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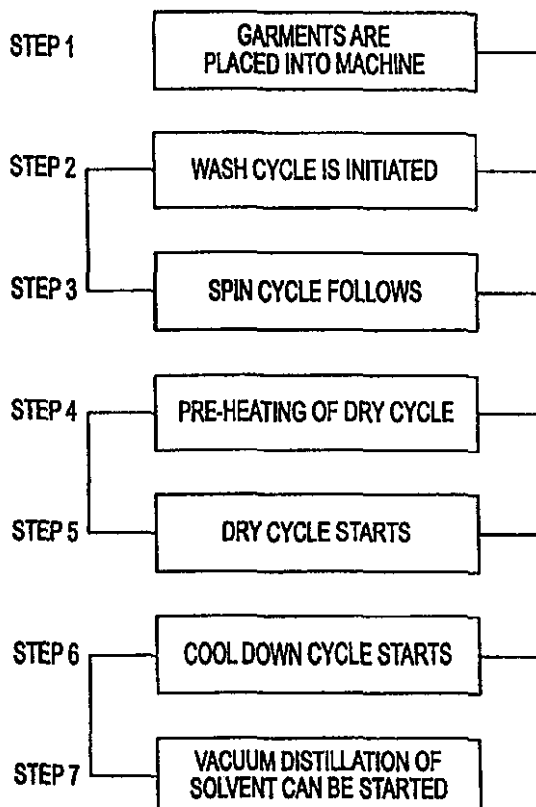
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(21) International Application Number: PCT/US99/15920 (22) International Filing Date: 14 July 1999 (14.07.99) (30) Priority Data: 09/115,352 14 July 1998 (14.07.98) US (71) Applicant: GREENEARTH CLEANING, LLC [US/US]; 3724 West 119th Terrace, Leawood, KS 66209 (US). (72) Inventors: BERNDT, Wolf-Dieter, R.; 895 Apollo Way, P.O. Box 4413, Incline Village, NV 89450 (US). GRIFFIS, John, McLeod; Apartment 5, 2360 Union Street, San Francisco, CA 94123 (US). (74) Agent: STEPHENS, L., Keith; Hickman Stephens & Coleman, LLP, P.O. Box 52037, Palo Alto, CA 94303-0746 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report.

(54) Title: DRY CLEANING METHOD AND SOLVENT

(57) Abstract

A dry cleaning system and method comprises specially designed or modified machinery used in conjunction with a cyclic siloxane solvent. In a preferred embodiment, the method comprises the steps of loading articles into a cleaning basket; agitating the articles and the siloxane composition in which they are immersed; removing most of the siloxane composition; centrifuging the articles; subjecting the articles to a partial vacuum pressure and elevated temperature; and removing the articles from the basket after cooling the articles and returning the pressure to ambient.



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DRY CLEANING METHOD AND SOLVENT

BACKGROUND OF THE INVENTION

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FIELD OF THE INVENTION

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This invention is in the general field of dry cleaning of clothing, textiles, fabrics and the like. The invention is more particularly directed to a method and apparatus for dry cleaning fabrics using a solvent not heretofore used in dry cleaning machines. The invention is more particularly directed to a dry cleaning apparatus wherein a silicon-based solvent is utilized which has a desirable flash point rating (over 140 degrees Fahrenheit) and fabric-safe qualities (non-dye pulling and non-shrinkage) together with superior solvency for fatty acids, grease and oils in a specially designed dry cleaning process.

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PRIOR ART

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Dry cleaning is a major industry throughout the world. In the United States alone, there are more than forty thousand dry cleaners (many of these have multiple locations).

The dry cleaning industry is an essential industry in the present economy. Many articles of clothing (and other items) must be dry cleaned in order to remain clean (the removal of body fats and oils), and presentable (do not shrink or discolor clothing).

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The most widely used dry cleaning solvent until now has been Perc. There are numerous disadvantages to Perc including its toxicity and odor. The machinery widely used, until now, has been manufactured specifically for use with Perc. This has been another limiting factor in the industry.

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Another problem in this field is that different fabrics require different handling in the presently used systems in order to prevent damage to the fabrics during the dry cleaning process.

