Title: SOLIDIFIED AND SHELLED ALCOHOLS

Abstract: Alcohols effectively solidified by using various hydroxides in combination with different cellulose compounds, and also, alcohols effectively solidified by using various cyanoacrylate monomers in combination with different cellulose compounds. The cyanoacrylate reactions complete very rapidly in seconds and generally release large amounts of heat. Suitable additives are added to slow down the reactions for gradual heat dissipation and easy manipulation. The alcohol liquids can be solidified as well. Solid alcohol blocks and alcohol gels may be shelved by dipping into cyanoacrylate and coating them with a cyanoacrylate shell for long term storage.
Solidified and Shelled Alcohols

FIELD OF THE INVENTION

[001] This invention relates to solidified and "shelled alcohols." This invention relates to jellification of alcohols utilizing (first method) hydroxide solution and modified cellulose; and also utilizing (second method) cyanoacrylates and modified cellulose. It relates to the dipping of alcohol compositions, resulting from the application of the first or second methods, into cyanoacrylate solvent to form a shell on the alcohol composition, to prevent evaporation. It relates to the use of compounds with an acetone structure to slow down the rate of the second (cyanoacrylate) method. It also relates to these alcohol compositions as carriers for chelated metals complexes, which these metal complexes may burn with different colored flames; and as carriers for different incenses. This invention also relates to condensed fuels for cooking and heating. It also relates to solid transparent plastic.

[002] This invention relates to gelled organic liquids where the structure of the organic liquids have been changed from free flowing liquids to liquids that do not flow and are considered solids under ASTM D4359-84. More particularly, this invention relates to organic liquids that can be used as fuels that are gelled to the extent that they are considered to be solids under ASTM D4359-84.
BACKGROUND OF THE INVENTION

[003] Polymer gels consist of cross-linked macromolecules that form a three dimensional network in which solvent molecules are absorbed by osmotic forces.

[004] There are several advantages of absorbing organic liquids into gels. For example, the liquid can be transformed into a soft solid by entrapping into a three dimensional matrix of a gel. Soft solids have typical properties that are intermediate between solids and liquids. For example, gelled organic liquids can have a high viscosity as well as a finite deformation modulus. It is easier to apply an organic liquid to a surface in a thickened condition rather than as a free flowing liquid. This is particularly the case with vertical surfaces. Products that are usefully thickened include organic based paints, paint and corrosion removers, nail polish removers, pastes, lotions, creams, salves, shampoos, household and commercial cleaners, oil drilling fluids, fuels and charcoal lighter fluids.

[005] Gelled fuels are particularly useful for cooking and chafing dishes. They are easier and safer to transport and are more effective owing to the slower diffusive release of the fuel from the gelled matrix. Such gelled fuels typically contain an alcohol, usually methanol or ethanol as the fuel, which may be mixed with other C1 to C6 alcohols. It is desirable to gel the fuel in such a manner that it does not
separate from the matrix on standing or on application of pressure. There are yet many other uses for thickened organic liquids. When the organic liquid is gelled, it will also have a significantly reduced rate of evaporation. Gelled fuels in transport vehicles reduce the risk of fire in an accident.

[006] Jellifying organic solvents has proceeded in different ways. In some cases, alcohol molecule were retained inside some salt precipitation, in other cases, nitrocellulose were used for holding the organic solvents. More recently, a long chain anionic polymer such as polyacrylic acid polymer have been used to crosslink the organic solvent molecule.

[007] One motivation for jellifying organic solvents, for example, is that it is easier to apply tan organic solvents to a surface in a thickened form rather than as a free flowing liquid. This is particularly true with respect to a vertical surface, for example, a wall. There are many other uses for thickened organic solvents. Paint, corrosion remover, household cleaner and charcoal lighter fluids include some of the areas for a thickened organic solvent.

[008] The gelled fuel, moreover, will retard the speed of evaporation and increase the effectiveness of burning. The gelled fuel also acts to decrease the amount of organic solvent in air. It has been found to reduce accidental fire hazards because, for example, the bulk of fuel will be inside the matrix instead of fully exposed and available to the flame, being easier to put out.
[009] A problem arises in applying the gels, is the lack of sufficient substantive structure (hardness), i.e., the gel preferably needs a very high viscosity of the gel itself. A solidified alcohol would tend to solve this problem.

