of cork comprised of:
first means for containing said cork,
second means for supplying steam from a steam generator for forming a steam flow from an inlet to an outlet of said first means, said steam in said steam flow being maintained at a given temperature and a given pressure selected for extracting a substance causing offensive odor from said cork,
third means for discharging the steam along with the substance causing offensive odor through said outlet of said first means.

15. The apparatus for deodorization of cork as set forth in claim 13 or 14, wherein said substance originating offensive odor is 2,4,6-trichloroanisole.

16. The apparatus for deodorization of cork as set forth in claim 13 or 14, wherein said substance originating offensive odor is 2,4,6-trichlorophenol, which is precursor of 2,4,6-trichloroanisole.

17. The apparatus for deodorization of cork as set forth in claim 13 or 14, wherein said cork is cut into pieces having a predetermined size.

18. The apparatus for deodorization of cork as set forth in claim 14, wherein said steam is pre-heated to the temperature of said cut cork.

19. The apparatus for deodorization of cork as set forth in claim 14, wherein said steam is pre-pressurized to a certain level.

20. The apparatus for deodorization of cork as set forth in claim 18, wherein said temperature and said pressure are maintained during deodorization.

21. The apparatus for deodorization of cork as set forth in claim 18, wherein said temperature is at least 100 °C.

22. The apparatus for deodorization of cork as set forth in claim 19, wherein said pressure is at least 760 mmHg.

23. The apparatus for deodorization of cork as set forth in claim 14, wherein said first means is formed in a longitudinal shape along with the direction of steam feeding.

24. The apparatus for deodorization of cork as set forth in claim 14, wherein said second means further comprises means for agitating said first means.

25. The apparatus for deodorization of cork as set forth in claim 24, wherein said agitating means comprises means for rotation and/or oscillation of said first means.

26. The apparatus for deodorization of cork as set forth in claim 24, wherein said agitating means is located in said first means and comprises means for stirring said cork in said first means.

27. The apparatus for deodorization of cork as set forth in claim 14, wherein said third means further comprises means for cooling said cork in said first means.

28. The apparatus for deodorization of cork as set forth in claim 27, wherein said cooling means is composed of:

means for generating a hot atmosphere, and
means for supplying said hot atmosphere to the interior of said first means while rotation and oscillation of said first means are maintained.

29. The apparatus as set forth in claim 28, wherein cooling means initially perform cooling of cork by natural cooling and said supplying means is activated to supply said hot atmosphere when cooling efficiency in natural cooling is lowered.