The prior art in dry cleaning includes the use of various solvents with appropriate machinery to accomplish the cleaning. In the most recent past, the solvent most widely used has been perchloroethylene (herein generally referred to as "Perc"). Perc has the advantage of being an excellent cleaning solvent, but the disadvantage of being a major health and environmental hazard (i.e., it has been linked to numerous forms of cancer and it is very destructive to ground water and aquatic life). In some areas Perc is no longer allowed to be used. Additionally, in the past other solvents such as petroleum-based solvents and glycol ethers and esters have been tried and used. These various solvents have been used with mixed cleaning results and problematic fabric/textile compatibility as compared to the results obtained with Perc.

The present invention is distinct from the prior art that it relies upon a non-Perc solvent with superior characteristics as described below, and used in a method involving dry cleaning machinery which has been specially designed for the solvent.

The only use of a cyclic siloxane composition for cleaning purposes is disclosed in U.S. Patent No. 4,685,930 to Kasprzak. However, the disclosure therein is for spot cleaning applications only. There is no disclosure of immersing articles into the cyclic siloxane nor is there any suggestion of using the cyclic siloxane in a dry cleaning machine. Moreover, there is no suggestion of subjecting such articles immersed in cyclic siloxane to agitation, spinning, partial vacuum and heating in a continuous process to dry clean articles in a bulk process for removing fats, oils, grease and other soils from a large number of entire clothing articles.

SUMMARY OF THE INVENTION

The present invention comprises a novel dry cleaning system and method, in which specially designed or modified machinery is used in conjunction with a specific solvent which is derived from an organic/inorganic hybrid (organo silicone). In this class of organo silicones is a group known as cyclic siloxanes. The cyclic siloxanes present the basis for material composition of the solvent chemistry which allows this dry cleaning system to be highly effective. The cyclic-siloxane-based solvent allows the system to result in an environmentally friendly process which is, also, more effective in cleaning fabrics and the like than any known prior system. The siloxane composition is employed in a dry cleaning machine to carry out the method of the invention. In a preferred embodiment, the method comprises the steps of loading articles into a cleaning basket; agitating the articles and the siloxane composition in which they are immersed; removing most of the siloxane composition; centrifuging the articles; subjecting the articles to a partial vacuum pressure and elevated temperature; and removing the articles from the basket after cooling the articles and returning the pressure to ambient.

OBJECTS OF THE INVENTION

It is therefore a principal object of this invention to provide a method of dry cleaning using environmentally friendly solvents and techniques.

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It is another object of this invention to provide a dry cleaning method wherein the articles being cleaned are not harmed by the solvent.

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It is another object of this invention to provide a dry cleaning solvent which does not deposit and or build up in clothing and is also hypoallergenic.

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Another object of this invention is to provide a dry cleaning solvent which has unique flammability characteristics, wherein the flashpoint and fire point are separated by at least 10 degrees Fahrenheit whereby the solvent is self extinguishing between the flashpoint and the firepoint.

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Yet another object of this invention is to provide a dry cleaning solvent which can be heated above room temperature (over 70 degrees Fahrenheit) without causing harm to fabrics which further improves and speeds up the cleaning process.

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Still another object of this invention is to provide a dry cleaning solvent which has a surface tension less than 18 dynes/square centimeter to better penetrate fabric fibers to remove debris to make it easier to remove the solvent from the fabric.

The foregoing and other objects and advantages of this invention will become apparent to those skilled in the art based upon the following description of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWING

The aforementioned objects and advantages of the present invention, as well as additional objects and advantages thereof, will be more fully understood hereinafter as a result of a detailed
5 description of a preferred embodiment when taken in conjunction with the following drawing in which:

FIG. 1 is a block diagram of the steps of the process showing one embodiment of the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The present method of dry cleaning is unique, particularly with the use of a commonly known fluid class of cyclic siloxanes used for cosmetics and topical pharmaceuticals. These cyclic siloxanes are more particularly known as **octamethyl-cyclotetrasiloxane (tetramer)** and **decamethyl-cyclopentasiloxane (pentamer)**. These fluids have never been disclosed as a dry cleaning solvent alternative for use in a dry cleaning machine. Combinations of the above tetramer and pentamer are by themselves not completely suitable for dry cleaning in their pure form. They are modified in the dry cleaning method of the preferred embodiment. The modification is in the form of adding soil suspending additives to prevent redeposition of dirt during the wash and rinse cycle, detergents for water-base stains, and disinfectants for the disinfection of bacteria and other forms of microorganisms which are present in all clothing.

