

METHOD FOR AROMATIZATION WITH COFFEE AROMA, ARTICLES USED FOR
SUCH AROMATIZATION AND APPARATUS USED IN PREPARING SUCH ARTICLES

SUMMARY OF THE INVENTION

Our invention is directed to a process for aromatizing a specific volume with stable coffee aroma by (1) effecting pressurization of coffee grinder gas in a pressure vessel free of molecular oxygen and fitted with spraying means and (2) engaging the spraying means in order to spray the stable coffee grinder gas into the specific volume. Our invention is also directed to apparatus for effecting such aromatization, including a hollow pressurized container free of molecular oxygen containing stable coffee grinder gas as well as the hollow pressurized container free of molecular oxygen containing stable coffee grinder gas itself.

More specifically, our invention is directed to a process for aromatizing a specific volume V_1 having an ambient temperature T_1 which is in the range of 20-30°C and a pressure P_1 which is about atmospheric pressure zero psig, with the stable coffee aroma comprising the steps of:

- (a) providing a hollow container having an internal void volume V_2 containing a mass of coffee grinder gas G_0 , said internal void volume being substantially free of molecular oxygen at a pressure P_2 in the range of from about 40 psig up to about 2,000 psig at a temperature T_2 of from about 20°C up to about 40°C and equipped with spraying means for spraying contents contained within the container into volume V_1 , said grinder gas G_0 having an initial analytical total ion chromatogram profile α_1 ; and
- (b) engaging said spraying means in said specific volume V_1 whereby said pressurized container is depressurized from P_2 to a pressure of P_3 at least as great as P_1 , and said volume V_1 is aromatized with the coffee aroma having, at the instant of spraying, a total ion chromatogram profile α_0 substantially equivalent to α_1 .

Our invention further comprises the additional step (a'), carried out immediately subsequent to step (a), supra, comprising storing the pressurized container containing mass G_0 for a period of time θ_s at the end of which period, the grinder gas has a total ion chromatogram profile α_0 substantially equivalent to α_1 .

Our invention is further directed to the process as set forth above wherein the spraying step (b) is governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_1} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta$$

$$- 0.6071 \theta$$

wherein the symbol: ΔA is the degree of aromatization of coffee aroma imparted to volume V_1 during time θ_1 ; wherein R is the gas constant 0.082 liter atmospheres per gram mole degree Kelvin; wherein T is temperature in degrees Kelvin; wherein P is pressure in atmospheres; wherein V is volume in liters; and wherein H is enthalpy. The algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_1} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta$$

$$- 0.6071 \theta$$

is derived from the general algorithm:

$$\Delta A = K \eta \int_0^{\theta_1} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta$$

$$- \lambda \theta$$

wherein K is a constant and the symbol η is the Joule-Thomson coefficient across the spray valve assumed to cover a process wherein the change in enthalpy is zero and wherein the symbol λ

is a decay constant resulting from the removal of aroma components during and after the time of spraying for the total period of time θ_T of measurement. The algorithm:

$$\Delta A = K \eta \int_0^{\theta_1} \left[\frac{46}{RT} (v + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,v,H} \right] d\theta - \lambda \theta$$

is derived from the two algorithms:

$$\left(\frac{\partial G}{\partial \theta} \right)_{v,T,H} = \frac{46}{RT} (v + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,v,H}$$

and

$$\Delta A = K \eta \int_0^{\theta_1} \left(\frac{\partial G}{\partial \theta} \right)_{v,T,H} d\theta - \lambda \theta$$

These algorithms, in turn, are derived from the algorithms:

$$\left(\frac{\partial G}{\partial \theta} \right)_{v,T,H} = \frac{(mw)}{RT} (v + c + b) \left(\frac{\partial P}{\partial \theta} \right)_{T,v,H}$$

and

$$\Delta A = K \eta \int_0^{\theta_1} \left[\frac{(mw)}{RT} (v + c + b) \left(\frac{\partial P}{\partial \theta} \right)_{T,v,H} \right] d\theta - \lambda \theta$$

wherein c and b are equation of state constants. The equation of state used herein is derived from the equation of state set forth in Volume 41, No. 8, *AIChE Journal*, August 19, 1995 at pages 1964-1970 inclusive (Title: "Avoiding the Use of Critical Constants in Cubic Equations of State," Soave, et al),

incorporated by reference herein. In the foregoing equations, the symbol MW represents the average molecular weight of the coffee grinder gas which is slightly greater than the molecular weight of carbon dioxide and has been calculated to be, on the average, 46. The definition of the Joule-Thomson coefficient having the symbol η is:

which is the partial derivative of temperature with respect to pressure at constant enthalpy.

Our invention also covers a process wherein the spraying step (b) as described, supra, is repeated at least once whereby pressure P_2 within the pressure vessel is diminished to P_2' ; and then pressure P_2' is reduced to P_2'' wherein $P_2' > P_1$ and P_2'' is at least as great as P_1 . Such a process is governed by the algorithm:

$$\Delta A_m = \sum_{i=1}^n \left\{ 7.8 \times 10^{-3} \int_0^{\theta_i} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta \right. \\ \left. - 0.6071 \theta_T \right\}$$

wherein n is the number of times that the spraying operation is repeated.

The foregoing processes are also governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] - 0.6071$$

which shows the rate and change of the degree of aromatization of the volume V_1 over a period of time.

The degree of aromatization indicated by the symbol ΔA as well as the maximum degree of aromatization having the

symbol ΔA_M is herein based on a scale of zero up to 10, with 10 being the highest degree of aromatization representing the highest quality, the highest intensity and the highest substantivity; and zero being the lowest amount having the lowest quality, substantivity and strength.

The process wherein the spraying is repeated is controlled using spray valve or spray valves, each of which is solenoid controlled. The solenoid valve control aspect of our process is taught in European Patent No. 136,383 published on April 10, 1985 (inventor: Jean-Piere Rouault), the specification for which is incorporated by reference herein.

Furthermore, the foregoing processes of our invention further can be controlled by electronic program controller means whereby the quantities of grinder gas located in the pressurized containers, internal pressures of the pressurized containers, length of spraying time and quantity of material being sprayed as well as number of repeated sprays per unit of time are controlled and made a function of consumer preference using computer software created using consumer marketing research.

As will be seen in the section herein entitled DETAILED DESCRIPTION OF THE DRAWINGS, the total ion chromatogram profile α_1 is substantially identical to the total ion chromatogram profile α_0 as exemplified by comparison of Figures 8 and 9 or as exemplified by comparison of Figures 8 and 10 described, infra, in detail.

More specifically, one embodiment of the process of our invention is for aromatizing a specific volume V_1 having an ambient temperature T_1 and a pressure P_1 (for example, a volume of 10,000 cubic feet having an ambient temperature of between about 25 and about 30°C and a pressure of about 14.7 psia or zero psig) with a stable coffee aroma consisting essentially of the sequential steps of:

- (a) providing a mass G of coffee grinder gas in the solid phase (at a temperature T_0 where T_0 is substantially less than T_1 (for example, at less than about -78°C at about atmospheric pressure)) said coffee grinder gas having an initial analytical total ion chromatogram profile α_1 ;
- (b) providing a hollow container capable of sustaining a high internal pressure P_2 (e.g., from about 40 up to about 2,000 psig) and having an internal void volume V_2 , the container being equipped with spraying means for spraying contents contained within the container into volume V_1 surrounding the container, said spray means being so designed that the difference in enthalpies of (a) gas within the container and (b) gas evolving from the container during a spraying operation is substantially zero;
- (c) cooling the internal void of the container to a temperature T_c wherein $T_c < T_0$; and purging molecular oxygen from the inner void thereof;
- (d) placing said mass G of solid phase coffee grinder gas within the internal volume V_2 of said hollow pressure container;
- (e) sealing the hollow pressure container containing said mass G ;
- (f) warming the thus-sealed hollow pressure container containing said mass G to temperature T_H wherein $T_H \geq T_1$ thereby causing a pressure buildup within the hollow pressure container to a pressure P_2 , with P_2 being in the range of from about 40 psig up to about 2,000 psig;
- (g) storing the pressurized container containing mass G for a period of time θ_s at the end of which period,

the grinder gas has an analytical total ion chromatograph profile α_0 substantially equivalent to α_1 ; and

- (h) engaging the spraying means in said specific volume V_1 , whereby the pressurized container is depressurized from P_2 to a pressure at least as great as P_1 and the volume V_1 is aromatized.

As stated, supra, the immediately foregoing process is governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_1} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta - 0.6071 \theta$$

wherein the symbol ΔA is a scaled value on a scale of 1 up to 10, with "10" being the best value of coffee aroma quality, strength and substantivity imparted to said volume V_1 ; and the symbol:

$$\left(\frac{\partial P}{\partial \theta} \right)_{T,V,H}$$

is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H .

The immediately-foregoing process can be modified wherein step (h) is repeated at least once whereby the pressure P_2 is first diminished to P_2' ; and then P_2' is reduced to P_2'' wherein $P_2' > P_1$; and P_2'' is at least as great as P_1 .

The immediately-foregoing process concerning repeated steps (h) is governed by the algorithm:

$$\Delta A_m = \sum_{i=1}^n K \eta \int_0^{\theta_i} \left(\frac{\partial G}{\partial \theta} \right)_{V,T,H} d\theta - \lambda \theta_T$$

The immediately-foregoing process is also governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] - 0.6071$$

wherein the symbol: $\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H}$

is the first partial derivative of the aromatization change of the volume V_1 with respect to time while the spraying means is engaged at constant temperature T , constant volume V and constant enthalpy H ; and wherein the symbol: ΔA is a scaled value on a scale of zero up to 10 with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 .

Our invention also includes the immediately-foregoing process wherein the oxygen is purged from the container void initially with a substance selected from the group consisting of liquid nitrogen, liquid carbon dioxide or gaseous carbon dioxide or gaseous nitrogen.

The process of our invention also includes the immediately-foregoing process controlled by electronic program controller means.

The process of our invention also includes the immediately-aforementioned process wherein repeated steps (h) are carried out wherein the spraying means is a solenoid controlled valve as specifically set forth in European Patent Specification No. 136,383, published on April 10, 1985 (Jean-Piere Rouault).

Another embodiment of the process of our invention for aromatizing a specific volume V_1 having an ambient temperature T_1 and pressure P_1 with stable coffee aroma consists essentially of the sequential steps of:

- (a) providing a mass G of coffee grinder gas in the solid phase at temperature T_0 where T_0 is substantially less than T_1 , said coffee grinder gas having an initial analytical total ion chromatograph profile α_1 ;
- (b) providing a first hollow container capable of sustaining a high internal pressure P_2 and having an internal void volume V_2 and having attachment means associated therewith for attachment to a manifold means wherein P_2 is substantially greater than P_1 ;
- (c) providing said manifold means (1) having attachment means for attaching said manifold means to said first hollow container and (2) having attached thereto a multiplicity (for example, 5) of hollow second hollow containers (for example, aerosol containers), each capable of sustaining a high internal pressure P_3 ; each having an internal volume V_3 and each equipped with spraying means for spraying contents contained within each of said second hollow containers into a volume V_1 surrounding each of said second containers, said spraying means being so designed that the difference in enthalpies of (a) gas within the second container and (b) gas evolving from the second container during a spraying operation is substantially zero wherein $P_2 > P_3 > P_1$ (for example, where P_2 is about 1,000 psig; P_3 is about 200 psig; and P_1 is about zero psig);
- (d) sealably attaching the manifold means to the first hollow container;

- (e) cooling the internal void of said first hollow container to a temperature T_c wherein $T_c < T_0$; and purging oxygen from the inner void thereof (using, for example, liquid nitrogen);
- (f) placing said mass G of solid phase coffee grinder gas within the internal volume V_2 of said first hollow container;
- (g) isolatably sealing said first hollow container containing said mass G ;
- (h) warming the thus-isolatably sealed hollow first container containing said mass G to temperature T_H wherein $T_H \geq T_1$, thereby causing a pressure buildup within said hollow void of said first container to a pressure P_2 , with P_2 being in the range of from about 700 psig up to about 2,000 psig;
- (i) purging oxygen from the inner voids of each of said second hollow containers; and reducing the internal pressure of the inner voids of each of said hollow containers to a pressure P_4 wherein $P_4 < P_1$ (for example, where P_4 is 0.1 atmospheres and P_1 is 1 atmosphere absolute pressure);
- (j) causing at least a portion fG of said mass G to flow from said first container into at least one of said second containers thereby causing a pressure buildup within said at least one of the hollow voids of said second containers to a pressure P_3 with P_3 being from about 40 psig up to about 250 psig wherein $f \leq 1$ and is the mass fraction of G moved from said first container to said at least one of said second containers and the amount of coffee grinder gas in said at least one of said second containers is:

$$\frac{fG}{N}$$

wherein N is the number of second containers being filled with gaseous coffee grinder gas from the first container;

- (k) sealably detaching said at least one of said second containers from said manifold means whereby the pressure of the inner void of said second hollow container is maintained at a pressure of about P_3 ;
- (l) storing said at least one of said second containers containing mass:

$$\frac{fG}{N}$$

for a period of time θ_s , at the end of which period, the grinder gas contained within the void of said second container has a total ion chromatograph profile α_0 substantially equivalent to α_1 ; and

- (m) engaging said spraying means on said at least one of said second containers whereby said at least one of said second containers is depressurized from a pressure of P_3 to a pressure at least as great as P_1 and said volume V_1 is aromatized.

The immediately-foregoing process is, in general, governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_s} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta - 0.6071 \theta$$

Furthermore, the immediately-foregoing process can be modified wherein the spraying step (m) is repeated at least once for at least one of said second containers whereby the pressure P_3 is first diminished to P_3' ; and then P_3' is reduced to P_3'' wherein $P_3' > P_1$ and P_3'' is at least as great as pressure P_1 , thus giving rise to the inequality: $P_3' > P_3'' \geq P_1$.

The immediately-foregoing process is governed by the algorithm:

$$\Delta A_m = \sum_{i=1}^n \left\{ 7.8 \times 10^{-3} \int_0^{\theta_i} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta \right. \\ \left. - 0.6071 \theta_T \right\}$$

The immediately-foregoing processes are also governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] - 0.6071$$

In the immediately-foregoing processes, at least one of the spraying means associated with at least one of said second containers may be a solenoid-controlled spray valve, for example, one specifically described in the European Specification No. 136,383 published on April 10, 1985 (inventor: Jean-Piere Rouault). Furthermore, the immediately-foregoing processes may be controlled by electronic program controller means whereby the degree of aromatization of volume V_1 is controlled by the amount G placed in the first container and the amount distributed from the first container to the second containers over a given period of time and the nature of the spraying, to wit: the length of time per spray and amount being sprayed based on the dimensions of the spraying means. These variables are governed by the input from marketing research which indicates optimum aroma strength, quality and substantivity in volumes that are to be aromatized, e.g., volume " V_1 ".

Our invention is also directed to a hollow container (e.g., an aerosol container) having an internal void volume V_2 (e.g., 0.25 liters) containing a stable mass of coffee grinder gas G_0 (e.g., 50 grams), said internal void volume being substantially free of molecular oxygen at a pressure P_2 in the range of from about 40 psig up to about 2,000 psig at a temperature in the range of from about 20°C up to about 40°C

and equipped with spraying means for spraying the contents of said container into the environment surrounding said container (e.g., a room having dimensions 10 feet high, 30 feet in length and 30 feet in width), said environment having a pressure of about zero psig (atmospheric pressure) and a temperature of from about 20°C up to about 40°C. The coffee grinder gas would contain preferably between about 92 up to about 98 weight percent carbon dioxide.