[0010] Gelled fuels may be used for cooking and heating foods. A difficulty may arise when a soft gel melts during the burning process. For indoor cooking it is preferred to have smoke-free fuels such as methanol and ethanol. Again, a solidified alcohol would tend to solve this problem.

[0011] Fuels to be effectively used without a wick to deliver the fuel to a burn surface must be gelled. The fuel must not separate from the gel on standing or upon the application of pressure. The primary reason is safety. If a gelled fuel is classified as a solid under ASTM D4359-84 it will be subject to less vigorous regulations for transport and storage. A solidified gel would tend to solve this problem.

[0012] Alcohol based gels have been formed by different gelling agents. In U.S. Patent No. 3,148,958 there is disclosed the gelling of an alcohol fuel through the use of carboxy vinyl polymers neutralized with a weak amine base. In U.S. Pat. No. 3,214,252 there is disclosed the use of olefin-maleic anhydride copolymers as gelling agents for alcohols. U.S. Patent No. 3,754,877 discloses the use of olefin modified hydroxyl alkyl cellulose as the gelling agent. U.S. Patent No. 3,759,674 discloses the dispersions of ethylene-acrylic acid copolymers and amine emulsifiers in water, which form gels when mixed with alcohols. U.S. Patent No. 4,261,700 and U.S. Patent No. 4,365,971 each disclose the use of
a Carbopol 934 ethylene acrylic acid copolymer gelling agent for an alcohol fuel. The Carbopol 934 is neutralized to form the gel using a weak amine base. U. S. Patent No. 4,436,525 discloses the gelling of a 3:1 mixture of methyl alcohol and isopropyl alcohol with a fatty acid soap and sodium hydroxide. U. S. Patent No. 5,641,890 discloses the use of an amine neutralized anionic polymer such as Carbopol 676 along with an amphoteric rheological additive such as dispersed alumina for gelling alcohol. U. S. Patent 6,794,467 B2 discloses a process for the preparation of polymeric absorbents useful for gelling organic liquids.

[0013] In U. S. Patent No. 4,536,188, the incorporation of alcohol soluble metal compounds to increase the visibility of flame was disclosed.

**BRIEF SUMMARY OF THE INVENTION**

[0014] This invention comprises alcohols effectively solidified by using various hydroxides in combination with different cellulose compounds, and also, alcohols effectively solidified by using various cyanoacrylate monomers in combination with different cellulose compounds. The cyanoacrylate reactions complete very rapidly in seconds and generally released with large amounts of heat. Suitable additives are added to slow down the reactions for gradual heat dissipation and easy manipulation. The alcohol liquids can be solidified as well. Solid alcohol blocks and alcohol gels may be shelled by dipping into cyanoacrylate and coating them with a cyanoacrylate shell for long term storage.
[0015] The invention comprises solid alcohols and shelled alcohols. A first alcohol composition solid is formed from a first reaction of a relatively small amount of sodium hydroxide or potassium hydroxide mixed with a suspension solution of modified cellulose polymer and an alcohol at low temperature.

[0016] A second alcohol composition solid may be formed from a second reaction of cyanoacrylate monomer mixed with a suspension solution of modified cellulose polymer and alcohol at low temperature. A third alcohol composition solid may be formed from a third reaction which is the second reaction modified with the addition of acetone-structure-containing compounds in the cyanoacrylate solvent, which are mixed with a solution of a suspension of modified cellulose polymer and alcohol, at room temperature. Acetone structure-containing compounds may be selected from a group including pyridine, borate, bromocresol purple, amidoback, and dimethylsulfoxide and other similar compounds containing acetone- like( CH3C=O ) structure.

[0017] The invention further comprises shelled alcohols: a coated, or shelled, alcohol-containing gel formed by dipping an alcohol-containing gel in a cyanoacrylate. The coating forms a relatively impervious shell, i.e., impervious to the evaporation of alcohol molecules. Wax granules may be added to the various reactions for forming the different solids in order to improve the smoothness of the respective solid's surface.

[0018] This invention further comprises organic liquids that can be used as fuels that are gelled to the extent that they are considered to be solids under ASTM D4359-84.
DETAILED DESCRIPTION OF THE INVENTION

[0019] The invention comprises solid alcohols and shelled (coated) alcohols.

[0020] The present invention is directed to produce solids and/or gels. This invention is directed to gelled organic liquids where the structure of the organic liquids have been changed from free flowing liquids to liquids that do not flow and are considered solids under ASTM D4359-84.