The following steps more specifically describe the dry cleaning method of the preferred embodiment:

At **step 1** garments or other items to be dry cleaned are placed in a vertical combination washer dryer with a horizontally rotating agitating cleaning basket (known to those skilled in the art). The barrel of the basket will have numerous holes or perforations, preferably each hole will be 1/8 to 3/8 inches in diameter.

At **step 2** the wash cycle is initiated with the solvent consisting of a combination of the tetramer and pentamer cyclic siloxane. The preferred combination is 80% tetramer and 20% pentamer by weight. The additives which modify the above mixture may be added separately just before the washing cycle and need not be part of the solvent composition. The use of these additives, namely detergents and suspending agents, allows the solvent to perform a total garment cleaning process. The solvent is pumped from a holding tank into the cleaning basket. The items being cleaned are agitated, such that the mechanical rubbing of the clothes and the infiltrating solvent dissolves and loosens dirt, debris and body fats from the fabric fibers, said agitation lasting from 3 to 10 minutes or more. The solvent is then pumped out of the basket back into the holding tank through a charcoal and/or clay filter system in order to remove the impurities which may have entered the solvent during the washing cycle.

At step 3 the items having been cleaned are spin dried, preferably for about three to five minutes somewhere between 350 to 1000 rpm (revolutions per minute); preferably between 450 to 750 rpm. This operation leaves no more than 3% solvent residue in the items being cleaned. The higher the rpm, the faster the solvent is removed by the centrifugal force of the spinning basket. The very low surface tension of the solvent maximizes the efficacy of solvent removal via this centrifugal spinning process.

At step 4 the garments are tumbled in the basket and heated to a temperature between 120 to 140 degrees Fahrenheit. This is accomplished by passing pressurized steam through a coil which heats up the air inside the basket through the use of a circulating fan. While this is happening, a partial vacuum is created inside the machine at negative pressure between 500 and 600 millimeters of mercury (where atmospheric pressure is 760 mm.). During this heating cycle, the solvent is vaporized and carried by circulating air to a refrigerated condensing coil which condenses the solvent from a vapor to a liquid collected out of the main air stream. In time, typically 15 to 20 minutes, all the solvent is removed from the garments.

At step 5 the heating cycle is stopped and the cooling cycle begins. The temperature is reduced from 140 degrees Fahrenheit to below 100 degrees Fahrenheit. This is accomplished by eliminating the vacuum and circulating the air through the refrigerated coils until the process is complete.

The cleaning process is complete when the garments are removed from the machine at near body temperature or below to reduce secondary wrinkling. Removing the garments at a high temperature would cause wrinkling.

Having thus disclosed a preferred embodiment of the method and apparatus of the present invention, it being understood that the description is only exemplary and not necessarily limiting of the scope of the invention, what is claimed is:

CLAIMS

1. The method of dry cleaning articles comprising the steps of: immersing said articles to be dry cleaned in a dry cleaning fluid containing cyclic siloxane composition; agitating the articles in said composition; and removing said composition from said articles by centrifugal action and heat.

2. A dry cleaning method according to claim 1 wherein the articles being dry cleaned, after having been agitated, but before being centrifuged and heated, are subjected to a vacuum by reducing pressure to lower the flashpoint of the composition.

3. The method recited in claim 1 wherein said cyclic siloxane composition comprises the pentamer and tetramer cyclic siloxane as a solvent for use in the dry cleaning machine.

4. The method recited in claim 1 wherein said cyclic siloxane composition comprises detergent, disinfectant, suspending agents and brighteners.

5. The method of dry cleaning articles comprising: placing articles to be dry cleaned in the cleaning basket of a washer and dryer combination; introducing a cyclic siloxane composition into the cleaning basket; agitating the articles and said composition in the cleaning basket; centrifuging the articles within the cleaning basket to remove the cyclic siloxane composition from the articles; subjecting the articles within the cleaning basket to a partial vacuum; heating the articles within the cleaning basket and under the partial vacuum; cooling the articles; and removing the articles from the cleaning basket.

6. An apparatus for dry cleaning articles; the apparatus comprising:
a dry cleaning machine having a basket for receiving said articles and a source of cyclic siloxane composition; a liquid pump for transferring said composition into said basket; a motor for agitating and spinning said basket; a vacuum pump for subjecting said articles to a partial pressure; and a heater for raising the temperature of said articles.

7. The apparatus recited in claim 6 wherein said composition comprises a mixture of octamethyl-cyclotetrasiloxane and decamethyl-cyclopentasiloxane.

