Jan. 19, 1971 J. L. DUNN, JR 3,555,695

METHOD FOR REMOVING VOLATILE SOLVENTS FROM DEEP-NAP FABRICS

Filed May 21, 1969 3 Sheets-Sheet 1

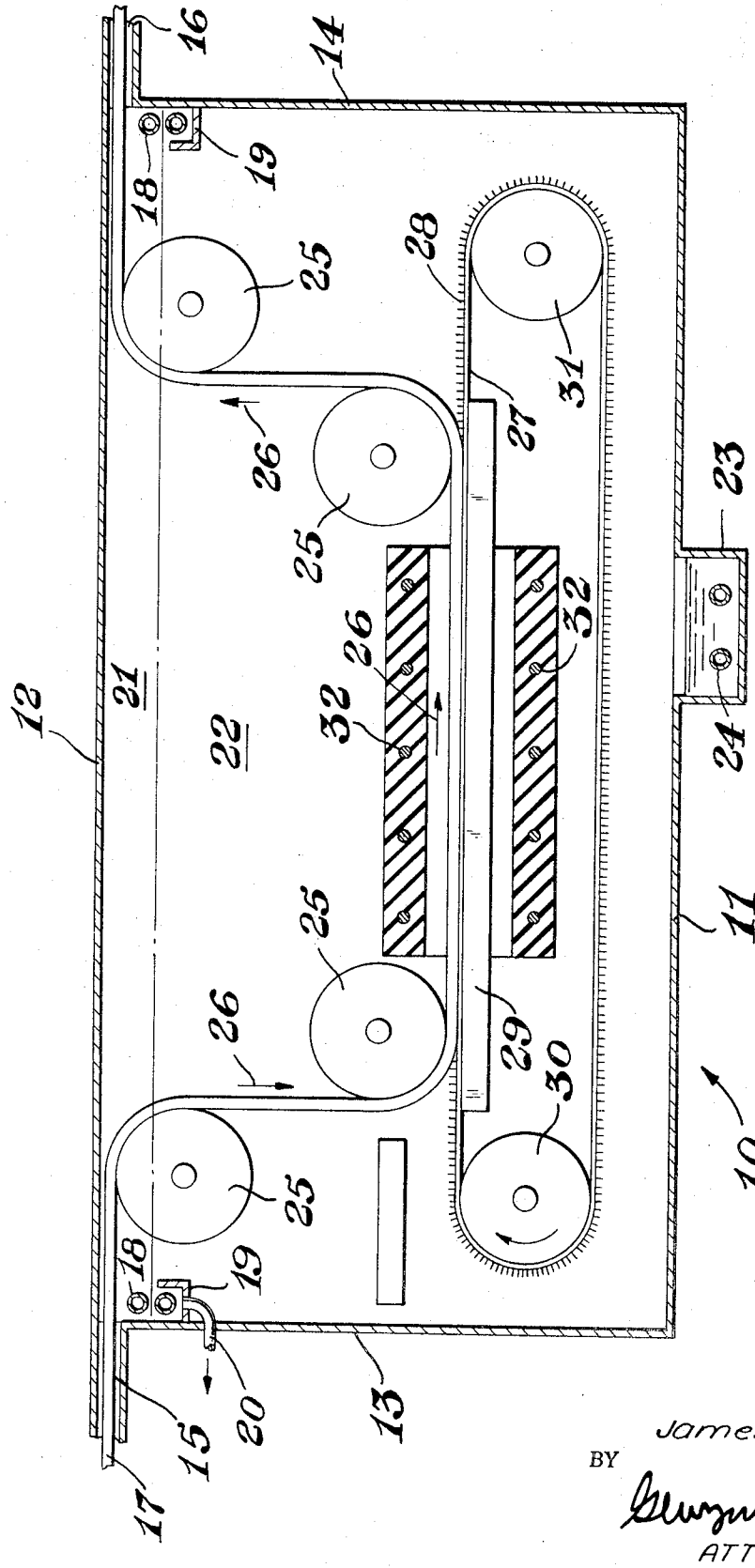


Fig. 1

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Filed May 21, 1969 3 Sheets-Sheet 2