[0021] This invention comprises a very rigid polymer matrix and a highly sticky gel shelled with the hard polymer matrix. This invention comprises a shelled alcohol gel or shelled alcohol solid which allows for storage of chemical energy for very long period, with almost no evaporation of the alcohol gel or alcohol solid.

[0022] Solid or gelled alcohol compositions are formed by a first method, a second method, and a third method. The shelled alcohols are formed by a fourth method. In a first aspect of the invention, a solid or gelled alcohols composition is formed by mixing an alcohol, a modified cellulose solution suspension, and a weak solution of an alkali such as sodium or potassium hydroxide.

[0023] In a second aspect of the invention, a solid or gelled alcohol compositions is formed from a first reaction of
cyanoacrylate monomer mixed with a suspension solution of modified cellulose polymer and alcohol at low temperature.

[0024] In a third aspect of the invention, which is a variation of the second aspect, a solid or gelled alcohol composition is formed from a reaction that also includes the addition of acetone-structure-containing compounds to the cyanoacrylate solvent, which is then mixed with a solution of a suspension of modified cellulose polymer and alcohol, at room temperature. Acetone (CH₃C=OCH₃) structure (CH₃C=O) containing compounds include pyridine, borate, bromocresol purple, amidoblack, and dimethylsulfoxide.

[0025] In a first preferred embodiment of this invention, a first alcohol composition is formed, comprising an alcohol with at least one carbon atom and containing a suspension of modified cellulose of about 1 to 13 per cent by weight which has been cross-linked by a metal hydroxide, where the metal hydroxide is about $2.5 \times 10^{-5}$ to $1.25 \times 10^{-3}$ per cent by weight, and distilled water of about 2 to 5 per cent by weight, where the distilled water increases the transparency of the alcohol gel.

[0026] An alcohol selected for use in the reactions herein includes simple alcohols (such as methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, butyl alcohol, pentyl alcohol, isobutyl alcohol, allyl alcohol, furfural), cyclic alcohols (cyclohexanol), aromatic ring containing alcohols (benzyl alcohol), diols (such as ethylene diols, propylene diols, butylene diols, diethylene glycol) and polyethylene glycols.
[0027] The modified cellulose selected for use in the reactions herein includes methyl cellulose and carboxyl cellulose.

[0028] The metal hydroxide selected for use in reactions herein includes sodium hydroxide and potassium hydroxide.

[0029] The cyanoacylates include all available cyanoacrylates including commonly used methyl cyanoacrylate and ethyl cyanoacrylates.

Example 1:

[0030] About 500 ml of methyl alcohol is mixed with a suspension solution of methyl cellulose which is 30 g, by weight (range: 5g to 50 g, preferably 25 to 35 g) and reacted with sodium hydroxide, which is 0.01 g by weight (range 0.01 to 0.2 g, preferably 0.01 to 0.5 g) and 10 ml of distilled water (range 10 ml to 20 ml, preferably 10 ml). The temperature of the reaction which produces this first alcohol composition is about 20°C (range: 10°C to 70°C, preferably 20°C) at a pressure of about 1 atmosphere.

[0031] To reduce smokiness of the resultant alcohol gel fuel, a low order alcohol, such as methanol or ethanol may be used.

[0032] In order to color the flame as the gelled/solid fuel burns, an agent which will burn with a color is added to the reaction which produces the gel/solid fuel. A metal atom carried in solution by a chelating agent, for example, ethylenediamminetetraacetate ion EDTA4-
EDTA forms very stable complexes with most of the transition metals. This hexadentate ligand forms very stable complexes (usually octahedral structures) with most of the transition metals. The donor atoms in EDTA are the two N atoms, and the four, negatively charged O atoms.

EDTA4-:

EDA-metel complexes will dissolve in an organic fluid and will burn with the characteristic color of the metal atom in a flame.

Example 2:
To form a variation of the first alcohol composition which may burn with a colored flame, ethyl alcohol (500 ml), a relatively small amount of an EDTA-metal complex and a suspension of methyl cellulose (30 g) (range: 5g to 50 g, preferably 25 to 35 g) are mixed with potassium hydroxide (.01 g) (range 0.01 to 0.2 g, preferably 0.01 to 0.5 g) and distilled water (15 ml) (range: 10 ml to 20 ml water), which ingredients react with cross linkages to form an alcohol gel in which the water acts to increase the transparency of the alcohol gel. This first variation alcohol composition formation is carried out at a temperature of
20°C, (range: 10°C to 70°C, preferably 20°C) and a pressure of about one atmosphere.