8. The apparatus recited in claim 6 wherein said composition comprises a mixture of at least two forms of cyclic siloxane.

5 9. The apparatus recited in claim 7 wherein said composition further comprises a detergent.

10 10. The apparatus recited in claim 8 wherein said composition further comprises at least one additive taken from the group consisting of detergents, disinfectants, suspending agents and brighteners.

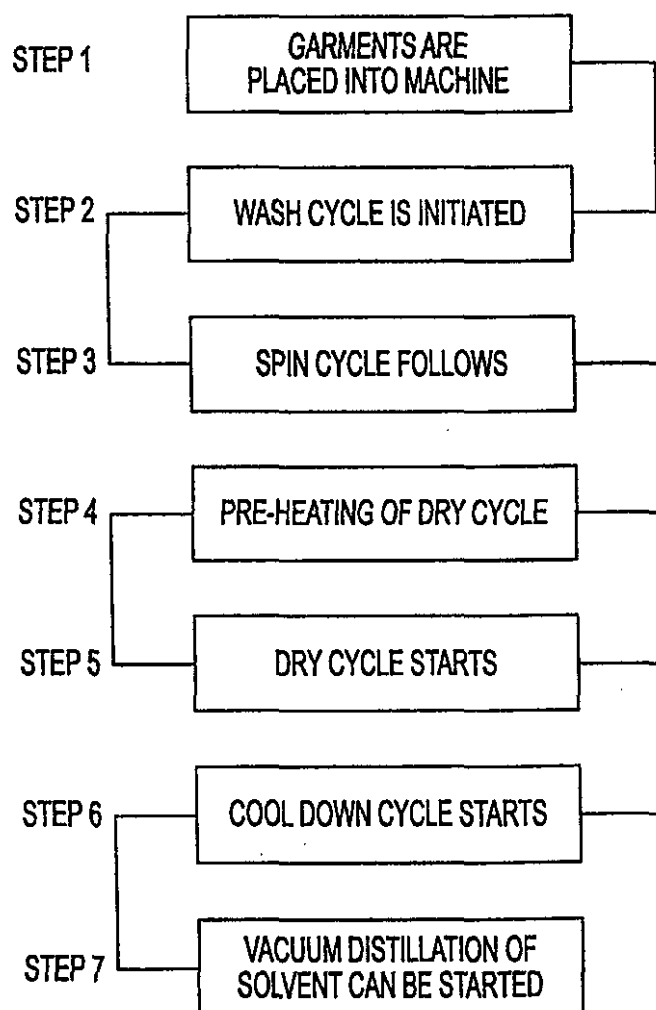


FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 99/15920

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 D06L1/02

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)

IPC 7 D06L D06F

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 37 39 711 A (KREUSSLER CHEM FAB) 8 June 1989 (1989-06-08)	1,3,4
Y	examples 1,2	1-10
X	--- DATABASE WPI Section Ch, Week 198908 Derwent Publications Ltd., London, GB; Class F07, AN 1989-058497 XP002119073 & JP 01 011599 A (FUJISHARYO KK), 17 January 1989 (1989-01-17)	6
Y	abstract	1-10
A	--- US 4 685 930 A (KASPRZAK KENNETH A) 11 August 1987 (1987-08-11) cited in the application claims 1,6 --- -/-	1,3-10

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

15 October 1999

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 301 379 A (SCHAAL ULRICH) 12 April 1994 (1994-04-12) abstract -----	1,2,5,6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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D06L 1/02

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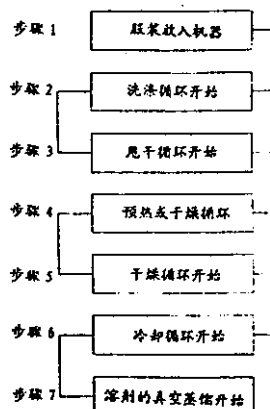
代理人 余 刚

权利要求书 2 页 说明书 5 页 附图页数 1 页

[54]发明名称 干洗方法和溶剂

[57]摘要

一种干洗系统和方法,包括特别设计的干洗机,结合使用一种 环状硅氧烷溶剂。在一个优选实施例中,所述方法包括以下步骤:衣物放入洗涤筐中;浸泡于硅氧烷合成物中,进行搅动;去除大部分硅氧烷合成物;对洗涤物进行离心甩干;将洗涤物置于部分真空中,并提升温度;冷却并恢复压力,取出洗涤物。