Our invention is also intended to be directed to apparatus for effecting aromatization of a specific volume having a pressure of about zero psig and a temperature of from about 20°C up to about 40°C with a stable coffee aroma comprising:

- (a) coffee grinder gas supplying means for supplying coffee grinder gas to sealable coffee grinder gas holding means;
- (b) cooling means to maintain coffee grinder gas being supplied from said supply means to said sealable holding means at or below the sublimation temperature of carbon dioxide and at a pressure of about zero psig (that is, atmospheric pressure);
- (c) sealable coffee grinder gas holding means having an inner void volume to hold coffee grinder gas under a pressure of from about 40 psig up to about 2,000 psig and capable of withstanding a pressure of from about 40 psig up to about 2,000 psig; and
- (d) spraying means for spraying stable coffee grinder gas held under a pressure ranging from about 40 psig up to about 2,000 psig and said holding means into said specific volume

whereby the total ion chromatogram of the coffee grinder gas supplied by said supplying means α_i is substantially identical to the total ion chromatogram of the coffee grinder gas sprayed by engaging said spraying means α_0 .

In one embodiment of the immediately-aforescribed apparatus, the sealable coffee grinder gas holding means of (c) has sealably attached thereto the spraying means of (d).

In another embodiment of the immediately-aforementioned apparatus, the sealable coffee grinder gas holding means of (c) comprises:

(c-1) sealable first hollow container means capable of sustaining a pressure in the range of from about 700 psig up to about 2,000 psig;

(c-2) attached to said sealable first hollow container means, manifold means for distributing stable coffee grinder gas to at least one of a multiplicity of second hollow container means, each of which is capable of sustaining a pressure of from about 40 psig up to about 350 psig; and

(c-3) detachably attached to said manifold means, said multiplicity of second hollow container means

and wherein said spraying means comprises a multiplicity of separate spraying means (i) each of which is sealably attached to one of said multiplicity of second hollow container means and (ii) each of which is capable of spraying stable coffee grinder gas into said specific volume.

Another embodiment of the immediately-aforementioned apparatus is one wherein the spraying means comprises an automatic timer-activated solenoid valve for automatically effecting pulsed time-series spraying of coffee grinder gas into said specific volume, for example, that described in European Patent Specification No. 136,383 published on April 10, 1985 (inventor: Jean-Piere Rouault).

Another embodiment of the immediately-aforementioned apparatus is that which is controlled by electronic program controller means having input from market research data.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a pressure vessel fitted with a spraying valve useful in the practice of the process of our invention.

Figure 2 is another embodiment of a pressure vessel fitted with spraying means useful in the practice of our invention wherein the spraying means is an automatic timer-actuated solenoid valve for automatically effecting pulsed time-series spraying of coffee grinder gas into a specific volume.

Figure 3 is a schematic side elevation view of apparatus for effecting aromatization of a specific volume with stable coffee aroma comprising:

- (a) coffee grinder gas supply means;
- (b) cooling means to maintain the coffee grinder gas being supplied; and
- (c) sealable coffee grinder gas holding means which further comprises sealable first hollow container means, manifold means for distributing the coffee grinder gas to second hollow containers and a multiplicity of second hollow container means detachably attached to the manifold means.

Figure 3A is an enlargement of solid feed means 34 of Figure 3 showing transportation of solid phase coffee grinder gas from the grinder gas supplying means to the first container means.

Figure 4 is a schematic representation of a process for recovering coffee grinder gas using the technique of PCT Application No. 97/10721 (Furrer, et al) filed on September 18, 1996 and published on March 27, 1997.

Figure 5A illustrates a top perspective view of a container as illustrated in Figure 1 having an additional

scented member affixed to the side of said container for further enhancing coffee aroma, said additional affixed scented member being an embodiment of U.S. Letters Patent No. 5,635,229 issued on June 3, 1997, the specification for which is incorporated by reference herein.

Figure 5B is a top perspective view of the scented member which is affixed to the container as shown in Figure 5A.

Figure 6 is a schematic block flow diagram showing a first embodiment of the process of our invention using a first embodiment of the apparatus of our invention.

Figure 7 is a block flow diagram of a second embodiment of the process of our invention showing the use of a second embodiment of the apparatus of our invention.

Figure 8 is total ion chromatogram from a gas chromatography-mass spectrometer (termed "GC-MS total ion chromatogram") for a flask enumerated as Flask No. 2 having an analysis set forth indicated as: "ANAL.2/12/97" which analysis sets forth relative area per scents (conditions: 50 meter x 0.32 mm x 0.5 diameter micrometer bonded methyl silicon column programmed from 40°C up to 225°C at 3°C per minute).

Figure 9 is GC-MS total ion chromatogram for Flask No. 2 containing coffee grinder gas stored for a period of approximately one month. The analysis is set forth in Table I under the column headed "ANAL.3/17/97" and the analysis is in terms of relative area percentages (conditions: 50 meter x 0.32 mm x 0.5 micrometer bonded methyl silicon column programmed from 40°C up to 225°C at 3°C per minute).

Figure 9A is an enlargement of that portion of the GC-MS total ion chromatogram of Figure 9 taken from scan No. 277 up to scan No. 458.

Figure 9B is an enlargement of that portion of the GC-MS total ion chromatogram of Figure 9 taken from scan No. 484 up to scan No. 902.

Figure 9C is an enlargement of that portion of the total ion chromatogram of Figure 9 taken from scan No. 944 up to scan No. 1479.

Figure 9D is an enlargement of that portion of the total ion chromatogram of Figure 9 taken from scan No. 1477 up to scan No. 2200.

Figure 9E is an enlargement of that portion of the total ion chromatogram of Figure 9 taken from scan No. 2283 up to scan No. 4263.

Figure 9F is an enlargement of that portion of the total ion chromatogram of Figure 9 taken from scan No. 4325 up to scan No. 7599.

Figure 10 is a GC-MS total ion chromatogram for Flask No. 2 wherein the contents of Flask No. 2, the coffee grinder gas is stored for a period of two months. The analysis is set forth in Table I under the heading "ANAL.4/24/97" and is shown as relative area percentages under the column entitled "REL./AR.%" (conditions: 50 meter x 0.32 mm x 0.5 micrometer bonded methyl silicon column programmed from 40°C up to 225°C at 3°C per minute):

Figure 10A is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 331 up to scan No. 511.

Figure 10B is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 538 up to scan No. 958.

Figure 10C is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 1076 up to scan No. 1561.

Figure 10D is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 1128 up to scan No. 1709.

Figure 10E is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 1711 up to scan No. 2971.

Figure 10F is an enlargement of that portion of the total ion chromatogram of Figure 10 taken from scan No. 3035 up to scan No. 5849.

Figure 11 is a GC-MS total ion chromatogram for Flask No. 9 containing coffee grinder gas having an analysis as set forth in Table II, the analysis being indicated for each "SCAN NO." by "AREA %" (conditions: 50 meter x 0.32 mm x 0.5 micrometer silica bonded methyl silicon column programmed from 75-225°C at 3°C per minute).

Figure 11A is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 134 up to scan No. 206.

Figure 11B is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 190 up to scan No. 276.

Figure 11C is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 283 up to scan No. 512.

Figure 11D is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 512 up to scan No. 674.

Figure 11E is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 695 up to scan No. 845.

Figure 11F is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 872 up to scan No. 1201.

Figure 11G is an enlargement of that portion of the total ion chromatogram of Figure 11 taken from scan No. 1221 up to scan No. 1650.

Figure 12 is an exploded view of an aerosol spray dispensing device employing an adapter of U.S. Letters Patent 5,383,580 issued on January 24, 1995 (the specification for which is incorporated by reference herein), showing the constituent elements of the aerosol spray dispensing device of U.S. Letters Patent No. 5,383,580.

Figures 13 and 14 contain close-up, detail, sectional views of the components of the adapter of Figure 12 and their assembly with the other elements of the aerosol spray dispensing device useful in the processes of our invention.

Figures 15 and 16 are perspective views showing the manner of assembly of the aerosol can component with the spray-forming component of the device (as specified in U.S. Letters Patent No. 5,383,580, the specification for which is incorporated by reference herein).

Figures 17A and 17B are cutaway, schematic front and side views of an automatic gas discharge intruder deterrent having a cannister of prestressed fluid with a solenoid valve controlling discharge in response to detection, which apparatus is adaptable to the process of our invention and which apparatus is set forth in detail in European Patent Specification No. 136,383 published on April 10, 1985.

Figure 17C is a schematic diagram of the electrical circuit taken in conjunction with the aerosol can of European Patent Specification No. 136,383 published on April 10, 1985, the specification for which is incorporated by reference herein.

Figure 18A shows the apparatus of Figure 6 used in conjunction with an electronic programming controller which uses marketing input information.

Figure 18B shows the apparatus of Figure 7 used in conjunction with an electronic programming controller which uses marketing input information.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to Figure 1, container 10, a pressurizable metallic container capable of withstanding pressures as high as 350 psig consists of a holding device 5 having fitted thereto a valve body 4 equipped with spray button 1 and relief valve 3. If coffee grinder gas is placed into device 5 prior to fitting the valve body 4 onto the device 5, then inlet valve 2 remains sealed. If it is desired to increase the pressure within device 5 above that generated by the originally-placed coffee grinder gas crystals, then additional carbon dioxide and/or nitrogen may be added via inlet valve 2.

Figure 2 sets forth another embodiment of the spray vessel set forth in Figure 1, that is, one having a solenoid valve indicated by SV in Figure 2. The solenoid valve, operated intermittently and powered accordingly through leads 4a and 4b, is within valve body 4a having attached thereto relief valve 3a which prevents overpressurizing. If additional pressure is desired, then additional CO₂ and/or nitrogen can be added through the inlet valve 2a. Device 5a, containing the coffee grinder gas, is depressurized intermittently through the spray device 1a. Overall, the pressurized container is indicated using reference numeral 20.

As shown in Figure 3, a multiplicity of spray cans can be filled from a first pressurized container source to which solid coffee grinder gas is originally added. Thus, storage cylinder 31, adapted to withstand pressures of from 850 up to 2,000 psig, is first purged of oxygen using purge gas from source 32 which flows through line 37 controlled by valve 36, while valve 41 is closed. Valve 36 is then closed and solid coffee grinder gas consisting primarily of solid carbon dioxide is fed from source 33 through the solid feed feeding device 34 into pressure container 31 through opening 35. Opening 35 has a closable pressure seal. The solid feed device 34 is shown in detail in Figure 3A. After a suitable amount of solid coffee grinder gas is placed in pressurizable storage cylinder 31, pressure seal 39 is closed and feed opening 35 is closed, keeping valve 41 in line 40 also

closed. Pressure gauge 38 will then register a higher pressure as storage cylinder 31 is permitted to warm up. Initially, storage cylinder 31 is kept at least as low as the temperature of the solid coffee grinder gas, namely, approximately -80°C . Preferably, the temperature of cylinder 31 is initially kept down to -110°C . The temperature of cylinder 31 is then allowed to warm to ambient temperatures, e.g., $20-30^{\circ}\text{C}$. In doing so, the pressure within the cylinder builds up to a pressure of between 850 and 2,000 psig, depending upon the quantity of solid coffee grinder gas initially added to the cylinder through feeding device 34. When the pressure reaches steady state at between 850 and 2,000 psig within the cylinder (as shown on pressure gauge 38), valve 41 is opened and coffee grinder gas then flows through line 40 into at least one of containers 10a, 10b, 10c, 10d, 10e and/or 10f, if the lines to these containers are opened (as desired). Thus, for example, coffee grinder gas will flow into container 10a when valve 42a is opened and the flow of gas is through line 43a. By the same token, coffee grinder gas flows into container 10b past valve 42b through line 43b. Initially, the coffee grinder gas pressure builds up in manifold 44 prior to flowing through lines 43a, 43b, 43c, 43d, 43e and 43f into containers 10a, 10b, 10c, 10d, 10e and 10f, respectively. In addition, when the coffee grinder gas flows through manifold 44 past open valve 42c, it flows through line 43c into container 10c. When valve 42d is open, the coffee grinder gas flows through line 43d into container 10d. When valve 42e is open, the coffee grinder gas flows through line 43e into container 10e. When valve 42f is open, the coffee grinder gas flows through line 43f into container 10f. When the pressure of the coffee grinder gas reaches that which is desired, that is, a pressure of between about 40 up to about 350 psig, the valves to the particular container are closed, for example, when the pressure in container 10a reaches a desired pressure such as 200 psig, valve 42a is closed and the inlet valve to the container is sealed. The container 10a is then removed from line 43a and used to aromatize a volume as desired. Furthermore, the container, such as container 10a, 10b and the like, may be equipped with a solenoid valve and may be used for

intermittent spraying as controlled by a solenoid valve program. The entire apparatus of Figure 3 is indicated using reference numeral 30.

Referring to Figure 3A which shows in detail the feeding device of solid coffee grinder gas from coffee grinder gas source 33 into pressure vessel 31, the solid coffee grinder gas which is cooled to a temperature of below -78°C is located in container 33. The solid material is then moved through inlet 34a into feeding device 34b which contains a threaded conveyor 34c. The threaded conveyor is maintained at a temperature of -110°C using appropriately-placed cooling coils. Cooling coils 34g (preferably cooled using liquid nitrogen) are used to cool conveying belt 33 onto which the grinder gas particles 33 are placed. The surface of conveyor 33, a moving surface, is indicated by reference numeral 34d. The conveyor is powered using rollers 34f. The conveying belt moves the particles 33 through feed inlet 35 finally into pressure vessel 31.

Figure 4 sets forth apparatus used in a process for recovering aroma from ground coffee according to PCT Application No. 97/10721, Furrer, et al, assigned to Société des Produits Nestlé S.A.. The recovery process comprises:

- (a) transporting ground coffee through an elongated mixing zone 60 while agitating;
- (b) introducing an aqueous fluid 66 into the mixing zone to moisten the ground coffee during transport and agitation;
- (c) removing the aroma gases 70 released from the moistened ground coffee;
- (d) cooling at location 72 the removed aroma gases; and
- (e) cryogenically freezing the gases at location 78 to provide aroma frost.

More specifically, referring to Figure 4, a process for capturing the aroma is as follows:

Ground coffee is introduced into a suitable mixer 60 through a solids inlet 62 which contains an airlock. The mixer 60 may be a preconditioner, a screw conveyor or other suitable continuous mixer. A feed hopper and a screw feeder may be used to introduce the ground coffee into the mixer 60. Once in the mixer 60, the ground coffee is transported while being agitated to a solids outlet 64 at the opposite end of the mixer 60. An airlock is positioned in the solids outlet 64. An aqueous liquid is sprayed into the mixer 60 through a liquid inlet nozzle 66 positioned near the solids inlet 62. Thus, as the ground coffee is transported through the mixer 60, it is mixed with the aqueous liquid and moistened. The moistened ground coffee falling through the solids outlet 64 is then transported directly to a suitable extraction apparatus. The aqueous liquid may be at any desired temperature, especially in the range of about 20°C up to about 120°C. It is found, however, that better results can be obtained if the temperature is above about 50°C, for example, from about 70°C up to about 95°C. If desired, steam at pressures of from about zero psig up to about 10 psig may be introduced into the mixer 60 through gas inlets to supplement the aqueous liquid. In this case, the mass flow rate of the steam is suitably 5 to 10 times less than the mass flow rate of the ground coffee into the mixer 60. Alternatively, sufficient steam may be introduced into the mixer 60 to totally replace the aqueous liquid. The ratio of ground coffee to aqueous fluid fed into the mixer 60 is suitably in the range of about 5:1 up to about 1:5, preferably about 1:2 to about 2:1, with about 1:1 being particularly suitable.

The mean residence time of the ground coffee particles in the mixer is sufficient to achieve uniform wetting of the coffee particles, for example, in the range of 30 seconds up to about 4 minutes. Although longer times are acceptable, they are not necessary and provide no advantage.

An inert gas is blown by a fan or compressor 96 through a gas inlet 68 to the mixer 60 positioned near the liquid inlet nozzle 66 and the solids inlet 62. The gas used as the sweeping gas may be any suitable gas which is sufficiently inert so that it does not degrade the coffee or coffee aromas, for example, nitrogen, carbon dioxide and helium or mixtures thereof. Nitrogen gas as the primary gas is particularly suitable.