[0036] In a second preferred embodiment of this invention, a second alcohol composition comprising an alcohol with at least one carbon atom and containing a suspension of modified cellulose of about 1 to 13 per cent by weight which has been cross-linked a cyanoacrylate, where the cyanoacrylate to alcohol volume ratio is 1:1 with a with a range of 1:5 to 5:1.

[0037] The mixing of alcohol and cyanoacrylate may be done with equal volume of each reagent. However in applications the alcohol/cyanoacrylate ratios may be varied in a range from 1:5 to 5:1 depending upon which alcohol or cyanoacrylate is used. The basic reaction rates may be controlled by utilizing low temperature and adding specific chemicals.

**Example 3:**

[0038] About 500 ml of ethyl alcohol is mixed with a suspension solution of ethyl cellulose which is about 30 g, by weight (range: 5g to 50 g, preferably 25 to 35 g) and reacted with ethyl cyanoacrylate, which is in about a 1:2 ratio by volume, i.e., 250 ml (with a range about 5:1 to 1:5 by volume). The temperature of the reaction which produces this second alcohol composition is about 10°C (range: 1°C to 15°C) at a pressure of about 1 atmosphere.

[0039] In a third preferred embodiment, the alcohol gel and the reaction may be modified with the addition of acetone.
structure containing compounds in cyanoacrylate solvent. The reaction of such solution with suspension of modified cellulose polymer and alcohol is then performed at room temperature. The reaction may be much slower and more easily controlled. The alcohol gel structure retains cross-linkage from the cyanoacrylate reacted more slowly the alcohol suspension of a modified cellulose.

[0040] Acetone structure containing compounds include the addition of the following compounds: pyridine, borate, bromocresol purple, amidoblock, and dimethylsulfoxide and other similar compounds containing acetone-like

\[
\begin{align*}
R \\
\text{CH}_3\text{C}=&\text{O}
\end{align*}
\]

structure, where for acetone, \( R \) is \( \text{CH}_3 \).

**Example 4:**

[0041] About 500 ml of methyl alcohol is mixed with a suspension solution of carboxyl cellulose, which is about 30 g. by weight (range: 5g to 50 g, preferably 25 to 35 g) and reacted with methyl cyanoacrylate which contains a small amount of pyridine, which is in about a 1:1 ratio by volume, i.e., 500 ml, (with a range about 5:1 to 1:5 by volume). The temperature of the reaction which produces this third alcohol composition is about 22°C (preferably room temperature with some range, about 5°C to 70°C) at a pressure of about 1 atmosphere.

[0042] The invention further comprises shelled alcohols, a coated, or shelled, alcohol-containing gel. Shelled alcohols are formed by dipping an alcohol-containing solid or gel formed from the first
method, the second method or the third method into a cyanoacrylate monomer. Wax granules, dissolvable in a cyanoacrylate, may be added to the second or third reaction for forming the second solid in order to improve the smoothness of the solid’s surface.

[0043] Shelled, or coated, alcohols are formed by the method of dipping the solid or gel from the first method, second method or third method into cyanoacrylate monomer. Reduced evaporation of alcohol from said alcohol solid is achieved by said applied, relatively impervious, cyanoacrylate shell. The cyanoacrylate coating forms a relatively impervious shell, i.e., impervious to the evaporation of alcohol molecules.

[0044] The alcohols and the cyanoacrylates which may be used in these reactions have already been listed above.

[0045] This invention may be applied toward solving some current problems associated with the use of gelled fuels. This invention tends to prevent any substantial loss of solvent by evaporation after long term storage. The shelled alcohols of this invention provide methods and products for achieving this lowered evaporation rate since the cyanoacrylate provides a sealed shell covering which is relatively impervious to evaporating alcohol molecules.

[0046] This invention tends to solve the problem of lack of solidity of the gel by utilizing a solidified alcohol.

[0047] This invention tends to solve the problem when a soft gel melts during the burning process.
[0048] This invention tends to solve the problem of using a fuel to be effectively used without a wick by delivering the fuel to a burn surface. The fuel tends not to separate from the gel on standing or upon the application of pressure since the alcohol solid fume may be classified as a solid under ASTM D4359-84. It will consequently be subject to less vigorous regulations for transport and storage.