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权 利 要 求 书

1. 一种干洗物品的方法，包括如下步骤：将要干洗的洗涤物浸泡于含有环状硅氧烷组分的干洗液中；在所述组分中搅动洗涤物；除去绝大部分硅氧烷组分；用离心甩干、加热的方法除去洗涤物中所述的组分。

2. 根据权利要求 1 的一种干洗方法，所述的进行干洗的衣物，在被搅动之后，被加热甩干之前，提供真空负压，以降低混合物闪点。

3. 根据权利要求 1 中所述的方法，所述的环状硅氧烷合成物包含五聚物、四聚物环状硅氧烷，作为溶剂使用于干洗机中。

4. 根据权利要求 1 中所述的方法，所述的环状硅氧烷混合物，包含清洁剂、消毒剂、悬浮剂和增光剂。

5. 一种洗涤物干洗的方法由以下步骤组成：洗涤物被放入一个垂直的洗涤、干燥一体机的洗涤筐中；向洗涤筐中引入一种环状硅氧烷混合物；搅动所述的洗涤筐中的洗涤物和硅氧烷混合物；对洗涤筐中的洗涤物进行离心甩干，去除洗涤物中的环状硅氧烷混合物；将洗涤筐中的洗涤物置于部分真空中；在部分真空中条件下加热洗涤筐中的洗涤物；冷却洗涤物；从洗涤筐中取出洗涤物。

6. 一种用于干洗衣物的设备，由下列部分组成：
一种干洗机，有一个盛放所述的洗涤物及环状硅氧烷混合物料源的洗衣筐；一台液体泵，用于将混合物打入洗衣筐；一部电动机，用于搅动和旋转洗衣筐；一台真空泵，用于向洗涤物施加负压；一台加热器，用于提高洗涤物温度。

7. 根据权利要求 6 所述的设备, 所用的合成物包括八甲基环四硅氧烷和十甲基环戊硅氧烷组成的混合物。

8. 根据权利要求 6 所述的设备, 所用的合成物由至少两种环状硅氧烷混合物组成。

9. 根据权利要求 7 所述设备, 所用的合成物更进一步包括一种清洁剂。

10. 根据权利要求 8 所述的设备, 所用的合成物进一步包括至少一种添加剂, 可以是清洁剂、消毒剂、悬浮剂和增亮剂。

说明书

干洗方法和溶剂

本发明所属技术领域

本发明属于对服装、织物、纺织品等进行干洗的一般领域。本发明涉及一种更为独特的方法和设备，用于干洗织物，采用一种以前不曾干洗机中使用过的溶剂。该发明特别地作用于干洗设备，使用硅氧烷基溶剂，这种溶剂有着理想的闪点值(超过 140 华氏度)，在特别设计的干洗过程中，对织物安全可靠(不掉色，不起皱)，并且具有上好的溶解脂肪酸、油垢、油脂的特性。

在先技术

干洗是一种遍及世界的重要行业。仅在美国就有 4 万多家干洗店(其中许多有连锁店)。

干洗是当今经济中不可缺少的行业。许多衣物(及其他物品)必须进行干洗，以除去身体分泌油脂，保持清洁，同时防止缩水及褪色。

迄今为止普遍采用的干洗剂是全氯乙烯(PERC)。它的使用存在着许多不利因素，包括其自身的毒性和气味。迄今为止，广泛使

用的机器设备，都是专为使用全氯乙烯设计的。这也是在工业中的另一个限制因素。

在该领域中存在的另一个问题是，不同的织物需要不同的系统，以防止织物在干洗过程中被损坏。

先前的干洗工艺包括使用各式溶剂及适合的机器来完成洗涤。过去最普遍采用的溶剂是全氯乙烯（通常称为 PERC）。全氯乙烯有着非常好的洗涤效果，但其主要缺陷是危害健康，污染环境（即，它的使用会导致许多种癌症，污染地下水，损害水生物）。在一些地区，全氯乙烯已被禁用。此外，过去也曾尝试使用其他溶剂，例如石油基溶剂、乙二醇酯、醚类。所述各类溶剂的洗涤效果及与织物的适用，可与全氯乙烯进行类比。