FIG. 1

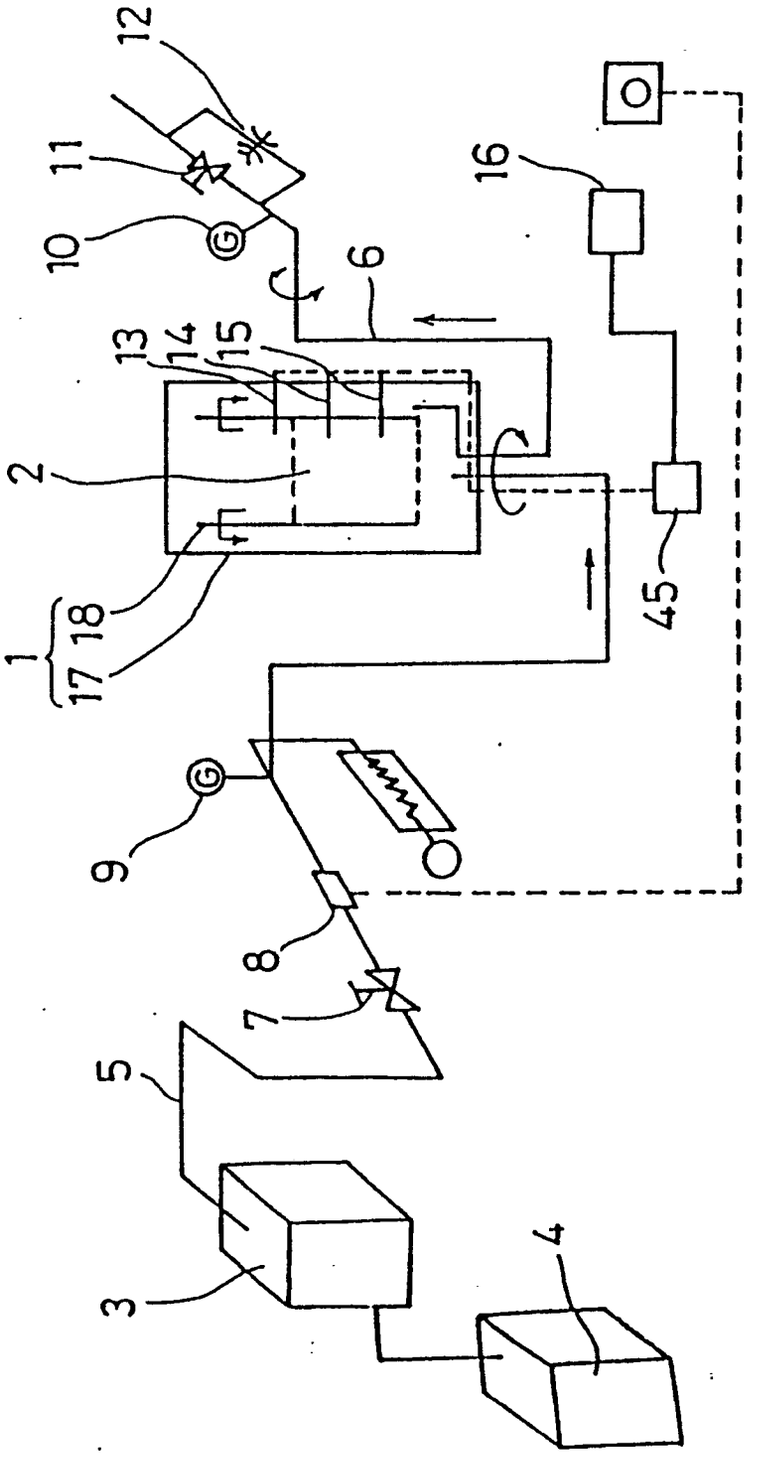


FIG. 2

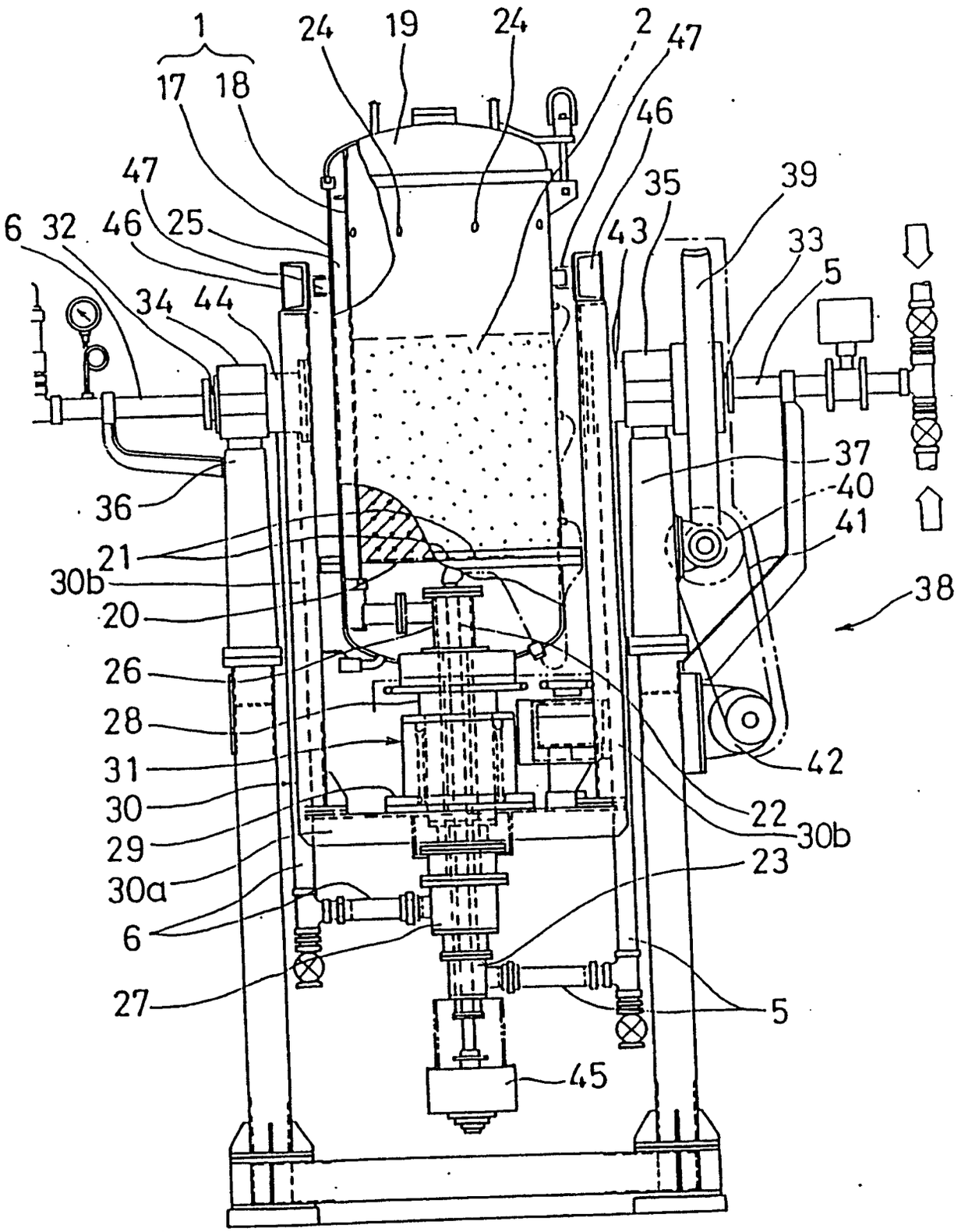

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30a
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42
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30b
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5
45