[0049] The solidified alcohols have a wide area of application. Three particular areas of usage are: a) as carriers for different incenses; b) as condensed fuels for cooking and heating; and c) as solid transparent plastic.
CLAIMS

WHAT IS CLAIMED IS:

1. A first alcohol composition, comprising:
   an alcohol with at least one carbon atom and containing a suspension of
   modified cellulose of about 1 to 13 per cent by weight which has been cross-
   linked by a metal hydroxide, where the metal hydroxide is about 2.5 X 10-5
   to 1.25 x 10-3 per cent by weight, and distilled water of about 2 to 5 per cent
   by weight, wherein the distilled water increases the transparency of said
   alcohol composition.

2. The composition of claim 1, further comprising:
   a metal atom carried in solution by a chelating agent wherein said
   composition containing said metal complexes will burn
   with a characteristic color of the metal atom in a flame.

3. The composition of claim 2, further comprising:
   EDTA4- as said chelating agent.

4. A method for forming a shell on an alcohol composition, comprising the steps
   of:
   dipping said alcohol composition into a solvent consisting essentially
   of cyanoacrylate monomer wherein coating said alcohol
   composition with cyanoacrylate;
   forming an essentially cyanoacrylate shell on said alcohol composition.
5. A method for using a cyanoacrylate shell to reduce evaporation, comprising the steps of:
   applying said cyanoacrylate shell to an alcohol solid;
   reducing evaporation of alcohol from said alcohol solid wherein said cyanoacrylate shell is relatively impervious to the evaporation of alcohol molecules.

6. A method for making a first alcohol composition, comprising the steps of:
   providing a suspension solution of modified cellulose polymer and alcohol;
   mixing a metal hydroxide solution with said suspension solution; and adding distilled water to add transparency of the gel.

7. The method of claim 6, further comprising the steps of: selecting said alcohol from a group consisting of methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, butyl alcohol, pentyl alcohol, hexanol, isobutyl alcohol, allyl alcohol, furfural, cyclohexanol, benzyl alcohol, ethylene diols, propylene diols, butylene diols, diethylene glycol, polyethylene glycols, and polyols.

8. The method of claim 7, further comprising the step of: selecting a low order alcohol, said alcohol selected from the group consisting of methanol and ethanol wherein the smokiness of said alcohol composition, used as a fuel, may be reduced.
9. The method of claim 6, further comprising the step of: selecting said modified cellulose polymer from a group consisting of methyl cellulose polymer and carboxyl cellulose polymer.

10. The method of claim 6, further comprising the step of: producing said alcohol composition as a solid.

11. The method of claim 6, further comprising the step of: producing said alcohol composition as a gel.

12. The method for of claim 6, further comprising the steps of:
   dipping said alcohol composition into a solvent consisting essentially of cyanoacrylate monomer therein coating said alcohol composition with cyanoacrylate;
   forming an essentially cyanoacrylate shell on said alcohol composition.
13. A second alcohol composition, comprising:
   an alcohol with at least one carbon atom; a modified cellulose of about 1
to 13 per cent by weight which has been cross-linked; a cyanoacrylate,
wherein the cyanoacrylate to alcohol volume ratio is 1:1, with a ratio
range of 1:5 to 5:1 by volume.

14. A method for making a second alcohol composition, comprising the steps of:
   providing a suspension solution of modified cellulose polymer and
   alcohol;
   mixing cyanoacrylate monomer solvent with said suspension solution;
   slowing rate of a reaction of said cyanoacrylate and said suspension
   solution by maintaining a low temperature.

15. The method of claim 14, further comprising the step of: selecting said alcohol
   from a group consisting of methyl alcohol, ethyl alcohol, propyl alcohol,
   isopropyl alcohol, butyl alcohol, pentyl alcohol, hexanol, isobutyl alcohol,
   allyl alcohol, furfural, cyclohexanol, benzyl alcohol, ethylene diols,
   propylene diols, butylene diols, diethylene glycol, polyethylene glycols,
   and polyols.

16. The method of claim 14, further comprising the step of: selecting said
   cyanoacrylate from a group consisting of methyl cyanoacrylates and ethyl
   cyanoacrylates.

17. The method of claim 14, further comprising the step of: selecting said cellulose
   polymer from a group consisting of methyl cellulose and carboxyl
   cellulose.
18. The method of claim 14, further comprising the step of: producing said alcohol composition as a water-free alcohol gel.

