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NITROCELLULOSE GEL AND METHOD OF PRODUCING

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This invention relates to an improvement in nitrocellulose gels, such, for example, as so-called solidified alcohol used for fuel purposes, and method of producing.

Heretofore it has been known to produce a nitrocellulose gel, as, for example, solidified alcohol, by dissolving an alcohol-soluble type of nitrocellulose in an alcohol at low temperature and bringing the resulting solution to a water content of about 10%. On bringing the mixture to room temperature the mixture gels.

Nitrocellulose gels as heretofore composed and produced have not proved satisfactory, since they are inherently unstable, and on exposure to moderate temperatures will liquefy irreversibly. Liquefaction or syneresis can also be brought about by relatively slight mechanical agitation of the gel.

The lack of stability of nitrocellulose gels as heretofore produced is disadvantageous, due to the fact that by virtue of syneresis the gel often reaches the consumer in a partially liquid condition, in which condition the product will not burn evenly. Further the lack of stability prevents the marketing of the product in the convenient tube form, since mechanical agitation of the product approximating that to which it would be subjected if packed into tubes will cause syneresis.

Now it is the object of this invention to provide combustible nitrocellulose gel, or solidified fuel, free in large measure from syneresis or from a tendency to liquefy on exposure to moderate temperatures and on mechanical agitation, and a method for its production.

In one practical adaptation of this invention the gel is formed by the addition to a substantially anhydrous solution of nitrocellulose in a suitable solvent, of (*a*) a metal, alloy or mixture of metals or alloys and (*b*) a salt in relatively small amounts, either the metal, etc., containing copper or the salt being a copper salt, the procedure being carried out at room temperature.

In preparing one form of nitrocellulose gel in accordance with this invention the nitrocellulose may be of any desired type as to nitrogen content, viscosity, etc., but will desirably be of the type or types used heretofore in making solidified alcohol. The alcohol may be of any desired type adaptable for fuel, as isopropyl, ethyl, methyl, and the like, or mixtures of alcohols.

As the metal, alloy or mixture of metals or alloys, which will desirably be in powdered form, one may use, for example, fine copper dust, copper-containing bronze powders, zinc dust, aluminum powder, etc., etc., while as the salt one may use, for example, a halogen salt, an acetate, sulfate, etc., as, for example, a chloride bromide, acetate or the like of copper, iron, zinc, aluminum, mercury, nickel, chromium, cobalt, manganese, calcium, magnesium, etc., etc., or mixtures thereof.

It will be noted that either the metal, etc., or the salt, or both, will contain copper. Otherwise the gelling agents and the amounts and relative proportions thereof may be chosen within wide limits, it being only desirable to keep the amount of the gelling agents at a minimum consistent with obtaining gels of maximum desired stability.

As more specifically illustrative of the practical adaptation of this invention gels of desired stability may be made on the following formulae:

Formula A

	Parts by weight
Alcohol soluble 40 second nitrocellulose	5.0
Anhydrous ethyl alcohol	95.0
Copper bronze powder	.04
Copper chloride	.04

Formula B

	Parts by weight
Ester soluble 40 second nitrocellulose	5.0
Anhydrous ethyl alcohol	90.0
Acetone	5.0
Copper bronze powder	.04
Copper chloride	.04

Formula C

	Parts by weight
Alcohol soluble 15 second nitrocellulose	6.0
Anhydrous ethyl alcohol	94.0
Zinc dust	.06
Copper chloride	.04

Instead of using anhydrous ethyl alcohol, as in the above examples, we may use in place thereof acetone, ethyl-methyl ketone, diethyl ketone, etc., methyl, ethyl, isopropyl acetate, or mixtures of ethyl ether, isopropyl ether, etc. with any suitable monohydric alcohol. Thus, for example, any of the above solvents may be substituted in Formula A for the anhydrous ethyl alcohol used therein.

In making up the gels according to the above formulae, for example, the nitrocellulose will be dissolved in a part of the solvent and the copper bronze powder thoroughly agitated into the solution formed, then the copper chloride in solution

in the remaining solvent added and mixed in, all without cooling or at room temperature, say a temperature within about the range 15–30° C. The gelling will occur, at room temperature, in from one-half to eighteen hours depending upon the amount of gelling agent used, and by way of example will occur in about two hours in the case of Formula A above.

The gels, in accordance with this invention, will be found to have high stability, to be remarkably resistant to mechanical action and to be heat reversible if exposed to temperatures below 50° C. The method in accordance with this invention will be found to be simple and economical and to possess the advantage that the entire operation will be carried out at room temperature as compared with the necessity in prior methods for refrigeration and heating.

It will be understood that where in the claims appended hereto the term "copper" is used, such is intended to embrace and include copper metal per se or alloyed and copper salts as equivalents within the scope of this invention.

What we claim and desire to protect by Letters Patent is:

1. A stable nitrocellulose gel including nitrocellulose, a nitrocellulose solvent, finely divided metal powder non-reactive with the nitrocellulose solvent and a metallic salt non-reactive with and soluble in the nitrocellulose solvent, either the metallic powder or the metallic salt including copper.

2. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper and a metallic salt non-reactive with respect to and soluble in the nitrocellulose solvent.

3. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, a metal non-reactive with the nitrocellulose solvent and a copper salt.

4. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper and a metallic halide soluble in the nitrocellulose solvent.

5. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper and a metallic acetate soluble in the nitrocellulose solvent.

6. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, a metal non-reactive with the nitrocellulose solvent and a copper halide.

7. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, a metal non-reactive with the nitrocellulose solvent and a copper acetate.

8. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, a metal non-reactive with the nitrocellulose solvent and copper chloride.

9. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper bronze and a metallic salt non-reactive with respect to and soluble in the nitrocellulose solvent.

10. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper bronze and a metallic halide soluble in the nitrocellulose solvent.

11. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper bronze and copper chloride.

12. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, zinc dust and copper chloride.

13. The method of making a nitrocellulose gel comprising the addition to a solution of nitrocellulose in a solvent therefor, of a finely divided metallic powder non-reactive with the nitrocellulose solvent and a metallic salt non-reactive with respect to and soluble in the nitrocellulose solvent, one of which contains copper, and allowing the mixture to stand until gelation occurs.

14. The method of making a nitrocellulose gel comprising the addition at room temperatures to a solution of nitrocellulose in a solvent therefor, of a finely divided metallic powder non-reactive with the nitrocellulose solvent and a metallic salt non-reactive with respect to and soluble in the nitrocellulose solvent, one of which contains copper, and thereupon allowing the mixture to stand at room temperature until gelation occurs.

15. The method of making a nitrocellulose gel comprising the addition to a solution of nitrocellulose in a solvent therefor, of a finely divided metallic powder non-reactive with the nitrocellulose solvent and a metallic salt non-reactive with the nitrocellulose solvent in solution in a solvent miscible with the nitrocellulose solvent, one of the said powder and the said salt containing copper, and allowing the mixture to stand until gelation occurs.

16. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper and a metallic sulphate non-reactive with respect to and soluble in the nitrocellulose solvent.

17. A stable nitrocellulose gel including a nitrocellulose solvent, nitrocellulose a metal non-reactive with the nitrocellulose solvent and copper sulphate non-reactive with respect to and soluble in the nitrocellulose solvent.

18. A nitrocellulose gel including a nitrocellulose solvent, nitrocellulose, copper and copper sulphate.

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