FIG. 3

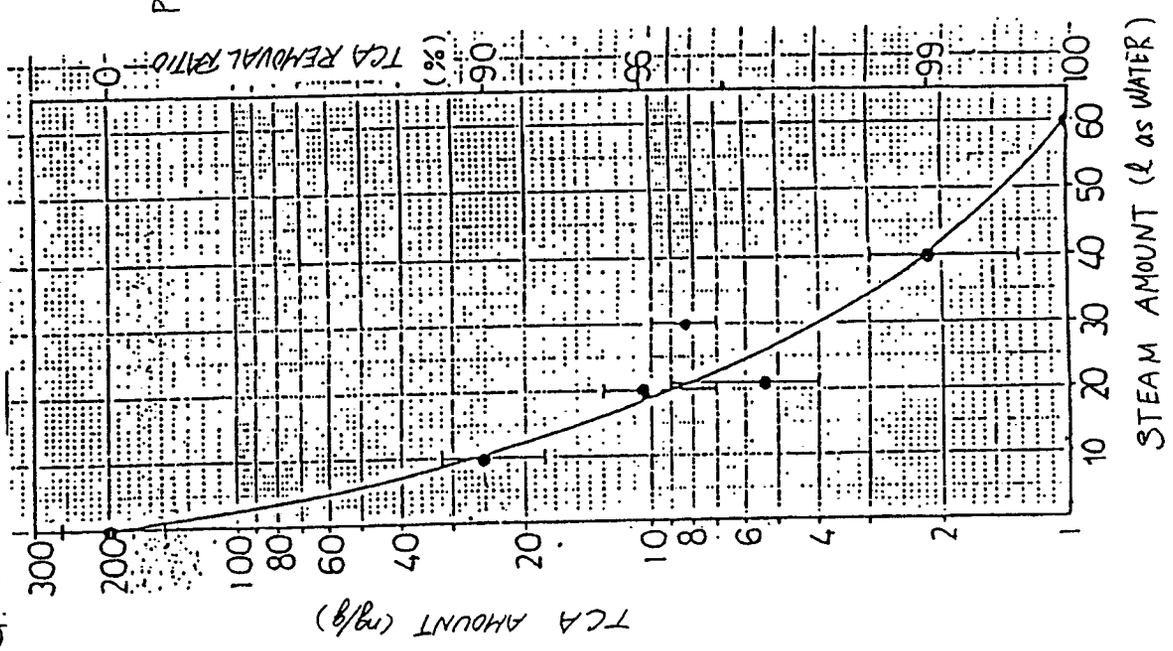
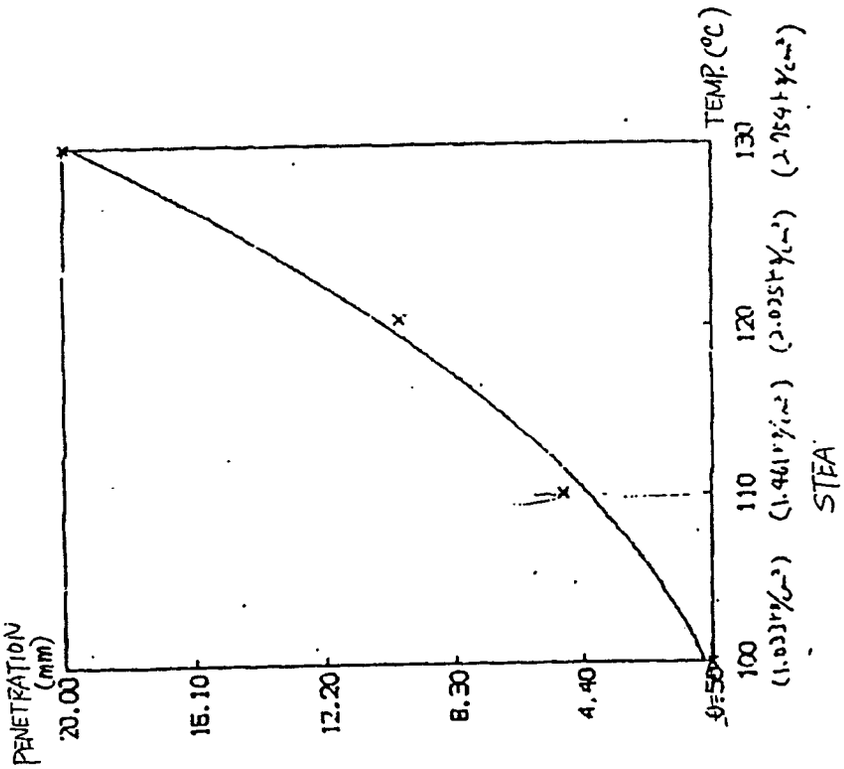

TCA AMOUNT (mg/g)
300
200
100
80
60
40
20
10
8
6
4
2
1
TCA REMOVAL RATIO (%)
0
90
95
99
100
STEAM AMOUNT (ℓ as WATER)
10
20
30
40
50
60

FIG. 4


PENETRATION (mm)
20.00
15.10
12.20
8.30
4.40
θ=50
100
110
120
130
TEMP. (°C)
STEA

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 7858

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.5)
A	DE-C- 264 305 (A. MILCH) * The whole document *	1	B 27 K 7/00
A	DE-C- 267 733 (GRÜNZWEI & HARTMANN) * The whole document *	1-7	
A	DE-C- 557 849 (GRÜNZWEIG & HARTMANN) * The whole document *	1-9	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 27 K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-08-1990	FLETCHER A.S.

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