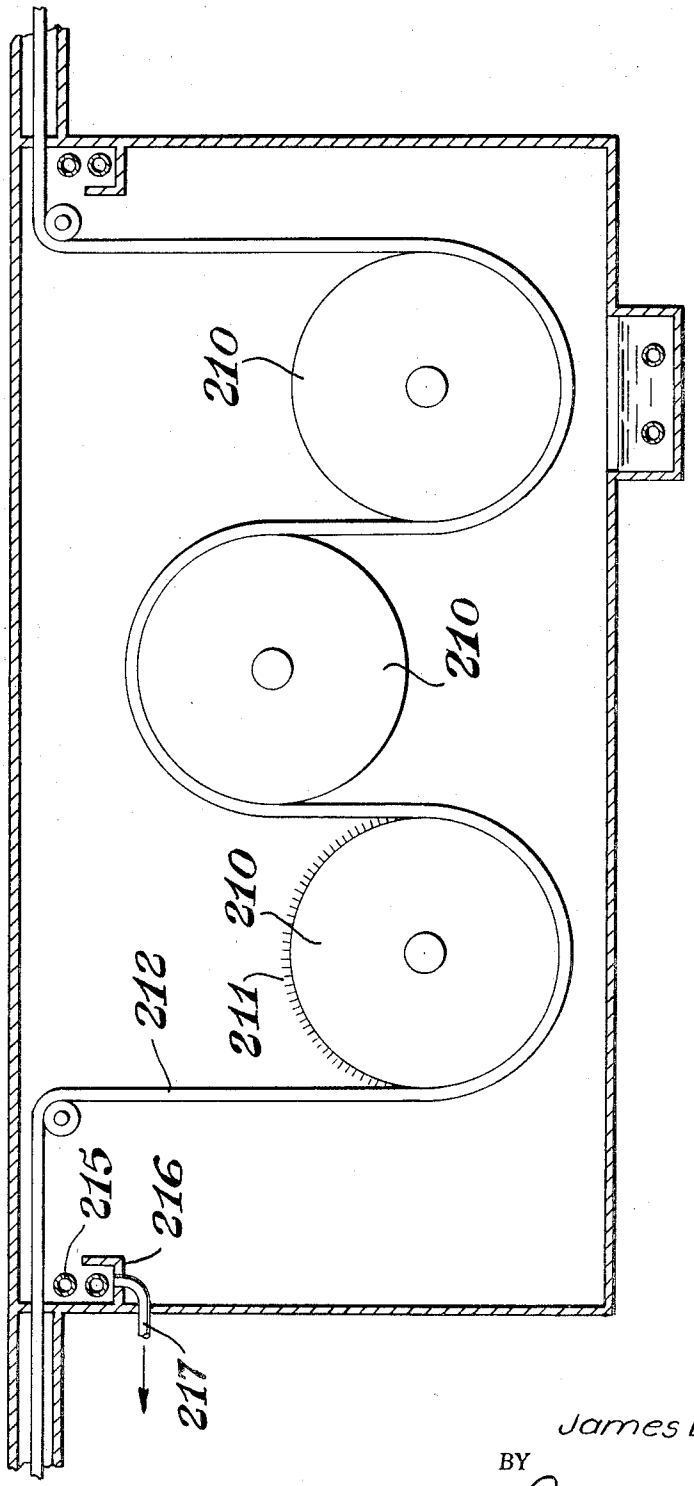


Fig. 2

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Filed May 21, 1969 3 Sheets-Sheet 3