本发明与传统工艺有着明显的不同之处，它采用的非全氯乙烯溶剂，如下所述，有着良好的特性，并且，所采用的方法，包括为所述的溶剂专门设计的干洗机设备。

唯一将环状硅氧烷组分用于洗涤目的描述，在美国专利 4,685,930 号中由 Kasprzak 披露。然而，该披露仅就斑点清洗提出申请。既没有披露在环状硅氧烷中浸泡衣物，也没有任何关于在干洗机中使用环状硅氧烷的建议。此外，没有建议涉及诸如将纺织品浸泡于环状硅氧烷中，搅动，旋转，部分抽真空及加热等连续过程，以批量方式干燥、清洁衣物，从大量衣物上去除脂肪、油脂和其他污物。

发明简述

本发明包括一种新的干洗系统和方法，在本发明中，改进的干洗机与特制溶剂结合使用，所述的溶剂源于一种有机/无机杂化物

(有机硅氧烷)。在此类有机硅氧烷中，有一组已知为环状硅氧烷。这类环状硅氧烷作为溶剂材料的基本化学组分，使干洗系统更为有效。所述的环状硅氧烷基溶剂，使该系统应用对环境保护更为有利，同时，在洗涤织物等方面也较以往系统更为有效。所述的硅氧烷组分被用于干洗机，以贯彻本发明的方法。在一个优选实施例中，该流程包括如下步骤：将衣物放置于洗涤筐；洗涤物浸泡于硅氧烷组分中，搅动洗涤物；除去绝大部分硅氧烷组分；离心甩干洗涤物；对洗涤物施以负压，升温；冷却并恢复常压后，将洗涤物从筐中取出。

发明目的

本发明的主要目的，提供了一种无害于环境的干洗溶剂和技术。

本发明的第二个目的，是提供的一种所用的溶剂不损伤衣物的干洗方法。

本发明第三个目的，提供了一种不沉淀或积聚于衣物，同时是低应变源的干洗溶剂。

本发明的第四个目的，提供了一种有着独特的可燃性特征，其闪点和燃点至少分离 10 华氏度，因而在闪点和燃点间可以自熄的干洗溶剂。

本发明的第五个目的，提供的干洗溶剂可以加热到室温，(70 华氏度以上)，进一步改进和加速洗涤过程，而不会损伤织物。

本发明第六个目的，提供的干洗溶剂具有小于 18 达因/平方厘米的低表面张力，能更好地穿透织物纤维，去掉污渍，并更易于从衣物上去除溶剂。

前述的目的和本发明的其他目的及优点,结合对以下优选实施例的描述,对本行业技术人员来说,是显而易见的。

附图简要描述

前述本发明的目的和优点,以及附加的目的和优点,将通过下文的发明详细描述、优选实施例,以及附图得到更好的理解。

图 1 是本发明一个实施例的方框流程图。

一个优选实施例的详细描述

所述的干洗方法是独特的,采用了常见的液态的、环状硅氧烷溶剂,该溶剂普遍用于化妆品和制药行业。以下环状硅氧烷更为独特:八甲基环四硅氧烷(四聚物),十甲基环戊硅氧烷(五聚物),十二甲基环六硅氧烷(六聚物)。这种液体从不曾作为用于干洗机或作为干洗溶剂被披露过。上述四聚物和五聚物的合成物,其自身的单纯形式是无法完全适应干洗过程的。在优选实施例的干洗方法中对其进行了改良。改良形式有:加入沙土悬浮添加剂,防止尘土等脏物在洗涤、漂洗过程中再沉淀;加入水溶性污渍清洗剂;及消毒、灭菌剂,以消灭所有衣物中存在的微生物和细菌。

下列步骤更明确地描述了优选实施例的干洗方法:

在步骤 1 中,服装或要干洗的其他物品,被放入一个垂直的洗涤、干燥一体机中,带有一个水平搅动洗衣筐(本领域技术人员熟知)。筐筒有许多孔洞,优选的是每孔直径 1/8-3/8 英寸。

在步骤 2 中,洗涤循环被引入由环状硅氧烷四聚物和五聚物组成的溶剂。优选的组合是占重量 80%四聚物和 20%五聚物。用来对

前述混合物做调整的添加剂，可在洗涤循环前加入，不必作为溶剂的组成部分。所述的添加剂，也就是清洁剂和悬浮制剂，允许溶剂完成服装的整个洗涤过程。溶剂从储存罐中被泵入洗涤筐。洗涤物被搅动，对衣物进行机械揉搓，渗入的溶剂去除织物纤维中的尘垢和身体脂肪，所述的搅动持续 3-10 分钟。然后，通过一个阀门，溶剂泵出洗涤筐，通过活性炭或粘土过滤器系统，去除洗涤过程中混入的污物，流入保存罐。