The inert gas flows through the mixer 60 co-currently with the ground coffee and aqueous liquid, conveying with it aroma gases released from the ground coffee. The inert gas, which is now aroma-laden, is drawn off through a gas outlet 70 positioned near the solids outlet 64 and led to a condenser 72. The condenser 72 is operated at a temperature sufficiently low to condense most of the water vapor in the inert gas. A temperature of below about 50°C is suitable, although cooling to below 20°C is preferred. Preferably, more than one condenser is used, each succeeding condenser being operated at a lower temperature. Preferably, the downstream condenser is operated at a temperature of about 0°C up to about 10°C.

The aqueous liquid which condenses in the condenser 72 is also a good source of aqueous aroma components and is recovered through liquid aroma line 74. The aqueous aroma components may be recovered in any of many conventional processes, for example, by running the aqueous liquid through a stripping column or the like. Alternatively, it may be mixed with liquid coffee extract and processed in a conventional manner.

The inert gas and the aroma components which do not condense in the condenser 72 are then fed through a gaseous aroma line 76 to a cryogenic aroma condenser 78. Many suitable aroma condensers are known and have been reported in the literature. Preferably, however, the aroma condenser 78 has a housing 80 formed of an upper cylindrical section 82 and a lower conical section 84.

The lower end of the conical section 84 terminates in a discharge opening 90. Several cylindrical filters 86, preferably porous stainless steel, extend vertically within the upper cylindrical section 82. The inner bore of each cylindrical filter 86 is connected to a gas manifold 88.

An inert gas in liquid form is sprayed into the housing 80 from a liquid gas source through a gas input line 92. The liquid inert gas is preferably the same as the inert gas used to carry the aroma components, more preferably, nitrogen. Sufficient liquid inert gas is sprayed into the housing to maintain the housing 80 at a temperature below about -80°C , for example at about -110°C or lower, but sufficiently high such that the liquid inert gas vaporizes in the housing 80.

Therefore, most aroma components introduced into the housing 80 freeze into a frost while the inert gas carrying it does not. The aroma frost falls to the bottom of the housing 80 and out of the discharge opening 90. The inert gas passes through the cylindrical filters 86 and into the manifold 88. Some aroma frost collects on the cylindrical filters 86, but this may be removed by pulsing inert gas back through the cylindrical filters 86 at regular intervals to dislodge the frost.

Additional details of the operation of the cryogenic aroma condenser 78 can be obtained from U.S. Letters Patent Nos. 5,182,926 and 5,323,623; the disclosures of which are incorporated by reference herein. Other cryogenic aroma condensers may be used, for example, that disclosed in U.S. Letters Patent No. 5,030,473, the disclosure of which is incorporated by reference herein.

Referring to Figures 5A and 5B, an additional aromatic member referred to as embodiment 110 includes a small ring structured of an absorbment, flexible, somewhat elastic material such as cotton cording which has been saturated with

coffee scent. Although the coffee scent preferably includes coffee aroma, other aromas can also be utilized, for example, peppermint aroma. The aerosol container 112 has the aroma device 110 permanently affixed thereto using an adhesive-coated support 116. Support 116 can be removed from the aerosol container 112 and the aromatic member removed and placed over the upper end 118 of aerosol container 112 and positioned over neck 114. Cap 120 of aerosol container 112 helps to maintain 111 in position over neck 114 of the container 120. The spraying nozzle 121 of the aerosol container 112 is usually engaged simultaneously with the removal of cover 116, thereby exposing the aroma component 110. The details of this particular embodiment are set forth in U.S. Letters Patent No. 5,635,229, the disclosure of which is incorporated by reference herein.

Referring to Figure 6, the block flow diagram of one embodiment of the process using one embodiment of the apparatus of our invention, solid grinder gas from location 25, for example, that produced using the apparatus of Figure 4, is added to open pressure vessel 27 which has been previously cooled to a temperature of about -80°C at location 26. The open pressure vessel optionally may be purged with nitrogen from location 28 with the nitrogen flowing through line 29 past valve 53 into the open pressure vessel prior to adding the solid grinder gas. The resulting open pressure vessel now containing the solid grinder gas is then sealed and simultaneously fitted with an aerosol valve. The vessel can be stored then at ambient conditions. Thus, the temperature of the vessel is allowed to warm up to about $20-30^{\circ}\text{C}$. As a result, depending upon how much solid grinder gas is added to the vessel, pressures in the range of from about 40 up to about 2,000 psig are obtained. As a general rule, it is preferred in the case of hand-held pressure vessels to have a pressure in the range of from about 40 up to about 350 psig. The resultant vessel, sealed at location 51 and stored at location 52, may then be used at location 54 entirely or intermittently, as for example, when it is equipped with a solenoid-equipped spray valve wherein the container is depressurized intermittently as a result of the solenoid valve being actuated intermittently.

Figure 7 sets forth a second embodiment of the process of our invention using the second embodiment of the apparatus of our invention. Thus, the feeder pressure vessel is attached to a manifold at location 11 and is then cooled to a temperature of about -80°C or less at location 12. Solid grinder gas such as that produced as shown in Figure 4, from location 13, is added to the cooled open feeder pressure vessel at location 17 which has been previously purged with nitrogen from location 14, the nitrogen flowing through line 15 past valve 16. The open feeder pressure vessel containing the solid grinder gas is then sealed at location 18 and permitted to warm to ambient temperature, e.g., $20-30^{\circ}\text{C}$. The evacuated and cooled spray cans from location 19 are attached at location 21 to the manifold. Grinder gas from the feeder pressure vessel is then permitted to flow into each of the evacuated, cooled spray cans attached to the manifold at location 22 after the valves to the spray cans and to the feeder pressure vessel are opened thereby enabling the spray cans to be filled to a pressure in the range of 40 up to 350 psig in a controllable manner and at a controllable rate. The pressurized spray cans are sealed, containing grinder gas at elevated pressure at location 23. The spray cans are then detached from the manifold and stored at location 24. The spray cans can then be used entirely or intermittently as desired. Each of the spray cans can be fitted with a solenoid valve which can effect automatic, intermittent spraying.

Referring to Figures 8, 9, 9A, 9B, 9C, 9D and 9F, Figures 10, 10A, 10B, 10C, 10D, 10E and 10F, each of the peaks of these Figures, total ion chromatograms from a gas chromatography-mass spectrometer is set forth in Table I as follows:

TABLE I

ANAL. 2/12/97 SCAN NO.	REL. AR. %	ANAL. 3/17/97 SCAN NO.	REL. AR. %	ANAL. 4/24/97 SCAN NO.	REL. AR. %	CID	FORMULA	MW	NAME	STRUCTURE
ND	...	ND	...	ND	...	19354	O ₂ S	64	SULFUR DIOXIDE	$O=S=O$
284	0.03	ND	...	ND	...	20666	C ₃ H ₆	42	1-PROPENE	$H_2C=CH_2$
300	0.58	299	0.77	354	1.24	4136	C ₂ H ₄ O	44	ACETALDEHYDE	H_3C-CHO
307	1.68	306	1.62	361	2.00	6495	C ₄ H ₈	56	1-PROPENE, 2-METHYL	$H_3C-C(H)=CH_2$
ND	...	312	0.73	367	2.22	6880	C ₄ H ₄ O S	48	METHYL MERCAPTANE (METHANETHIOL)	H_3C-SH
313	2.00	ND	...	ND	...	7699	C ₂ H ₄ O ₂	60	METHYLFORMATE	$H-C(=O)-O-CH_3$
ND		ND	...	ND	...	6391	C ₂ H ₆ O	46	ETHANOL	H_3C-CH_2-OH

TABLE I
continued

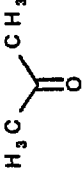
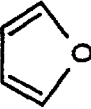
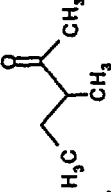
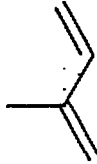
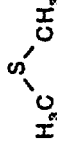
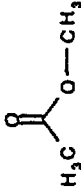
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
364	# 14.99	353	8.45	398	5.66	4779	C ₃ H ₆ O	58	ACETONE	
360	# ...	362	1.40	408	4.2	11749	C ₄ H ₄ O	68	FURAN	
ND	...	ND	...	ND	...	6014	C ₆ H ₁₂ O	100	3-METHYL-2-PENTANONE	
ND	...	ND	...	418	# 3.9	12555	C ₅ H ₈	68	ISOPRENE	
378	< 0.01	367	1.25	437	# ...	1928	C ₂ H ₆ S	62	DIMETHYL SULFIDE	
395	5.46	386	4.31	437	5.27	7268	C ₃ H ₆ O ₂	74	METHYL ACETATE	

TABLE I
continued

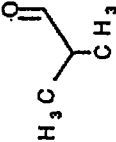
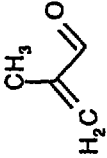
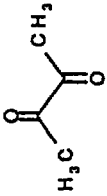
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	28631	C5 H6	66	1,3-CYCLOPENTADIENE	
422	8.96	412	7.06	462	9.01	6822	C4 H8 O	72	ISOBUTYRALDEHYDE	
ND	...	ND		ND	...	6031	C4 H6 O	70	METHACROLEIN (2-PROPENAL, 2-METHYL)	
ND	...	ND		ND	...	...	C2 H5 S	60	THIRANE	
ND	...	ND		ND	...	...	C4 H6 O	70	2,3-DIHYDRO-FURAN	
460	# ...	448	# ...	498	1.5	4242	C4 H6 O2	86	DIACETYL (2,3-BUTANEDIONE)	

TABLE I
continued

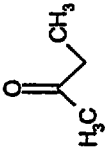
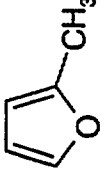
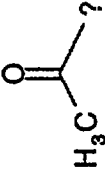
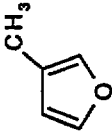
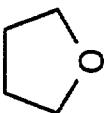
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
470	# 5.5	458	#4.77	511	4.46	8253	C4 H8 O	72	METHYL ETHYL KETONE	
495	18.43	484	14.96	538	15.39	3734	C5 H6 O	82	FURAN, 2-METHYL	
ND	...	ND	...	ND	...	...	C5 H6 O	82	UNKNOWN	...
ND	...	ND	...	ND	...	...	...	...	UNKNOWN METHYL KETONE	
512	1.85	501	0.99	553	< 0.30	^ ...	C5 H6 O	82	FURAN, 3-METHYL	
ND	...	ND	...	ND	...	6102	C4 H8 O	72	TETRAHYDROFURAN	

TABLE I
continued

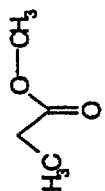
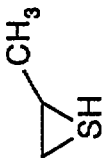
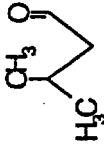
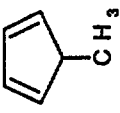
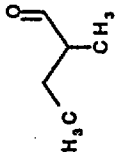
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
541	0.67	528	0.54	583	0.49	6618	C ₄ H ₈ O ₂	88	METHYL PROPIONATE	
ND	...	ND	...	ND	...	...	C ₃ H ₆ S	74	2-METHYL-THIIRANE	
ND	...	ND	...	ND	...	^...	C ₆ H ₈	80	2,4-CYCLOPENTADIENE, 1-METHYL	
586	8.52	571	8.74	626	9.83	234	C ₅ H ₁₀ O	86	ISOVALERALDEHYDE (BUTANAL, 3-METHYL)	
613	# 9.11	598	#9.99	652	# 11.44	398	C ₅ H ₁₀ O	86	2-METHYLBUTANAL	

TABLE I
continued

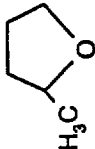
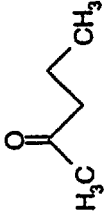
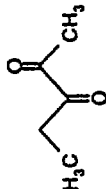
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
622	# ...	610	# ...	664	# ...	6816	C ₆ H ₆	78	BENZENE	
635	0.49	621	0.24	676	< 0.30	14751	C ₄ H ₄ S	84	THIOPHENE	
647	0.20	632	0.31	690	< 0.30	15685	C ₅ H ₁₀ O	86	2-METHYLTETRAHYDROFURAN	
676	0.56	660	0.55	719	0.48	1480	C ₅ H ₁₀ O	86	METHYL PROPYL KETONE (2-PENTANONE)	
699	1.87	684	# ...	739	< 0.30	4573	C ₅ H ₈ O ₂	100	ACETYL PROPIONYL (2,3-PENTANEDIONE)	

TABLE I
continued

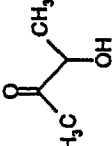
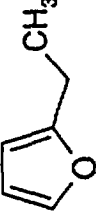
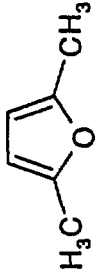
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
706	1.33	692	#1.7	750	1.49	5981	C ₅ H ₈ O	84	DIHYDROPYRAN	
ND	...	ND		840	0.67	6938	C ₄ H ₈ S	88	3-(METHYLTHIO)-1-PROPENE	
729	0.16	716	<0.01	ND	...	4140	C ₄ H ₈ O ₂	88	ACETON (2-BUTANONE, 3-HYDROXY)	
756	0.21	742	0.12	800	< 0.30	227	C ₆ H ₈ O	96	2-ETHYLFURAN	
784	2.36	768	1.42	824	< 0.30	9346	C ₆ H ₈ O	96	FURAN, 2,5-DIMETHYL	
ND	...	ND	...	839	< 0.30	8093	C ₇ H ₁₆	100	HEPTANE	

TABLE I
continued

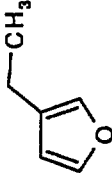
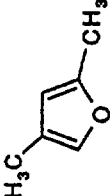
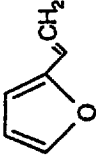
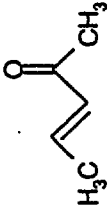
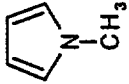
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	^ ...	C ₆ H ₈ O	96	FURAN, 3-ETHYL	
812	0.47	797	<0.01	ND	...	...	C ₆ H ₈ O	96	FURAN, 2,4-DIMETHYL	
833	0.12	812	0.08	ND	...	1750	C ₄ H ₄ N ₂	80	PYRAZINE	
847	0.47	831	0.14	ND	...	27541	C ₆ H ₆ O	94	FURAN, 2-VINYL	
ND	...	ND	...	ND	...	362	C ₅ H ₈ O	84	3-PENTEN-2-ONE	
884	1.26	860	<0.01	ND	...	4584	C ₅ H ₇ N	81	N-METHYL-PYRROLE	

TABLE I
continued

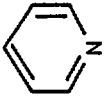
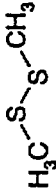
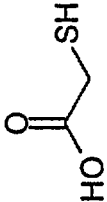
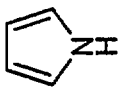
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
889	4.77	867	6.77	ND	...	3799	C ₅ H ₅ N	79	PYRIDINE	
ND	...	ND	...	ND	...	...	...	84	UNKNOWN	...
916	< 0.01	902	1.47	958	4.14	7442	C ₂ H ₆ S ₂	94	DIMETHYL DISULFIDE	
961	# 0.52	944	<0.01	ND	...	^ 7427	C ₂ H ₄ O ₂ S	92	MERCAPTOACETIC ACID	
974	# ...	958	<0.01	ND	...	...	C ₇ H ₁₀	94	UNKNOWN HYDROCARBON	...
ND	...	ND	...	ND	...	4612	C ₄ H ₅ N	67	1H-PYRROLE	
ND	...	ND	...	ND	...	^ ...	C ₄ H ₆ S	86	DIHYDROTHIOPHENE	