19. The method of claim 14, further comprising the step of producing said alcohol composition as a solid.

20. The method of claim 19, further comprising the step of: adding dissolvable wax granules to said cyanoacrylate solvent wherein said solid forms with a smoother surface.

21. The method of claim 14, further comprising the steps of:
   dipping said alcohol composition into a solvent of cyanoacrylate monomer therein coating said alcohol composition with cyanoacrylate; and forming a cyanoacrylate shell on said alcohol composition.

22. A method for making a third alcohol composition, further comprising the steps of:
   providing a suspension solution of a modified cellulose polymer and an alcohol;
   mixing a cyanoacrylate monomer solvent with said suspension solution;
   slowing rate of a reaction of said cyanoacrylate and said suspension solution with the addition of at least one acetone-structure-containing compound in said cyanoacrylate monomer solvent wherein said reaction may be performed at room temperature.
23. The method of claim 22, further comprising the step of: producing said alcohol composition as a water-free alcohol gel.

24. The method of claim 22, further comprising the step of: producing said alcohol composition as a solid.

25. The method of claim 22, further comprising the steps of:
adding dissolvable wax granules to said cyanoacrylate solvent wherein said solid forms with a smoother surface.

26. The method of claim 22, further comprising the steps of:
dipping said alcohol composition into a solvent consisting essentially of cyanoacrylate monomer therein coating said alcohol composition with cyanoacrylate;
forming an essentially cyanoacrylate shell on said alcohol composition.

27. The method of claim 22, further comprising the step of: selecting said at least one acetone-structure-containing compound from a group consisting of:
pyridine, borate, bromocresol purple, amidoblack, and dimethylsulfoxide.

28. The method of claim 22, further comprising the step of: selecting said alcohol from a group consisting of methyl alcohol, ethyl alcohol, propyl alcohol, isopropyl alcohol, butyl alcohol, pentyl alcohol, hexanol, isobutyl alcohol, allyl alcohol, furfural, cyclohexanol, benzyl alcohol, ethylene diols, propylene diols, butylene diols, diethylene glycol, polyethylene glycols, and polyols.
29. The method of claim 22, further comprising the step of: selecting said cyanoacrylate from a group consisting of methyl cyanoacrylates and ethyl cyanoacrylates.

30. The method of claim 22, further comprising the step of: electing said cellulose polymer from a group consisting of methyl cellulose and carboxyl cellulose.

31. The method of claim 22, further comprising the step of: producing said alcohol composition as a water-free alcohol gel.

32. The method of claim 22, further comprising the step of: producing said alcohol composition as a solid.

33. The method of claim 32, further comprising the step of: adding dissolvable wax granules to said cyanoacrylate solvent wherein said solid forms with a smoother surface.

34. The method of claim 22, further comprising the steps of:
   dipping said alcohol composition into a solvent consisting essentially of cyanoacrylate monomer therein coating said alcohol composition with cyanoacrylate;
   forming an essentially cyanoacrylate shell on said alcohol composition.
35. A method for making a alcohol composition which may burn with a colored flame, comprising the steps of:

selecting an alcohol dissolvable chelating agent;
forming a metal complex with a metal atom;
dissolving said metal complex in said alcohol; and
reacting said alcohol to form a composition chosen from the group consisting of a gel and a solid whereby said composition containing said metal complexes may burn with a characteristic color of the metal atom in a flame.

36. The method of claim 33, further comprising the step of: selecting
37. EDTA- as said chelating agent.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C10L 7/04
US CL : 44/267

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 44/267

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 3,964,880 A (SIEGRIST) 22 June 1976 (22.06.1976), abstract; col. 3, lines 1-13, 16-17 and claims 3 and 9.</td>
<td>1 and 6-11</td>
</tr>
<tr>
<td>X</td>
<td>US 4,575,379 A (BROWNING) 11 March 1986 (11.03.1986), abstract; col. 2, lines 64-67; col 3, lines 5-13, 57-60; col. 4, lines 14-21.</td>
<td>1 and 6-11</td>
</tr>
<tr>
<td>X</td>
<td>US 4,971,597 A (GARTNER) 20 November 1990 (20.11.1990), abstract; col. 1, lines 66-68; col. 2, lines 1-8, 55-65; col. 3, lines 29-37.</td>
<td>1 and 6-11</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search

18 March 2005 (18.03.2005)

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