在步骤 3 中，将被洗净的衣物甩干，优选的是 3-5 分钟，转速大约为 350-1000 RPM（转数/分钟）；最好是 450 转/分钟-750 转/分钟。此过程使洗涤物中残存溶剂不超过 3%。转速越高，离心力作用于旋转筐，去除溶剂速度越快。所述溶剂的低表面张力，最大程度地提高了离心过程去除溶剂的效力。

在步骤 4 中，服装在盛衣筐中翻滚，加热至 120-140 华氏度。通过蛇形管注入加压蒸汽，使用一个循环通风器，加热盛衣筐中的空气，完成加热过程。与此同时，可在机器内产生部分真空，提供 500-600 毫米汞柱（大气压为 760 毫米汞柱）的负压。在此加热循环中，溶剂混合物被汽化，被循环空气带入冷凝蛇形管中，主气流中蒸汽被冷凝成液态，进行收集。气流可在闭环系统中被再次加热。一般是用 15-20 分钟，溶剂混合物从洗涤物中去除。

步骤 5 中，加热循环停止，冷却循环开始。温度会从 140 华氏度降至 100 华氏度。此过程是通过去除真空，将空气在冷却管中循环，直至完成冷却过程。

在接近或低于体温的条件下，从机器内取出衣物，结束洗涤过程，可以减少二次起皱。温度较高时取出，则会引起褶皱。

在此披露的本发明方法和设备的优选实施例，应理解为是示范性描述，而非限定性描述。

说明书附图

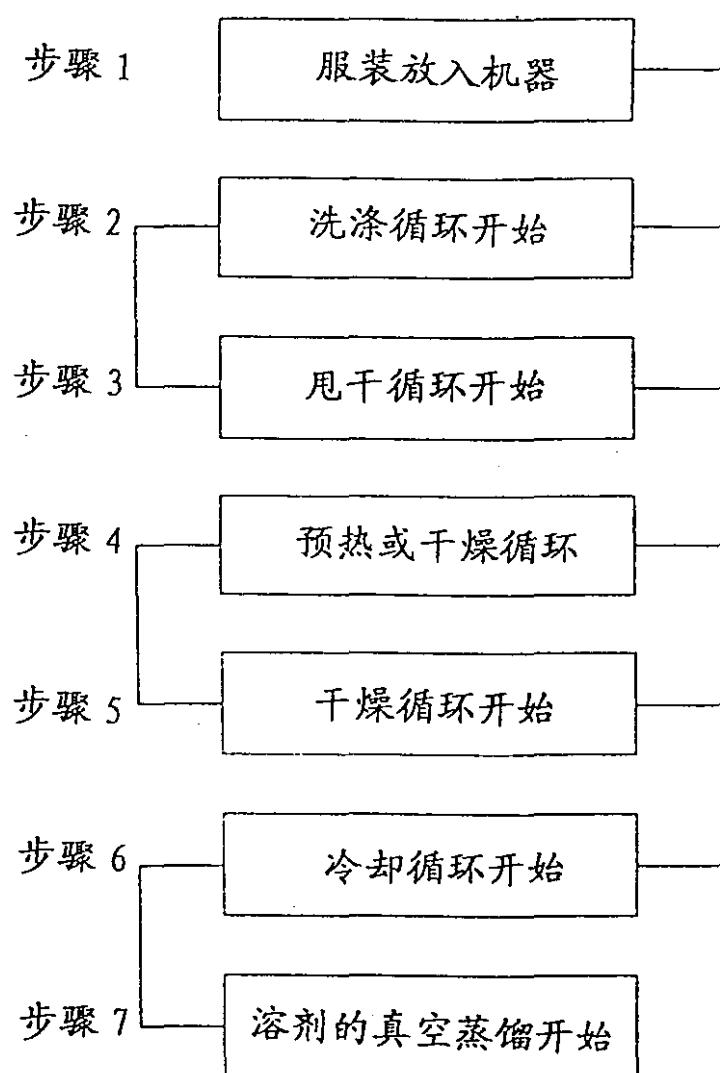


图 1