TABLE I
continued

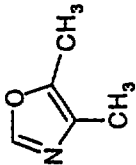
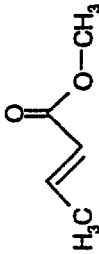
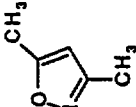
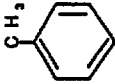
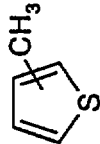
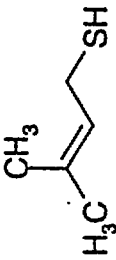
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
1011	< 0.01	1003	< 0.01	1076	< 0.30	^ ...	C5 H7 NO	97	OXAZOLE, 4,5-DIMETHYL	
ND	...	ND	...	ND	...	13475	C5 H8 O2	100	2-BUTENOIC ACID: METHYL ESTER, (E)	
1034	< 0.01	ND	...	ND	...	^ ...	C5 H7 NO	97	ISOOXAZOLE, 3,5-DIMETHYL	
1093	# 0.24	1074	# < 0.01	1128	0.45	8234	C7 H8	92	TOLUENE	
1105	# ...	1087	# ...	1296	0.44	...	C5 H6 S	98	THIOPHENE, 2-METHYL	
1120	# ...	1098	# ...	1353	3.38	...	C5 H10 S	102	3-METHYL-3-BUTENE-1-THIOL	

TABLE I
continued

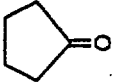
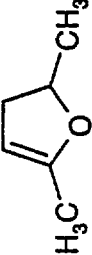
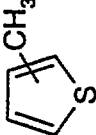
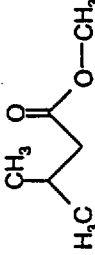
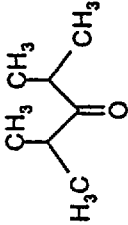
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
1132	# ...	1109	# ...	1166	< 0.30	10161	C ₅ H ₈ O	84	CYCLOPENTANONE	
1142	# 0.08	1136	# ...	ND	...	...	C ₆ H ₁₀ O	98	DIHYDROFURAN, 2,5-DIMETHYL	
ND	...	ND	...	ND	...	...	C ₅ H ₆ S	98	THIOPHENE, ?-METHYL	
1161	# ...	1140	# ...	1193	< 0.30	1994	C ₆ H ₁₂ O ₂	116	METHYL ISOVALERATE (BUTANOIC ACID, 3-METHYL: METHYL ESTER)	
1171	# 0.3	1150	# < 0.01	ND	...	223	C ₇ H ₁₄ O	114	2,4-DIMETHYL-3-PENTANONE	

TABLE I
continued

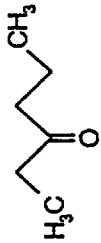
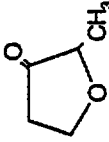
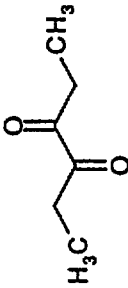
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
1184	# ...	1190	<0.01	1211	<0.30	6297	C ₆ H ₁₂ O	100	ETHYL PROPYL KETONE (3-HEXANONE)	
ND	...	ND	...	ND	...	4406	C ₆ H ₁₂ O	100	METHYL N-BUTYL KETONE (2-HEXANONE)	
ND	...	ND	...	ND	...	^ ...	C ₇ H ₈ O	108	FURAN, 2-(2-PROPENYL)	
1250	0.65	1239	0.24	1278	<0.30	4970	C ₅ H ₈ O ₂	100	2-METHYLTETRAHYDROFURAN-3-ONE	
ND	...	ND	...	ND	...	...	...	110	UNKNOWN	...
1279	<0.01	1264	<0.01	ND	...	9463	C ₈ H ₁₀ O ₂	114	3,4-HEXANEDIONE	
1300	<0.01	1298	<0.01	1296	<0.30	1330	C ₆ H ₁₂ O	100	UNKNOWN KETONE	

TABLE I
continued

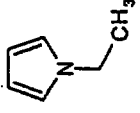
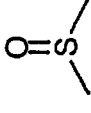
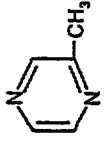
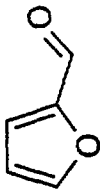
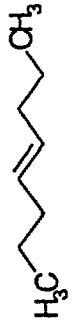
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
1322	< 0.01	1316	<0.01	ND	...	...	...	110	UNKNOWN	...
1360	< 0.01	1357	0.13	ND	...	457	C ₆ H ₉ N	95	N-ETHYLPYRROLE	
ND	...	ND	...	1353	3.38	6033	C ₂ H ₆ O S	78	METHYL SULFOXIDE	
1409	0.69	1404	0.64	1432	0.24	4582	C ₅ H ₆ N ₂	94	METHYLPYRAZINE	
ND	...	ND	...	ND	...	2022	C ₇ H ₁₄ O	114	UNKNOWN	...
1441	0.20	1444	0.11	1458	0.37	4423	C ₅ H ₄ O ₂	96	FURFURAL (2-FURANCARBOXALDEHYDE)	
1471	# 0.06	ND	...	ND	...	10324	C ₈ H ₁₆	112	4-OCTENE	

TABLE Icontinued

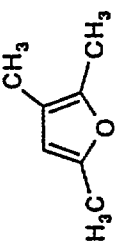
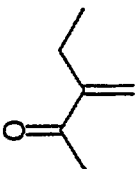
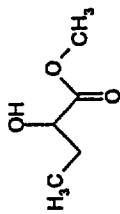
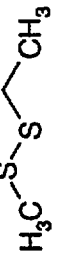
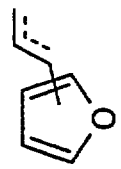
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
1471	# ...	1479	<0.01	ND	...	...	C7 H10 O	110	2,3,5-TRIMETHYL-FURAN	
1514	0.09	1519	<0.01	1525	<0.30	...	C6 H8 O2	112	2-(METHOXYMETHYL)-FURAN	
ND	...	ND	...	1535	0.57	^ ...	C6 H10 O	98	2-PENTANONE, 2-METHYLENE	
ND	...	ND	...	ND	...	6799	C5 H10 O3	118	BUTYRATE, METHYL 2-HYDROXY	
ND	...	1556	<0.01	1561	0.39	1952	C3 H8 S2	108	METHYL ETHYL DISULFIDE	
ND	...	ND	...	1672	1.51	...	...	...	SILYLATED COMPOUND	...
1561	0.21	1576	<0.01	ND	...	^ ...	C7 H8 O	108	FURAN, 2-(2-PROPENYL)	

TABLE I
continued

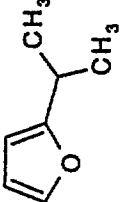
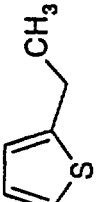
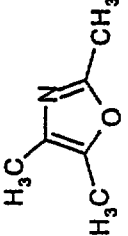
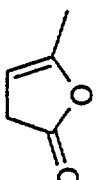
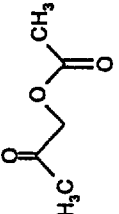
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	...	C ₇ H ₁₀ O	110	2-ISOPROPYL-FURAN	
ND	...	ND	...	ND	...	13287	C ₆ H ₈ S	112	2-ETHYL-THIOPHENE	
ND	...	ND	...	ND	...	...	...	128	UNKNOWN	...
ND	...	ND	...	ND	...	...	C ₆ H ₉ N O	111	TRIMETHYLOXAZOLE	
1667	0.34	ND	...	ND	...	...	...	106	UNKNOWN SULFIDE	...
ND	...	ND	...	1710	0.16	7614	C ₅ H ₆ O ₂	98	2(3H)-FURANONE, 5-METHYL	
1706	1.47	ND	...	ND	...	1953	C ₅ H ₈ O ₃	116	ACETOL ACETATE (2-PROPANONE, 1-HYDROXY: ACETATE)	

TABLE I
continued

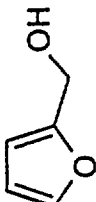
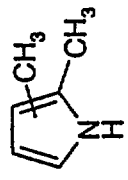
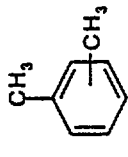
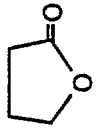
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	3616	C ₅ H ₆ O ₂	98	FURFURYL ALCOHOL	
1741	<0.01	1770	<0.01	ND	...	...	C ₇ H ₈ O	108	FURAN, 2-PROPENYL	
1765	<0.01	ND	...	ND	...	...	C ₇ H ₈ O	108	UNKNOWN	...
1771	<0.01	ND	...	ND	...	...	C ₆ H ₈ N	95	2,2-METHYL-PYRROLE	
ND	...	ND	...	ND	...	...	C ₈ H ₁₀	106	1,2-DIMETHYL-BENZENE	
ND	...	ND	...	ND	...	...	...	112	UNKNOWN KETONE	...
1891	0.04	ND	...	ND	...	4057	C ₄ H ₆ O ₂	86	BUTYROLACTONE, GAMMA-(FURAN-2(3H)-ONE, DIHYDRO)	

TABLE I
continued

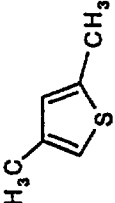
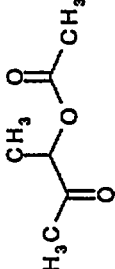
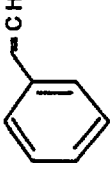
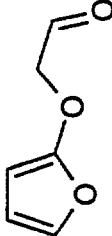
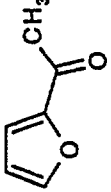
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	3557	C ₆ H ₈ S	112	2,4-DIMETHYL-THIOPHENE	
1947	< 0.01	ND	...	ND	...	4142	C ₆ H ₁₀ O ₃	130	ACETONIN ACETATE	
ND	...	ND	...	ND	...	...	...	128	UNKNOWN	...
2012	...	ND	...	ND	...	6007	C ₈ H ₈	104	STYRENE	
2065	# 0.22	ND	...	ND	...	3617	C ₆ H ₆ O ₃	126	2-FURANMETHANOL: FORMATE	
2065	# ...	2109	< 0.01	ND	...	9040	C ₆ H ₆ O ₂	110	2-ACETYL-FURAN	
ND	...	1686	0.19	ND	...	...	...	...	SILYLATED COMPOUND, COLUMN BLEED?	...

TABLE I
continued

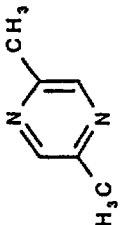
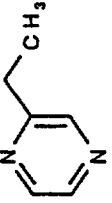
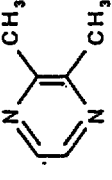
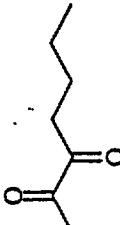
ANAL. 2/12/97	ANAL. 3/17/97	ANAL. 4/24/97	CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %				
2111	0.32	2150	0.19	2121	< 0.30	108 2,5-DIMETHYLPYRAZINE	
2140	0.04	2182	0.05	ND	...	108 2-ETHYLPYRAZINE	
2170	0.33	ND	...	ND	...	UNKNOWN SULFIDE	...
ND	...	ND	...	ND	...	108 2,3-DIMETHYLPYRAZINE	
ND	...	ND	...	ND	...	128 2,3-HEPTANEDIONE	
2322	0.57	ND	...	ND	...	UNKNOWN SULFIDE	...
ND	...	2283	<0.01	ND	...	UNKNOWN KETONE	...
ND	...	ND	...	ND	...	120 ALLYL METHYL DISULFIDE	

TABLE I**continued**

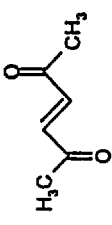
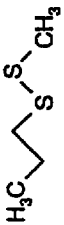
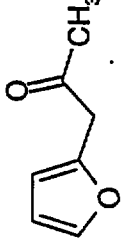
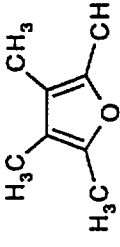
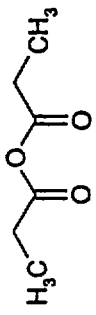
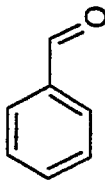
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	13434	C ₆ H ₈ O ₂	112	3-HEXENE-2,5-DIONE, (E)	
ND	...	ND	...	ND	...	6660	C ₄ H ₁₀ S ₂	122	METHYL PROPYL DISULFIDE	
ND	...	ND	...	ND	...	...	...	112	UNKNOWN	...
2399	< 0.01	ND	...	ND	...	449	C ₇ H ₈ O ₂	124	1-(2-FURYL)-2-PROPANONE	
ND	...	ND	...	ND	...	...	C ₈ H ₁₂ O	124	TETRAMETHYLFURAN	
2433	# ...	ND	...	ND	...	7255	C ₆ H ₁₀ O ₃	130	PROPIONIC ANHYDRIDE	
ND	...	ND	...	2425	< 0.30	8229	C ₇ H ₆ O	106	BENZALDEHYDE	

TABLE I
continued

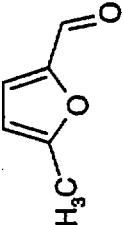
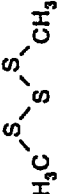
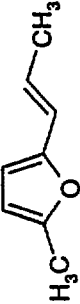
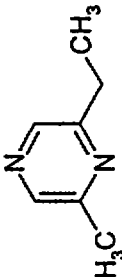
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
2443	# 0.11	ND	...	ND	...	6104	C6 H6 O2	110	5-METHYLFURFURAL	
2459	# ...	ND	...	ND	...	...	C6 H10 O3	130	UNKNOWN	...
2528	0.02	2589	0.04	ND	...	1685	C2 H6 S3	126	DIMETHYL TRISULFIDE	
ND	...	ND	...	ND	...	...	C8 H10 O	122	2-METHYL-2-(2-PROPENYL)-FURAN	
ND	...	ND	...	ND	...	2501	C6 H8 O S	128	5-METHYL-2-THIOMETHYLFURAN	
2724	0.67	2796	0.09	ND	...	2026	C7 H8 O3	140	FURFURYL ACETATE	
2773	# 0.08	2834	#0.09	ND	...	3756	C7 H10 N2	122	2-ETHYL-6-METHYLPYRAZINE	

TABLE I
continued

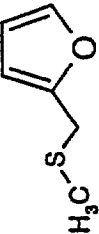
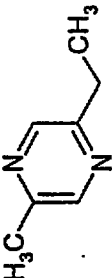
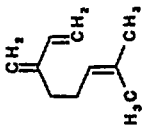
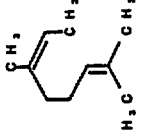
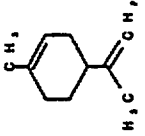
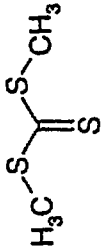
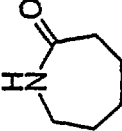
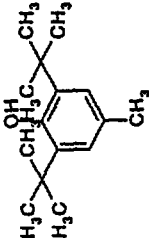
ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
2773	# ...	2834	# ...	ND	...	4425	C6 H8 O S	128	FURFURYL METHYL SULFIDE	
2796	0.03	ND	...	ND	...	...	...	...	UNKNOWN SULFIDE	...
2815	< 0.01	2864	<0.01	ND	...	8277	C7 H10 N2	122	2-ETHYL-5-METHYL-PYRAZINE	
ND	...	ND	...	ND	...	^ 2469	C10 H16	136	MYRCENE (7-METHYL-3-METHYLENE-1,6-OCTADIENE)	
ND	...	ND	...	ND	...	19412	C10 H18	138	2,6-OCTADIENE, 2,6-DIMETHYL, (Z)	
ND	...	ND	...	3035	0.34	...	...	...	SILYLATED COMPOUND	...
ND	...	ND	...	2971	< 0.30	6140	C10 H22	142	DECANE	
ND	...	3186	<0.01	ND	...	6463	C10 H16	136	LIMONENE (DIPENTENE; CYCLOHEXENE, 1-METHYL-4-ISOPROPENYL)	

TABLE I
continued

ANAL. 2/12/97 SCAN NO.	REL. AR. %	ANAL. 3/17/97 SCAN NO.	REL. AR. %	ANAL. 4/24/97 SCAN NO.	REL. AR. %	CID	FORMULA	MW	NAME	STRUCTURE
3077	0.07	ND	...	ND	...	...	C8 H18 O	130	UNKNOWN ALCOHOL	...
3352	< 0.01	ND	...	ND	...	4696	C8 H12 N2	136	2-ETHYL-3,6-DIMETHYL- PYRAZINE	
3367	< 0.01	ND	...	ND	...	...	...	154	UNKNOWN ALCOHOL	...
ND	...	ND	...	ND	...	12536	C9 H8 O2	148	2,2'-METHYLENEBISFURAN	
ND	...	ND	...	ND	...	...	...	146	UNKNOWN SULFIDE	...
ND	...	ND	...	ND	...	...	...	148	UNKNOWN	...
ND	...	ND	...	ND	...	...	C3 H8 S3	140	(METHYLTHIO)- METHYL, METHYLDISULFIDE	
3667	< 0.01	ND	...	ND	...	400	C7 H14 O S	146	4-METHYL-4-(METHYLTHIO)-2- PENTANONE	
ND	...	ND	...	ND	...	1645	C7 H12 O2 S	160	S-(1-ACETYLPROPYL)- ETHANETHIOATE	

TABLE I
continued

ANAL. 2/12/97		ANAL. 3/17/97		ANAL. 4/24/97		CID	FORMULA	MW	NAME	STRUCTURE
SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %	SCAN NO.	REL. AR. %					
ND	...	ND	...	ND	...	...	C ₃ H ₆ S ₃	138	DIMETHYL-CARBONOTRITHIOATE	
4152	<0.01	4242	<0.01	ND	...	1875	C ₆ H ₈ O S ₂	160	2-[(METHYLDITHIO)METHYL]-FURAN	
ND	...	4325	0.42	4226	2.21	16215	C ₆ H ₁₁ N O	113	HEXAHYDRO-2H-AZEPIN-2-ONE (CAPROLACTAM)	
ND	...	5955	0.03	5850	0.31	8231	C ₁₅ H ₂₄ O	220	IONOL CP (2,6-DI-TERT. BUTYL-4-METHYL-PHENOL)	

The columns entitled "ANAL.2/12/97" are for the total ion chromatogram of Figure 8. The reference numerals of Figure 8 are set forth under the title "SCAN NO.".

The total ion chromatograms of Figures 9, 9A, 9B, 9C, 9D, 9E and 9F have analyses as set forth under the columns "ANAL.3/17/97" and represent the analyses after approximately one month's storage.

The total ion chromatograms for Figures 10, 10A, 10B, 10C, 10D, 10E and 10F are set forth in the columns entitled "ANAL.4/24/97" and are for analyses of product after two month's storage.

Reference numerals for each of the foregoing Figures are set forth under "SCAN NO." and the relative area percentages for each peak are set forth in the columns entitled "REL. AR.%".

Referring to Figures 11, 11A, 11B, 11C, 11D, 11E, 11F and 11G, Figure 11 is the total ion chromatogram from a gas chromatography-mass spectrometer for a flask identified as "Flask No. 9" of coffee grinder gas produced, for example, using the apparatus of Figure 4. Figures 11A, 11B, 11C, 11D, 11E, 11F and 11G are enlargements of various segments of the total ion chromatogram of Figure 11 as set forth in the "BRIEF DESCRIPTION OF THE DRAWINGS". Table II sets forth the analyses for the coffee grinder gas of "Flask No. 9" as follows:

TABLE II

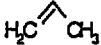
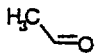
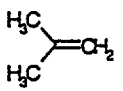
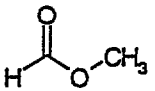
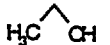
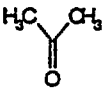
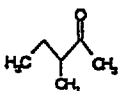
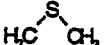
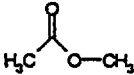
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
134	0.33	...	C O ₂	44	CARBON DIOXIDE	CO ₂
138	0.12	20666	C ₃ H ₆	42	1-PROPENE	
144	0.88	4136	C ₂ H ₄ O	44	ACETALDEHYDE	
148	0.19	6495	C ₄ H ₈	56	1-PROPENE, 2-METHYL	
151	0.63	...	C ₂ H ₄ O ₂	60	METHYLFORMATE	
160	0.08	6391	C ₂ H ₆ O	46	ETHANOL	
167	2.78	4779	C ₃ H ₆ O	58	ACETONE	
172	1.63	11749	C ₄ H ₄ O	68	FURAN	
178	1.28	6014	C ₆ H ₁₂ O	100	3-METHYL-2-PENTANONE	
180	1.75	1928	C ₂ H ₆ S	62	DIMETHYL SULFIDE	
184	2.15	7268	C ₃ H ₆ O ₂	74	METHYL ACETATE	

TABLE II
continued

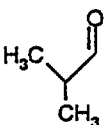
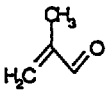
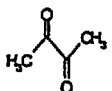
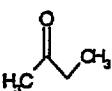
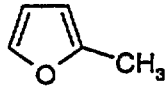
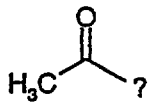
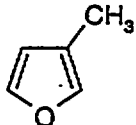
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
193	0.25	28631	C5 H6	66	1,3-CYCLOPENTADIENE	
199	3.44	6822	C4 H8 O	72	ISOBUTYRALDEHYDE	
206	<0.005	6031	C4 H6 O	70	METHACROLEIN (2-PROPENAL, 2-METHYL)	
215	0.78	6301	C2 H4 O2	60	ACETIC ACID	
221	2.82	4242	C4 H6 O2	86	DIACETYL (2,3-BUTANEDIONE)	
227	2.17	8253	C4 H8 O	72	METHYL ETHYL KETONE	
239	3.49	3734	C5 H6 O	82	FURAN, 2-METHYL	
242	2.14	...	C5 H6 O	82	UNKNOWN	...
246	0.61	...	...	...	UNKNOWN METHYL KETONE	
250	1.31	^ ...	C5 H6 O	82	FURAN, 3-METHYL	
ND	0.07	...	...	...	UNKNOWN	...

TABLE II
continued

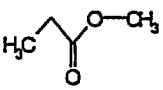
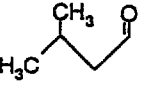
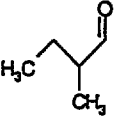
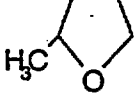
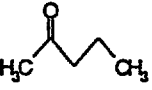
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
264	1.23	6618	C ₄ H ₈ O ₂	88	METHYL PROPIONATE	
276	0.55	...	C ₃ H ₆ S	74	UNKNOWN SULFIDE	...
286	0.14	^...	C ₆ H ₈	80	2,4-CYCLOPENTADIENE, 1-METHYL	
295	7.80	234	C ₅ H ₁₀ O	86	ISOVALERALDEHYDE (BUTANAL, 3-METHYL)	
314	7.81	398	C ₅ H ₁₀ O	86	2-METHYLBUTANAL	
316	#...	6816	C ₆ H ₆	78	BENZENE	
321	0.89	14751	C ₄ H ₄ S	84	THIOPHENE	
326	0.45	15685	C ₅ H ₁₀ O	86	2-METHYLTETRAHYDROFURAN, ANHYDROUS, 99+% (EX SIGMA ALDRICH)	
343	0.97	1480	C ₅ H ₁₀ O	86	METHYL PROPYL KETONE (2-PENTANONE)	

TABLE II
continued

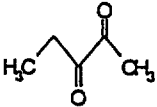
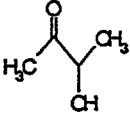
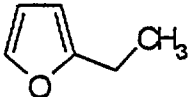
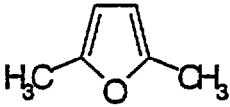
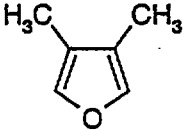
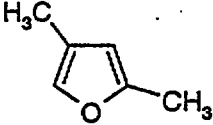
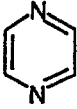
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
362	4.05	4573	C ₅ H ₈ O ₂	100	ACETYL PROPIONYL (2,3-PENTANEDIONE)	
366	0.75	...	...	...	UNKNOWN	...
378	0.86	4140	C ₄ H ₈ O ₂	88	ACETOIN (2-BUTANONE, 3-HYDROXY)	
392	0.47	227	C ₆ H ₈ O	96	2-ETHYLFURAN	
410	2.94	9346	C ₆ H ₈ O	96	FURAN, 2,5-DIMETHYL	
415	0.13	...	...	...	UNKNOWN	...
421	0.33	^...	C ₆ H ₈ O	96	FURAN, 3,4-DIMETHYL	
426	0.56	^...	C ₆ H ₈ O	96	FURAN, 2,4-DIMETHYL	
431	1.34	1750	C ₄ H ₄ N ₂	80	PYRAZINE	

TABLE II
continued

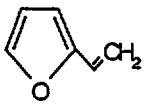
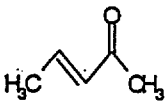
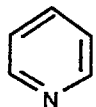
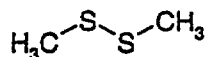
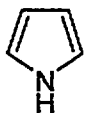
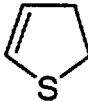
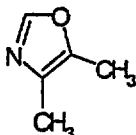
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
445	1.02	27541	C ₆ H ₆ O	94	FURAN, 2-VINYL	
461	# ...	362	C ₅ H ₈ O	84	3-PENTEN-2-ONE	
475	# 8.39	3799	C ₅ H ₅ N	79	PYRIDINE	
479	1.82	...	...	84	UNKNOWN	...
483	1.30	...	...	...	UNKNOWN	...
487	2.64	7442	C ₂ H ₆ S ₂	94	DIMETHYL DISULFIDE	
497	0.07	...	...	...	UNKNOWN	...
500	0.07	...	...	...	UNKNOWN	...
512	# ...	...	C ₇ H ₁₀	94	HYDROCARBON	...
519	# 1.09	4612	C ₄ H ₅ N	67	1H-PYRROLE	
523	0.11	...	...	...	UNKNOWN	...
529	# 0.21	^ ...	C ₄ H ₆ S	86	DIHYDROTHIOPHENE	
530	# ...	^ ...	C ₅ H ₇ NO	97	OXAZOLE, 4,5-DIMETHYL	

TABLE II
continued

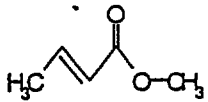
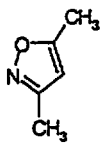
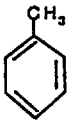
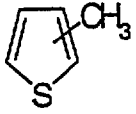
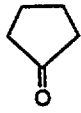
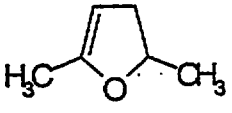
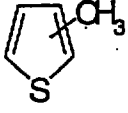
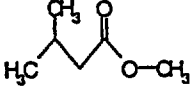
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
538	0.06	13475	C5 H8 O2	100	2-BUTENOIC ACID: METHYL ESTER, (E)	
543	0.14	^...	C5 H7 NO	97	ISOOXAZOLE, 3,5-DIMETHYL	
565	0.59	8234	C7 H8	92	TOLUENE	
571	0.48	...	C5 H6 S	98	THIOPHENE, 7-METHYL	
577	0.58	10161	C5 H8 O	84	CYCLOPENTANONE	
586	0.25	...	C6 H10 O	98	DIHYDROFURAN, 2,5-DIMETHYL	
591	0.45	...	C5 H6 S	98	THIOPHENE, 7-METHYL	
593	#...	1994	C6 H12 O2	116	METHYL ISOVALERATE (BUTANOIC ACID, 3-METHYL: METHYL ESTER)	

TABLE II
continued

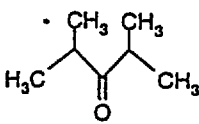
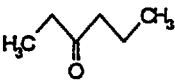
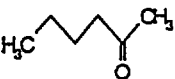
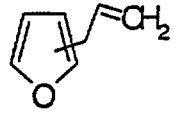
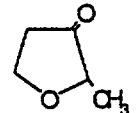
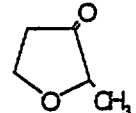
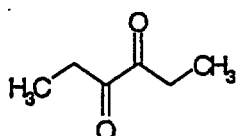
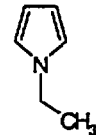
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
598	# 0.8	223	C7 H14 O	114	2,4-DIMETHYL-3-PENTANONE	
601	0.42	6297	C6 H12 O	100	ETHYL PROPYL KETONE (3-HEXANONE)	
609	0.07	4406	C6 H12 O	100	METHYL N-BUTYL KETONE (2-HEXANONE)	
614	0.06	^ ...	C7 H8 O	108	 FURAN, 2-(2-PROPENYL)	
631/636	1.81	4970	C5 H8 O2	100	2-METHYLTETRAHYDROFURAN-3-ONE	
631/636	1.40	4970	C5 H8 O2	100	2-METHYLTETRAHYDROFURAN-3-ONE	
642	# 0.43	...	...	110	UNKNOWN	...
643	# ...	9463	C6 H10 O2	114	3,4-HEXANEDIONE	
648	0.59	...	...	100	UNKNOWN	...
659	0.15	...	...	110	UNKNOWN	...
674	0.76	457	C6 H9 N	95	N-ETHYLPYRROLE	

TABLE II
continued

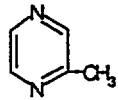
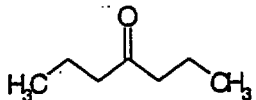
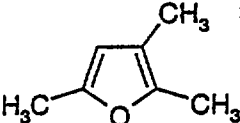
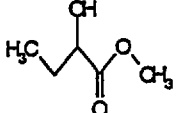
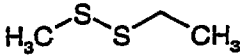
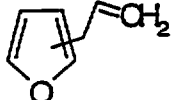
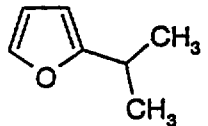
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
695	3.20	4582	C5 H6 N2	94	METHYLPYRAZINE	
704	# ...	...	...	114	4-HEPTANONE	
707	# 0.71	...	...	110	UNKNOWN	...
716	0.23	...	...	112	4-OCTENONE	
716	# ...	...	...	110	2,3,5-TRIMETHYL-FURAN	
723	0.03	...	...	...	UNKNOWN	...
733	1.02	...	...	...	UNKNOWN	...
741	0.12	6799	C5 H10 O3	118	BUTYRATE, METHYL 2-HYDROXY	
746	0.32	1952	C3 H8 S2	108	METHYL ETHYL DISULFIDE	
753	0.98	^ ...	C7 H8 O	108	FURAN, ?-(2-PROPENYL)	
761	0.07	...	C7 H10 O	110	2-ISOPROPYL-FURAN	

TABLE II
continued

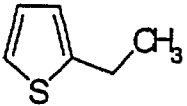
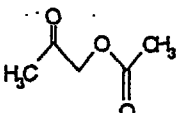
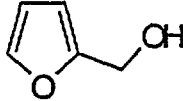
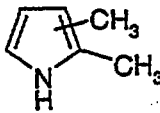
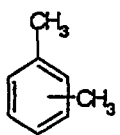
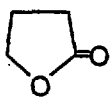
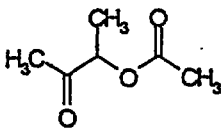
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
769	0.21	...	C ₆ H ₈ S	112	2-ETHYL-THIOPHENE	
777	0.16	...	...	128	UNKNOWN	...
783	0.03	...	...	...	UNKNOWN	...
800	1.10	1953	C ₅ H ₈ O ₃	116	ACETOL ACETATE (2-PROPANONE, 1-HYDROXY: ACETATE)	
812	1.97	3616	C ₅ H ₆ O ₂	98	FURFURYL ALCOHOL	
819	0.19	...	C ₇ H ₈ O	108	UNKNOWN	...
826	<0.005	...	C ₇ H ₈ O	108	UNKNOWN	...
830	# 0.17	^...	C ₆ H ₈ N	95	2,2-METHYL-PYRROLE	
839	<0.005	...	C ₈ H ₁₀	106	1,7-DIMETHYL-BENZENE	
845	0.10	...	...	112	UNKNOWN KETONE	...
872	0.34	4057	C ₄ H ₆ O ₂	86	BUTYROLACTONE, GAMMA- (FURAN-2(3H)-ONE, DIHYDRO)	
886	0.07	...	C ₆ H ₁₀ O ₃	130	ACETOIN ACETATE	
898	0.14	...	...	128	UNKNOWN	...

TABLE IIcontinued

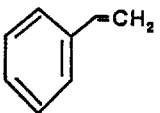
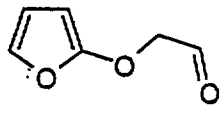
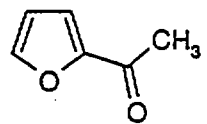
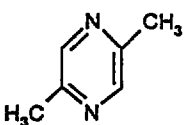
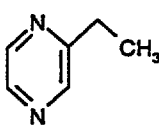
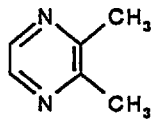
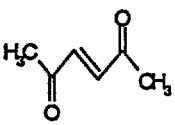
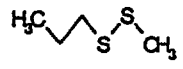
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
911	0.09	6007	C ₈ H ₈	104	STYRENE	
931	0.41	3617	C ₆ H ₆ O ₃	126	2-FURANMETHANOL: FORMATE	
933	# ...	...	C ₆ H ₆ O ₂	110	2-ACETYL-FURAN	
947	# 0.91	4931	C ₆ H ₈ N ₂	108	2,5-DIMETHYLPYRAZINE	
956	0.21	8272	C ₆ H ₈ N ₂	108	2-ETHYLPYRAZINE	
963	0.13	6821	C ₆ H ₈ N ₂	108	2,3-DIMETHYLPYRAZINE	
969	0.01	...	...	...	UNKNOWN	...
989	0.03	...	...	...	UNKNOWN	...
1000	0.06	13434	C ₆ H ₈ O ₂	112	3-HEXENE-2,5-DIONE, (E)	
1016	0.02	6660	C ₄ H ₁₀ S ₂	122	METHYL PROPYL DISULFIDE	

TABLE II
continued

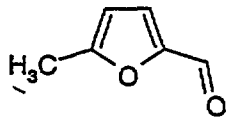
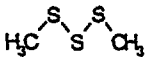
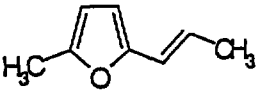
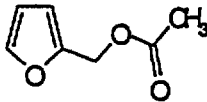
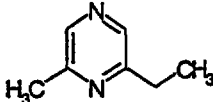
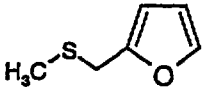
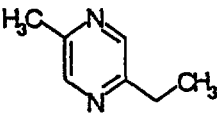
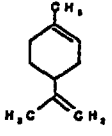
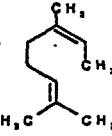
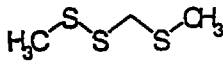
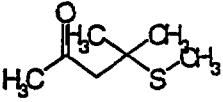
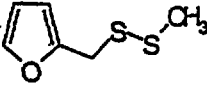
SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
1021	0.06	...	...	112	UNKNOWN	...
1046	0.05	...	...	...	UNKNOWN	...
1055	0.08	...	...	130	UNKNOWN	...
1062	# 0.15	6104	C6 H6 O2	110	5-METHYLFURFURAL	
1063	# ...	...	...	130	UNKNOWN	...
1097	0.08	1685	C2 H6 S3	126	DIMETHYL TRISULFIDE	
1103	0.03	...	C8 H10 O	122	2-METHYL-2-(2-PROPENYL)-FURAN	
1111	<0.005	...	...	130	UNKNOWN	...
1132	0.04	...	...	130	UNKNOWN	...
1158	0.34	2026	C7 H8 O3	140	FURFURYL ACETATE	
1173	0.05	3756	C7 H10 N2	122	2-ETHYL-6-METHYLPYRAZINE	
1178	0.05	4425	C6 H8 O S	128	FURFURYL METHYL SULFIDE	
1182	0.05	...	...	...	UNKNOWN	...
1189	0.01	...	...	...	2-ETHYL-5-METHYLPYRAZINE	
1201	0.02	...	...	138	UNKNOWN	...

TABLE II
continued

SCAN NO.	AREA %	CID	FORMULA	MW	NAME	STRUCTURE
1205	<0.05	...	...	...	UNKNOWN	...
1233	<0.05	6483	C ₁₀ H ₁₆	136	LIMONENE (DIPENTENE; CYCLOHEXENE, 1-METHYL-4-ISOPROPENYL)	
1293	<0.05	19412	C ₁₀ H ₁₈	138	2,6-OCTADIENE, 2,6-DIMETHYL, (Z)	
1453	0.03	...	...	148	UNKNOWN	...
1460	0.03	...	C ₃ H ₈ S ₃	140	(METHYLTHIO)METHYL-METHYL-DISULFIDE	
1483	<0.05	400	C ₇ H ₁₄ O S	146	4-METHYL-4-(METHYLTHIO)-2-PENTANONE	
1650	<0.05	...	C ₆ H ₈ O ₁ S ₂	160	FURFURYL METHYL DISULFIDE	

The reference numerals identifying each peak of the analyses are set forth in the column entitled "SCAN NO.". The analyses are set forth in the column entitled "AREA %".

In each of Tables I and II, the column entitled "CID" is the code number for the particular ingredient which is part of the overall analysis.

Referring to Figures 12-15, an aerosol spray can of the type set forth in Figure 1 can be produced using the process and apparatus as set forth in Figures 12-15 and also as set forth in U.S. Letters Patent No. 5,383,580 issued on January 24, 1995, the disclosure of which is incorporated by reference herein.

Thus, an aerosol spray dispensing device useful in the practice of our invention comprises an enclosure or housing having a nozzle through which aerosol spray (coffee grinder gas) is dispensed on an intermittent basis to an ambient atmosphere. The housing contains an aerosol can capable of sustaining pressures of between 40 and 2,000 psig, reference numeral 3016 of coffee grinder gas to be dispensed to the environment outside the housing. The aerosol can 3016 is mounted in releasable relation to a solenoid-activated valve mechanism 3018 (shown in Figures 12 and 13) fixedly mounted in the housing and operatively connected to the nozzle so that an aerosol spray of coffee grinder gas may be dispensed from the aerosol can through the nozzle. The valve mechanism 3018 may have any convenient structure which permits selective opening and closing to dispense aerosol spray of coffee grinder gas from the can 3016 through the nozzle. The structure may be that described in U.S. Letters Patent No. 3,666,144, the disclosure for which is incorporated by reference herein, but any other convenient mechanism may be adopted. The valve mechanism 3018 may be controlled by a suitable electronic control panel 3020 with an on-off switch 3021 and powered by an electric battery 3022. The control panel 3020 may control the frequency of opening of the valve mechanism 3018 for dispensing coffee grinder gas through the nozzle and the length of time for which the valve mechanism 3018 is open for such dispensing.

The aerosol can 3016 is mounted to the valve mechanism by a two-piece adapter 3024, comprising an upper element 3026 snap-fit mounted to the valve mechanism 3018 and a lower element 3028 snap-fit mounted to the aerosol can 3016, the upper and lower members 3026 and 3028 being screw-threaded together. While the upper element 3026 is illustrated as comprising an individual mountable and demountable element, such element may be permanently affixed to or may be part of the valve mechanism 3018.

As may be seen in Figure 13, the upper element 3026 is provided with an internal flange 3030 which snap-fits into a complimentary groove 3031 formed in the valve mechanism 3018 to mount the upper element 3026 to the valve mechanism 3018.

The lower element 3028 has an external groove 3032 which snap-fits over a bulbous rim 3034 of the aerosol can 3016.

The upper element 3026 has outer screw threads 3036 while the lower element 3028 has inner mating screw threads 3038 which enable the elements 3026 and 3028 to be screw-threaded together. The aerosol can 3016 is mounted to the valve mechanism 3018 by screw-threading the elements 3026 and 3028 together by rotating the aerosol can 3016 relative to the valve mechanism 3018. The snap-fit mountings of the elements 3026 and 3028 to the respective valve mechanism 3018 and aerosol can 3016 provides a structure which resists relative rotational movement between the respective element and the valve mechanism and aerosol can, permitting the aerosol can 3016 to be readily screw-threadedly mounted to the valve mechanism 3018. This arrangement ensures proper alignment of the valve stem 3040 of the aerosol can 3016 and its seat 3042 at the upstream end of the valve mechanism 3018, since screw-threaded engagement occurs before the stem 3040 becomes seated.

As also seen, particularly in Figure 13, the lower element 3028 is provided with an annular flange 3056 which seats against the underside of the flange 3052 of the upper element 3026 when the elements are fully screw-threadedly assembled (see Figure 14). A plurality of discontinuous protrusions 3058 is provided on a lower cylindrical portion 3060 of the lower element 3028 to snap into an undercut or groove 3062 of the bulbous rim, with the bulbous rim then being seated in the groove 3032 (as shown in Figures 13 and 14).

The lower element 3028 is intended to remain mounted on the aerosol can 3016 and to be discarded therewith when empty. Accordingly, the lower element is dimensioned so that the assembly is under tension and resists relative rotational movement of the lower element 3028 relative to the aerosol can 3016.

The provision of a series of discontinuous protrusions 3058 rather than a single continuous flange, however, permits

for more ready assembly of the lower element 3028 with the aerosol can by permitting inward flexure of the lower cylindrical portion 3060 of the lower element 3028. However, a continuous protrusion may be used, if desired. As in the case of the upper element 3026, such a flexure is resisted when the elements 3026 and 3028 are assembled together. In addition, the series of discontinuous protrusions 3058 enables the lower element 3028 to seat securely in the groove 3062, defined by the bulbous head 3034 of the rim of the aerosol can 3016.

As seen, particularly in Figures 15 and 16, the thread 3036 provided on the upper element 3026 and the thread 3038 provided on the lower element 3028, each is continuous and of complimentary chamfered shape, so as to be mating from initial engagement and throughout the screw assembly of the upper and lower elements 3026 and 3028 together as the aerosol can 3016 is mounted to the valve element 3018 by rotational movement of the aerosol can 3016.

The elements 3026 and 3028 are conveniently manufactured by moulding from suitable polymeric material as integral elements.

Figures 17A, 17B and 17C also show the function of an aerosol spray can containing coffee grinder gas for spraying controllably and intermittently, using a solenoid valve attached to the spray can. Aerosol spray can 3117 containing coffee grinder gas is attached via cylinder 3115 and fittings 3114 to solenoid valve 3112 having thereon a spraying device 3113 for intermittently spraying the coffee grinder gas into the atmosphere.

The electronic circuitry is shown in detail in Figure 17C. The power source 3126 is used to power the system. Light-emitting diode 3105 is interconnected with circuit 3104. The face of the container containing the equipment is indicated by reference numeral 3127 and the orifice for the intermittent spraying on face 3127 is also shown by reference numeral 3113, spraying device 3113 being behind the orifice.

The electronic circuitry includes relay R3101, contact R3111, contact R3121 (coupled in series with light-emitting diode 3105), contact R3102, contact R3112, and relay R3103. The operation of the apparatus of Figures 17A, 17B and 17C is explained in more detail in European Published Patent Application No. 136,383 published on April 10, 1985 (Jean-Piere Rouault).

The apparatus of Figures 6 and 7 can be used in conjunction with electronic program controllers. Thus, the apparatus of Figure 6 can be used in conjunction with electronic program controller 100a which uses marketing input information from source 99a via a control line feeding into the electronic program controller 100a and controlling the apparatus as illustrated in Figure 6. Thus, the apparatus shown in schematic diagram Figure 6 is also shown in schematic form in Figure 18A as associated with the electronic program controller (computer mechanism). More specifically, addition of solid grinder gas at location 25 is controlled through control line 25c. The nitrogen purge through line 29 past valve 53 into pressure vessel 27 previously cooled from location 26 is controlled through line 28c. The time at which the pressure vessel is sealed at location 51 is controlled through control line 51c, and the time of storage at location 52 is controlled through control line 22c. The spraying of coffee grinder gas at location 54 is controlled through control line 54c, including intermittent spraying using solenoid control valves as shown in the apparatus of Figures 17A, 17B and 17C and shown in the apparatus of Figures 12, 13, 14 and 15.

Similarly, the apparatus of Figure 7 can be used in conjunction with electronic program controller 100b which uses marketing input information from source 99b via control lines feeding into the electronic program controller and controlling the apparatus as illustrated in Figure 7. Thus, the apparatus shown in schematic diagram in Figure 7 is also shown in schematic form in Figure 18B as associated with the electronic program controller (computer mechanism) via control lines.

More specifically, the addition of solid grinder gas at location 13 is controlled through control line 13c. After the feeder pressure vessel has attached thereto the manifold at locations 11 and 12, the open feeder pressure vessel is purged, optionally, with a nitrogen purge from location 14 with the nitrogen flowing through line 15 past valve 16. The use of the optional nitrogen purge is controlled through control line 14c. Alternatively, the purge can be carried out with additional grinder gas which is allowed to evaporate prior to adding the full amount of grinder gas from location 13. This, too is controlled through control line 13c. After the feeder pressure vessel is sealed at location 18 and permitted to warm to ambient temperature, the evacuated and cooled spray cans from location 19 are attached thereto at location 21. The evacuation and cooling of the spray cans at location 19 is controlled through control line 19c. The attachment of the cooled spray cans to the manifold and timing thereof is controlled through control line 21c. The pressurization of the spray cans by means of opening the valves between the spray cans and the manifold and the feeder pressure vessel whereby the spray cans are pressurized to given pressures between 40 psig and 350 psig at location 22 is controlled through control line 22c. The sealing of the spray cans containing coffee grinder gas at elevated pressure so that they can be ultimately detached and released from the manifold is controlled at location 23 by means of control line 23c. The detaching of the spray cans for storage and subsequent use, either entirely or intermittently using solenoid valves at location 24, is controlled through control line 24c.

* * * * *

It will be understood that, while the invention has been described in part by means of the following specific example, reference should be had to the appended claims for a definition of the scope of the invention.

EXAMPLE IPREPARATION OF COFFEE GRINDER GAS BY MEANS OF
STEAM DISTILLATION OF COFFEE GROUNDS AND SUBSEQUENT
COMBINATION WITH CARBON DIOXIDE AND COOLING

Colombian Andes preground coffee from premium coffee is placed in a packed resin column, 4" x 24" attached to a cold water condenser and liquid nitrogen-cooled receiver. The amount of coffee in the packing is 2,150 grams.

High-pressure steam at a temperature of 220°C is passed through the column at a rate of 0.1 cubic feet per second and at a pressure of 1.5 atmospheres yielding the following fractions:

fraction 1: 9.7 grams per minute for 6 minutes: 58.2
grams total;

fraction 2: 11.1 grams per minute for 8 minutes: 88.8
grams total

fraction 3: 11.6 grams per minute for 8 minutes: 92.8
grams total;

fraction 4: 11.4 grams per minute for 6 minutes: 68.4
grams total;

fraction 5: 11.5 grams per minute for 8 minutes: 92
grams total; and

fraction 6: 11.7 grams per minute for 8 minutes: 93.6
grams total.

The resulting product is analyzed and the analysis is set forth in the following Table III:

TABLE III

###	CHEMICAL IDENTIFIED	1	2	3	4	5	6	7	composit 1-6
		< fractions collected during the steaming process >							
1	sulfur dioxide				0.61		1.25	1.24	
2	acetaldehyde	0.31	.....	0.98		0.18	0.27	0.49	0.96
3	butane							0.27	
4	2-methyl-1-propene				0.31				
5	isoprene				0.10				
6	ethanol						0.10	0.11	
7	acetone		.....	2.24			0.63	0.72	0.54
8	methyl formate	0.02							
9	propionaldehyde	0.47				0.50			
10	1,3-pentanedione					0.46			
11	isobutyraldehyde		0.25	5.38	0.20	1.30	0.60	.....	0.62
12	3-butane dione			1.93					
13	dihydro-2-methyl-3(2H)- furanone			3.61					
14	2-butenal				0.11				
15	methyl acetate	0.26	0.04	1.01	0.21			0.53	0.17
16	butanal	1.40	0.42						
17	methyl ethyl acetate	0.83							
18	diacetyl		0.44		0.56	1.04	0.94	1.05	
19	pyruvaldehyde						0.61		
20	2-butanol	0.09							
21	2-butanone				0.19	0.64		0.82	1.35
22	acetic acid			2.54	1.24	3.45	3.82	3.99	
23	hydroxy-2-butanone							0.29	
24	3-methyl-2-butanone							0.13	
25	2-methyl butanal							2.97	
26	2-methyl furan	0.27	0.19			1.00			0.23
27	methyl butenol								0.23
28	2-methyl-1-propanol		0.09						
29	3-hydroxy butanol		0.22						
30	ethyl acetate	0.21		3.37					
31	methyl propionate	0.26		0.95			0.18		
32	2-butenal						.....		
33	isovaleraldehyde	3.11	1.62	12.73	1.30	4.15	3.18		2.84
34	2-methyl butanal	2.05	2.29	12.64	1.25	4.54	2.85		3.43
35	5-hexen-2-one						.....		
36	2-pentanone		0.23	.....	.....	0.60	0.48	1.42	0.34
37	2-methyl-3-pentanone				1.60				
38	1-penten-3-ol				0.19				
39	3-hydroxy-2-butanone				0.20				
40	acetyl propionyl							3.62	3.61
41	methanthiol				0.58				0.39
42	thiophene					2.76			
43	1-hydroxy-2-propanone	0.10				0.87			
44	2,3-pentanedione		3.68			2.65	2.31		
45	butyl acetate			1.24					
46	3-pentanone					0.50		0.71	
47	2,5-dimethyl furan					1.84			
48	2-ketobutyric acid	2.89							
49	acetoin	0.39							
50	propyl acetate						0.64	0.98	
51	1,3-butane diol							0.56	
52	pyrazine	0.55	0.62	0.60	1.05	0.77	0.56		1.03
53	isobutyric acid			0.66					

TABLE III

continued

###	CHEMICAL IDENTIFIED	1	2	3	4	5	6	7	composit 1-6
		< fractions collected during the steaming process >							
54	2-methyl crotonaldehyde								0.76
55	3-penten-2-one				0.56		0.54	0.67	0.75
56	1-hydroxy -2-butanone						0.27	0.46	
57	hexanal			1.14	0.16		0.17	0.14	
58	cis-3-hexenol				.....				
59	isobutyl acetate			8.18	2.01			4.35	
60	vinyl propionate			2.41					
61	acetyl butyryl				1.22			0.95	
62	2-vinyl furan		0.36			0.67			
63	methyl vinyl ketone		0.70						
64	3-methyl-3-buten-1-ol	0.69							
65	2-methyl-2-butenal	0.97	1.01						
66	dimethyl disulfide	0.59	0.51		0.31	2.22	0.18	0.16	0.55
67	1-hexen-3-ol				0.35				
68	cyclohexanol					0.89			
69	4,5-dimethyl oxazole	0.18	0.22						0.21
70	3,5-dimethyl oxazole		0.19						
71	3-methyl-3-hexen-2-one								.....
72	3-methyl-2(5H)-furanone		.....			0.17			
73	butyl acetate		0.55				2.45	1.03	0.87
74	2,3-hexane dione						0.73		
75	2,5-dimethyl-3-pentanone		1.40			1.15			
76	methyl isobutyl ketone		0.13						
77	furfuryl alcohol	1.85	2.64			5.46			1.86
78	isobutyraldehyde	1.15							
79	2-hexanone				0.10				0.25
80	3-hexanone	0.54			0.67	0.74	0.52	0.44	0.72
81	3-methyl-2-pentanone				5.09				
82	acetyl propionyl						0.40	4.22	
83	dihydro -2-methyl-(3H) furanone					3.39			5.50
84	ethyl butyrate							0.42	
85	2-methyl pyrazine				4.99	3.30	3.02	3.12	0.87
86	3-heptanone	3.05							
87	4-methyl thiazole	0.36	0.47		0.19				0.29
88	furfural	15.52	18.52	3.1	11.63	6.52	8.8	10.8	15.04
89	nonane						0.79		
90	2,3-heptane dione				1.15			0.88	2.38
91	3-methyl crotonate				0.16				
92	2-methyl phenol					2.72			
93	3-methyl phenol					0.41			
94	3-octanone	0.32							
95	2-methyl pentenoate		0.46						
96	3-methyl-2-butyl acetate		0.36		0.87				0.50
97	isoamyl acetate	0.95		3.70	0.52		1.74		
98	2-methyl butyric acid			1.78					
99	acetol acetate	0.95		.....	0.70		0.99	0.86	
100	ethyl isovalerate						0.60		
101	2-cyclopenten-1,4-dione						1.05	1.13	
102	hexyl formate		0.67		0.31				0.87
103	2-propyl-2-butenal				0.59				
104	3-methyl hexanal								1.20
105	2-(2-propenyl) furan		1.31			2.25			

TABLE III

continued

###	CHEMICAL IDENTIFIED	1	2	3	4	5	6	7	compos 1-6
		< fractions collected during the steaming process >							
106	amyl acetate			4.67		2.23			
107	3-methyl-4-heptanone					0.89			1.31
108	hexanol		0.42						
109	2,3-heptanedione	0.37							
110	4-octanone	1.05	1.33						
111	2-heptanone	0.35	0.45		0.60	0.28	0.35	0.32	0.40
112	3,4-dimethyl-3-penten -2-one	0.91							
113	isoamyl acetate		0.85		2.73			2.55	
114	4-heptyl-2-heptanone							0.53	
115	isovaleric acid		0.52				1.15	1.14	
116	2-heptanal							1.37	
117	sec. amyl acetate						4.20	6.18	
118	3-methyl-4-heptanone							0.75	
119	3-methyl-4-pentanone						0.75		
120	styrolene		0.48		0.55	0.49	.....	.....	.....
121	furfuryl formate	5.09				2.50			
122	furfuryl acetate		2.14		3.46		2.03	1.62	
123	2-formyl-1-methyl pyrrole				1.87		1.83	1.56	
124	2-acetyl furan	5.57	2.73	.....	2.34		1.12	1.23	2.40
125	2,3-dimethyl pyrazine	0.46			0.44		0.34	0.21	
126	2,5-dimethyl pyrazine		4.11	.....	3.13	1.32	1.77	1.68	3.57
127	2-ethyl pyrazine					1.14	0.92	0.85	.....
128	2-cyclohexen-1-one				0.11				
129	prenyl acetate				0.97		0.96	1.15	
130	2,5-dimethyl-3(2H)- furanone							0.34	
131	3-hexen-2,5-dione				0.27		0.55		
132	3-methyl-3-hexen-2-one				0.52		0.63		
133	2,6-dimethyl-3-heptanone				0.80				
134	3-methyl-2-buten-1-ol, acetate	1.02	1.07			0.43			0.77
135	3-hexen-2,5-dione					0.59			
136	2-vinyl pyrazine	0.32	.....						
137	2-ethyl-5-methyl furan		0.38						
138	3-heptanone		0.26					.....	
139	allyl acetate	.....							
140	2-methyl-3-octanone	1.88	0.41			0.32	0.22	.....	0.49
141	acetyl cyclohexene					0.25			0.48
142	2,3-octane dione					1.08			
143	4-methyl-2-isopropyl pentanal		2.15				0.90	1.13	2.44
144	isobutyl butyrate							0.21	
145	5-methyl-2-furfural	4.36	2.27	0.41	7.52	4.20	4.20		4.26
146	methylpropyl butanoate				0.19				0.21
147	2-acetyl-5-methyl furan				0.48				
148	5-nonanone								0.29
149	2-nonanone								1.02
150	styrenol								
151	benzaldehyde		2.15			.....			
152	dimethyl trisulfide	0.58	0.38		0.27	0.99			2.44
153	3,4-dimethyl phenol		0.27						0.50
154	5-methyl-2-thiomethyl furan		0.96						

TABLE III

continued

###	CHEMICAL IDENTIFIED	1 < fractions collected	2	3	4	5	6	7 >	composit 1-6
155	furfuryl methyl sulfide		2.71			1.28			0.50
156	2-propionyl furan	1.10							0.95
157	2-acetyl thiazole	.....							
158	2-methyl-6-vinyl pyrazine	0.26	0.31						0.54
159	neral?	0.50							
160	2-ethyl-5-methyl pyrazine		0.81		2.07		0.76		0.45
161	2-ethenyl-6-methyl pyrazine				0.40			0.65	
162	limonene oxide							0.92	
163	3,7-dimethyl-1,7-octadien- 3,6-diol				0.60				
164	2-propyl pyrazine		0.17						
165	2-acetyl thiazole		0.17						
166	terpendiol II		0.32			0.73	1.61	0.53	
167	phenacetaldehyde	0.25	0.17		0.44	0.13	1.29	0.65	
168	n-ethyl-2-pyrrole- carboxaldehyde				0.32				
169	limonene				0.49				
170	acetophenone				0.16				
171	furacrolein						0.43		
172	terpinyl acetate						0.58	0.32	
173	1-phenyl ethanone							.....	
174	4-methyl benzaldehyde				0.33				
175	2-methyl benzaldehyde						0.27	.....	
176	n-methyl-2-acetyl pyrrole				0.75		0.84	0.48	
177	2,3-dihydro benzofuran				0.32			.....	
178	furfuryl propionate							0.32	
179	2,6-dimethyl pyrazine							0.23	
180	linalool oxide							.....	
181	2-ethyl-3,5-dimethyl pyrazine				0.67				
182	2-methoxy phenol				0.57				
183	4-methoxy phenol						1.57	1.20	
184	2,3-diethyl pyrazine							0.13	
185	2-acetyl thiophene						.....		
186	2,2'-difuryl methane	3.47	2.37		0.68	2.11			3.19
187	methyl-2-thiofuroate								.....
188	oxindole					0.40			0.18
189	nonanal					.....	0.59	1.99	
190	methylthio formate	0.37	0.44						
191	terpinolene		0.59						
192	linalool	0.74	0.59		0.72		0.59	0.61	
193	7-methyl benzofuran	0.35	0.22		0.29	0.15	0.97	0.21	0.15
194	5-methyl-2-acetyl thiophene							.....	
195	6-methyl-3,5-heptadien-2-one				.....				
196	2-hydroxy-3-methyl- benzaldehyde				0.19				
197	5-acetyl-2-furanmethanol				0.25				
198	2-hydroxy acetophenone				0.27			.....	
199	n(4-hydroxy phenyl)- acetamide							.....	
200	5-methyl-2-acetyl furan							.....	
201	ethyl-p-hydroxy benzoate						0.40		
202	1-(5-methyl-2-furanyl)-1 propanone		0.10						

TABLE III

continued

###	CHEMICAL IDENTIFIED	1	2	3	4	5	6	7	composit 1-6
		< fractions collected during the steaming process >							
203	2-nonenal	0.57	0.72		0.69	0.69	0.96		0.60
204	trans-2-carene-4-ol						0.54		
205	4,6-dimethyl-2,7-nonadien-5-one								0.25
206	1-furfuryl pyrrole				0.42	1.14	0.84		0.59
207	m-methyl acetophenone						.....	.....	
208	α -methyl-2-furanyl acrolein						.....		
209	1-(2-furfuryl)pyrrole	0.50							
210	1-(2-furanylmethyl)-1H-pyrrole		0.83						
211	2-(5'-methyl-2'-furfuryl)furan	0.82				0.90			0.80
212	3,4-dihydro benzofuran					.....			
213	2-hydroxy methyl benzoate					0.44			.....
214	2-isobutyl-3-methoxy pyrazine	0.34	0.48		0.46		1.02	1.01	0.30
215	methyl salicylate		0.19		0.23		0.84	0.97	
216	α -terpineol							.....	
217	robustone	0.31	0.29			0.64		0.83	0.30
218	furfuryl pentanoate	0.35	0.33		0.24	0.31	0.47	0.83	0.28
219	2-phenyl furan	0.13	0.17			0.45	0.29		0.20
220	3-phenyl furan				0.41				
221	1-naphthol							.....	
222	2,2'-methylene bis(5-methyl)furan				0.09				
223	2-methoxy-4-ethyl phenol				0.16			.....	
224	5-methoxy-6,7-dimethyl benzofuran					.....		.....	
225	2,2'-(oxybis(methylene))bis furan				0.10		.....	.....	
226	1-methyl naphthalene						.....	.....	
227	2-methyl naphthalene				0.11		.....	.....	
228	p-vinyl guaicol				0.07		.....	.....	
229	2,4-decadienal						.....	.....	
230	2-methoxy-4(1-propenyl)phenol						.....	.....	
231	3,7-dimethyl-2,4-octadienal						.....	.....	
232	2,2'-methylene bis(5-methyl)furan	.....	.....						
233	α -ionone		.....						
234	3,5-octadien-2-one		.....						
235	damascenone		.....		0.11	.....	2.23	0.45	0.09
236	furfuryl-5-methyl-2-furyl sulfide		.....		0.07	.....	.....	.....	0.14
237	1,6-dimethyl naphthalene						.....	.....	
238	dodecanol						.....	.....	
239	ionol				0.14	.....	.....	.....	0.07
240	5-methyl-2-furfuryl mercaptan	.....	.....						
241	methyl-2-methyl-1-(methyl thio)disulfide	.....							
242	oxothionate-095	.....							
243	methyl-1-(methylthio)-ethyl disulfide	.....							

17.5 Grams of the resulting composite of fractions 1-7 was admixed with 332.5 grams of solid carbon dioxide ("dry ice"). The resulting mixture is placed into a 2 liter container capable of sustaining pressures up to 2,000 psig. The container was pre-cooled with liquid nitrogen so that the initial temperature was -140°C . The container was sealed while being fitted with an aerosol spray valve. The container is then warmed to $+25^{\circ}\text{C}$ and maintained at $+25^{\circ}\text{C}$ for a period of 5 days. At the end of 5 days, 30 grams of the stored material was released. The released material was analyzed and the analysis was substantially identical to the analysis of the composite of Table III, supra. Thirty days later an additional 40 grams of gas was released and analyzed. The resulting analysis was substantially the same as the analysis of Table III, supra.

WHAT IS CLAIMED IS:

1. A process for aromatizing a specific volume V_1 having an ambient temperature T_1 which is in the range of from about 20°C up to about 30°C and a pressure of P_1 which is about atmospheric pressure, zero psig, with a stable coffee aroma comprising the steps of:

- (a) providing a hollow container having an internal void volume V_2 containing a mass of coffee grinder gas G_0 , said internal void volume being substantially free of molecular oxygen at a pressure P_2 in the range of from about 40 psig up to about 2,000 psig at a temperature T_2 of from about 20°C up to about 40°C and equipped with spraying means for spraying contents contained within the container into volume V_1 , said grinder gas G_0 having an initial analytical total ion chromatogram profile α_1 ; and
- (b) engaging said spraying means in said specific volume V_1 whereby said pressurized container is depressurized from P_2 to a pressure P_3 at least as great as P_1 and said volume V_1 is aromatized with a coffee aroma having, at the instant of spraying, a total ion chromatogram profile α_0 , substantially equivalent to α_1 .

2. The process of Claim 1 comprising the additional step (a'), carried out immediately subsequent to step (a) comprising storing the pressurized container containing mass G_0 for a period of time θ_s at the end of which period, the grinder gas has a total ion chromatogram profile α_0 , substantially equivalent to α_1 .



3. The process of Claim 1 wherein the step (b) is governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_1} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta - 0.6071 \theta$$

wherein:

ΔA is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ;

V is the void volume of the hollow container;

$\left(\frac{\partial P}{\partial \theta} \right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ;

θ is "time";

θ_1 is the time during which the grinder gas having a mass G_1 is sprayed into volume V_1 ; and

H is enthalpy of grinder gas G .

4. The process of Claim 1 wherein step (b) is repeated at least once, whereby pressure P_2 is first diminished to P_2' ; and then P_2' is reduced to P_2'' wherein $P_2' > P_1$; and P_2'' is at least as great as P_1 .

5. The process of Claim 4 wherein the repeated steps (b) are governed by the algorithm:



* C L M S *

$$\Delta A_m = \sum_{i=1}^n \left\{ 7.8 \times 10^{-3} \int_0^{\theta_i} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta \right\} - 0.6071 \theta_T$$

wherein:

ΔA_M is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ;

R is the gas constant, 0.08206 liter-atmospheres per gram mole degree Kelvin; wherein

T is temperature in degrees Kelvin; wherein

V is volume; wherein the symbol:

$\left(\frac{\partial P}{\partial \theta} \right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ; wherein

θ is "time"; wherein

θ_1 is the time during which the grinder gas having a mass G_1 is sprayed into volume V_1 per intermittent spray; wherein

n is the number of intermittent sprays; and wherein

θ_T is the total amount of time over which the total number of sprays is effected and represents down time as well as spraying time.



6. The process of Claim 3 governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] - 0.6071$$

wherein: $\left(\frac{\partial [\Delta A]}{\partial \theta} \right)_{T,V,H}$

represents the first partial derivative of the scaled value of aroma, ΔA on a scale of zero up to 10 with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ; wherein R is the gas constant, 0.08206 liter-atmospheres per mole degree Kelvin; wherein V is volume in liters; wherein the symbol:

$$\left(\frac{\partial P}{\partial \theta} \right)_{T,V,H}$$

represents the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ; wherein θ is "time" and wherein P is "pressure" in atmospheres.

7. The process of Claim 4 wherein the spraying means is a solenoid-controlled spray valve.

8. The process of Claim 1 controlled by electronic program controller means.

9. The process of Claim 4 controlled by electronic program controller means.

10. The process of Claim 7 controlled by electronic program controller means.



11. The process of Claim 1 wherein the total ion chromatogram profile α_1 is that of Figure 8 and the total ion chromatogram profile α_0 is that of Figure 9.

12. The process of Claim 1 wherein the total ion chromatogram profile α_1 is that of Figure 8 and the total ion chromatogram profile α_0 is that of Figure 10.

13. The process of Claim 1 for aromatizing a specific volume V_1 having an ambient temperature T_1 and pressure P_1 with a stable coffee aroma consisting essentially of the sequential steps of:

- (a) providing a mass G of coffee grinder gas in the solid phase at temperature T_0 where T_0 is substantially less than T_1 , said coffee grinder gas having an initial analytical total ion chromatogram profile α_1 ;
- (b) providing a hollow container capable of sustaining a high internal pressure P_2 and having an internal void volume V_2 equipped with spraying means for spraying contents contained within the container into V_1 surrounding the container, said spraying means being so designed that the difference in enthalpies of (i) gas within the container and (ii) gas evolving from the container during a spraying operation is substantially zero;
- (c) cooling the internal void of the container to a temperature T_c wherein $T_c < T_0$; and purging molecular oxygen from the inner void thereof;
- (d) placing said mass G of solid phase coffee grinder gas within the internal volume V_2 of said hollow pressure container;



* C L M S *

- (e) sealing said hollow pressure container containing said mass G;
- (f) warming the thus-sealed hollow pressure container containing said mass G to temperature T_H wherein $T_H \geq T_1$, thereby causing a pressure buildup within said hollow pressure container to a pressure P_2 , with P_2 being in the range of from about 40 psig up to about 2,000 psig;
- (g) storing the pressurized container containing mass G for a period of time θ_s , at the end of which period, the grinder gas has an analytical total ion chromatogram profile α_0 substantially equivalent to α_1 ; and
- (h) engaging said spraying means in said specific volume V_1 whereby said pressurized container is depressurized from P_2 to a pressure at least as great as P_1 and said volume V_1 is aromatized with coffee aroma.

14. The process of Claim 13 wherein step (h) is governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_s} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta - 0.6071 \theta$$


wherein:

ΔA is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ;

V is the void volume of the hollow container;

$\left(\frac{\partial P}{\partial \theta}\right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ;

θ is "time";

θ_1 represents the time during which the grinder gas having a mass G_1 is sprayed into volume V_1 ; and

H is the enthalpy of grinder gas G ;

R is the gas constant in units of liter-atmospheres per mole degree Kelvin; and

P is pressure in units of atmospheres.

15. The process of Claim 13 wherein step (h) is repeated at least once, whereby the pressure P_2 is first diminished to P_2' ; and then P_2' is reduced to P_2'' ; wherein $P_2' > P_1$ and P_2'' is at least as great as pressure P_1 .

16. The process of Claim 15 wherein the repeated steps (h) are governed by the algorithm:

$$\Delta A_M = \sum_{i=1}^n \left\{ 7.8 \times 10^{-3} \int_0^{\theta_i} \left[\frac{46}{R \cdot T} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta \right. \\ \left. - 0.6071 \theta_T \right\}$$

wherein:

ΔA_M is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 during the total of all of the intermittent sprays as well as during the "down time"; wherein



n represents the number of intermittent sprays performed; wherein

θ_i represents the time of each intermittent spray;

θ_T is the total time of the intermittent sprays and the down time between each of the intermittent sprays;

θ is "time"; wherein

R is the gas constant in units of liter-atmospheres per gram mole degree Kelvin; wherein

T is temperature in degrees Kelvin; and wherein

$\left(\frac{\partial P}{\partial \theta}\right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H .

17. The process of Claim 14 governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta}\right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{16}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta}\right)_{T,V,H} \right] - 0.6071$$

wherein:

$$\left(\frac{\partial [\Delta A]}{\partial \theta}\right)_{T,V,H}$$



represents the first partial derivative of the scaled value of aroma, ΔA on a scale of zero up to 10 with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ; wherein R is the gas

constant, 0.08206 liter-atmospheres per mole degree Kelvin; wherein V is volume in liters; wherein the symbol:

$$\left(\frac{\partial P}{\partial \theta} \right)_{T, V, H}$$

represents the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ; wherein θ is "time" and wherein P is "pressure" in atmospheres.

18. The process of Claim 13 wherein the total ion chromatogram profile α_i is that of Figure 8 and the total ion chromatogram profile of α_0 is that of Figure 9.

19. The process of Claim 13 wherein the oxygen is purged from the container void with a substance selected from the group consisting of liquid nitrogen and liquid carbon dioxide.

20. The process of Claim 13 wherein the total ion chromatogram profile α_i is that of Figure 8 and the total ion chromatogram profile of α_0 is that of Figure 10.

21. The process of Claim 13 controlled by electronic program controller means.

22. The process of Claim 15 controlled by electronic program controller means.

23. The process of Claim 15 wherein the spraying means is a solenoid-controlled spray valve.

24. The process of Claim 23 controlled by electronic program controller means.



25. The process of Claim 1 for aromatizing a specific volume V_1 having an ambient temperature T_1 and pressure P_1 with stable coffee aroma consisting essentially of the sequential steps of:

- (a) providing a mass G of coffee grinder gas in the solid phase at temperature T_0 where T_0 is substantially less than T_1 , said coffee grinder gas having an initial analytical total ion chromatogram profile α_1 ;
- (b) providing a first hollow container capable of sustaining a high internal pressure P_2 and having an internal void volume V_2 and having attachment means associated therewith for attachment to manifold means wherein P_2 is substantially greater than P_1 ;
- (c) providing said manifold means (i) having attachment means for attaching said manifold means to said first hollow container and (ii) having attached thereto a multiplicity of second hollow containers, each capable of sustaining a high internal pressure P_3 , each having an internal volume V_3 ; and each equipped with spraying means for spraying contents contained within each of said hollow containers into a volume V_1 surrounding each of said second containers, said spraying means being so designed that the difference in enthalpies of (i) gas within the second container and (ii) gas evolving from the second container during a spraying operation is substantially zero wherein $P_2 > P_3 > P_1$;
- (d) sealably attaching the manifold means to the first hollow container;
- (e) cooling the internal void of said first hollow container to a temperature T_c wherein $T_c < T_0$; and purging oxygen from the inner void thereof;



- (f) placing said mass G of solid phase coffee grinder gas within the internal volume V_2 of said first hollow container;
- (g) isolatably sealing said first hollow container containing said mass G ;
- (h) warming the thus-isolatably sealed hollow first container containing said mass G to temperature T_H wherein $T_H \geq T_1$, thereby causing a pressure buildup within said hollow void of said first container to a pressure P_2 , with P_2 being in the range of from about 700 psig up to about 2,000 psig;
- (i) purging oxygen from the inner voids of each of said second hollow containers; and reducing the internal pressure of the inner voids of each of said hollow containers to a pressure P_4 wherein $P_4 < P_1$;
- (j) causing at least a portion fG of said mass G to flow from said first container into at least one of said second containers thereby causing a pressure buildup within said at least one of the hollow voids of said second containers to a pressure P_3 with P_3 being from about 40 psig up to about 350 psig wherein $f \leq 1$ and is the mass fraction of G moved from said first container to at least one of said second containers; and the amount of coffee grinder gas in said at least one of said second containers is:

$$\frac{fG}{N}$$



wherein N is the number of second containers into which the coffee grinder gas is placed;

- (k) sealably detaching said at least one of said second containers from said manifold means whereby the

pressure of the inner void of said second hollow container is maintained at about P_3 ;

- (l) storing said at least one of said second containers containing mass:

$$\frac{fG}{N}$$

for a period of time θ_s , at the end of which which period, the grinder gas contained within the void of the second container has a total ion chromatogram profile α_0 substantially equivalent to α_1 ; and

- (m) engaging said spraying means on said at least one of said second containers whereby said at least one of said second containers is depressurized from P_3 to a pressure at least as great as P_1 and said volume V_1 is aromatized with coffee aroma.

26. The process of Claim 25 wherein the step (m) is governed by the algorithm:

$$\Delta A = 7.8 \times 10^{-3} \int_0^{\theta_s} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta - 0.6071 \theta$$



wherein:

ΔA is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ;

V is the void volume of the hollow container;

$\left(\frac{\partial P}{\partial \theta} \right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ;

θ is "time";

θ_1 represents the time during which the grinder gas having a mass G_1 is sprayed into volume V_1 ; and

H is the enthalpy of grinder gas G ;

R is the gas constant in units of liter-atmospheres per mole degree Kelvin; and

P is pressure in units of atmospheres.

27. The process of Claim 25 wherein step (m) is repeated at least once for at least one of said second containers whereby pressure P_3 is first diminished to P_3' ; and then P_3' is reduced to P_3'' wherein $P_3' > P_1$ and P_3'' is at least as great as P_1 .

28. The process of Claim 27 wherein the repeated steps (m) are governed by the algorithm:

$$\Delta A_m = \sum_{i=1}^n \left\{ 7.8 \times 10^{-3} \int_0^{\theta_i} \left[\frac{46}{RT} (V + 0.5) \left(\frac{\partial P}{\partial \theta} \right)_{T,V,H} \right] d\theta \right\}$$

$$- 0.6071 \theta_T$$

wherein:



ΔA_M is a scaled value on a scale of zero up to 10, with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ;

R is the gas constant, 0.08206 liter-atmospheres per gram mole degree Kelvin; wherein

T is temperature in degrees Kelvin; wherein

V is volume; wherein the symbol:

$\left(\frac{\partial P}{\partial \theta}\right)_{T,V,H}$ is the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ; wherein

θ is "time"; wherein

θ_1 is the time during which the grinder gas having a mass G_1 is sprayed into volume V_1 per intermittent spray; wherein

n is the number of intermittent sprays; and wherein

θ_T is the total amount of time over which the total number of sprays is effected and represents down time as well as spraying time.

29. The process of Claim 26 governed by the additional algorithm:

$$\left(\frac{\partial [\Delta A]}{\partial \theta}\right)_{T,V,H} = 7.8 \times 10^{-3} \left[\frac{46}{RT} (V+0.5) \left(\frac{\partial P}{\partial \theta}\right)_{T,V,H} \right] - 0.6071$$

wherein:

$$\left(\frac{\partial [\Delta A]}{\partial \theta}\right)_{T,V,H}$$

represents the first partial derivative of the scaled value of aroma, ΔA on a scale of zero up to 10 with "10" being the best value of coffee aroma quality, substantivity and strength imparted to said volume V_1 ; wherein R is the gas constant, 0.08206 liter-atmospheres per mole degree Kelvin; wherein V is volume in liters; wherein the symbol:



$$\left(\frac{\partial P}{\partial \theta}\right)_{T, V, H}$$

represents the first partial derivative of pressure with respect to time of the grinder gas within the void of the hollow container at constant temperature T , constant volume V and constant enthalpy H ; wherein θ is "time" and wherein P is "pressure" in atmospheres.

30. The process of Claim 25 wherein at least one of the spraying means associated with said second containers is a solenoid-controlled spray valve.

31. The process of Claim 25 controlled by electronic program controller means.

32. The process of Claim 27 controlled by electronic program controller means.

33. The process of Claim 30 controlled by electronic program controller means.

34. A hollow container having an internal void volume V_2 containing a stable mass of coffee grinder gas G_0 , said internal void volume being substantially free of molecular oxygen at a pressure P_2 in the range of from about 40 psig up to about 2,000 psig at a temperature in the range of from about 20°C up to about 40°C and equipped with spraying means for spraying the contents of said container into the environment surrounding said container, said environment having a pressure of about zero psig and a temperature of from about 20°C up to about 40°C.

35. The hollow container of Claim 34 wherein the coffee grinder gas contains from about 92 up to about 98 weight percent CO_2 .



36. Apparatus for effecting aromatization of a specific volume having a pressure of about zero psig and a temperature of from about 20°C up to about 40°C with a stable coffee aroma comprising:

- (a) coffee grinder gas supplying means for supplying coffee grinder gas to sealable coffee grinder gas holding means;
- (b) cooling means to maintain coffee grinder gas being supplied from said supply means to said sealable holding means at or below the sublimation temperature of CO₂ at a pressure of about zero psig;
- (c) sealable coffee grinder gas holding means having an inner void volume to hold coffee grinder gas under a pressure of from about 40 psig up to about 2,000 psig and capable of withstanding a pressure of from about 40 psig up to about 2,000 psig; and
- (d) spraying means for spraying stable coffee grinder gas held under a pressure of from about 40 psig up to about 2,000 psig in said holding means into said specific volume;

whereby the total ion chromatogram of the coffee grinder gas supplied by said supplying means α_1 is substantially identical to the total ion chromatogram of the coffee grinder gas sprayed by engaging said spraying means α_0 .

37. The apparatus of Claim 36 wherein the sealable coffee grinder gas holding means of (c) has sealably attached thereto said spraying means of (d).

38. The apparatus of Claim 36 wherein the sealable coffee grinder gas holding means of (c) comprises:

- (c-1): sealable first hollow container means capable of sustaining a pressure in the range of from about 700 psig up to about 2,000 psig;



(c-2): attached to said sealable first hollow container means, manifold means for distributing stable coffee grinder gas to at least one of a multiplicity of second hollow container means, each of which is capable of sustaining a pressure of from about 40 psig up to about 350 psig; and

(c-3): detachably attached to said manifold means, said multiplicity of second hollow container means;

and wherein said spraying means comprises a multiplicity of separate spraying means (i) each of which is sealably attached to one of said multiplicity of second hollow container means and (ii) each of which is capable of spraying stable coffee grinder gas into said specific volume.

39. The apparatus of Claim 36 wherein the spraying means comprises an automatic timer-actuated solenoid valve for automatically effecting pulsed time-series spraying of coffee grinder gas into said specific volume.

40. The apparatus of Claim 38 wherein the spraying means comprises an automatic timer-actuated solenoid valve for automatically effecting pulsed time-series spraying of coffee grinder gas into said specific volume.

41. The apparatus of Claim 36 controlled by electronic program controller means.

42. The apparatus of Claim 38 controlled by electronic program controller means.

43. The apparatus of Claim 39 controlled by electronic program controller means.

44. The apparatus of Claim 40 controlled by electronic program controller means.