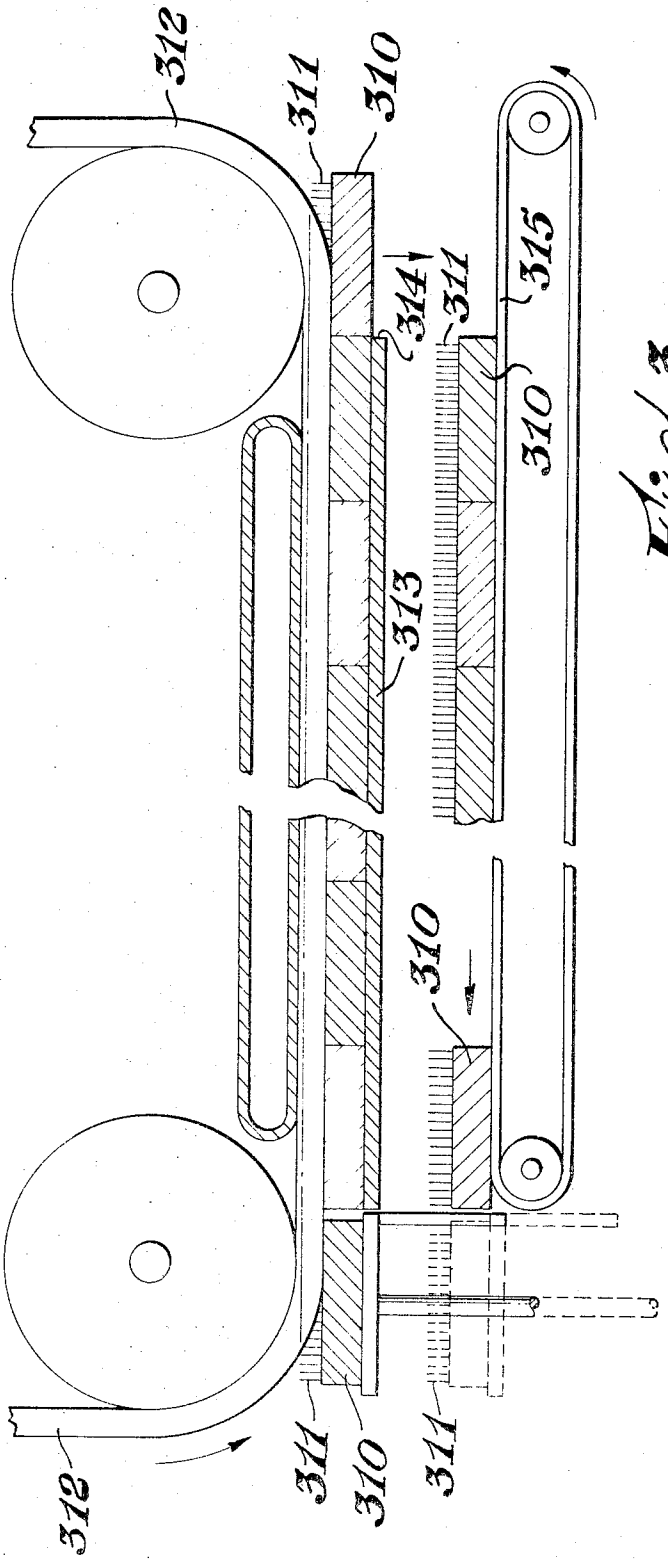


Fig. 3

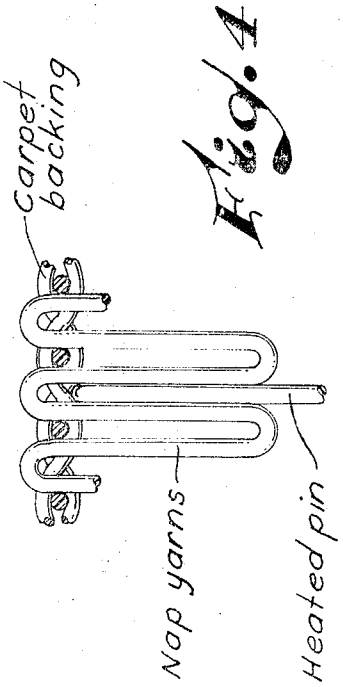


Fig. 4

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3,555,695

METHOD FOR REMOVING VOLATILE SOLVENTS FROM DEEP-NAP FABRICS

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Int. Cl. B01k 5/00
U.S. Cl. 34—1 3 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to a novel method for removing volatile solvents and/or carriers from deep-nap or deep-pile fabrics such as rugs, carpets, velours and the like. The method comprises introducing a volatile-solvent-wetted fabric into a zone of vapors of the volatile-solvent, contacting the pile or nap with a plurality of metal pins which are heated, maintaining said pins at a predetermined temperature at or above the boiling point of said solvent, maintaining said fabric pile and said pins in contact for a time sufficient to vaporize the solvent from the interior of said pile, removing said pins from contact with said pile, and withdrawing said fabric from said zone of vapors.

BACKGROUND OF INVENTION

The textile industry has employed substantially the same basic concepts for drying fabrics, rugs, carpets and the like. Whether the fabric is a light weight material or a heavy nap, such as carpeting, the industry has passed the fabric through a long drying tunnel. Heated air is generally passed over the fabric in a counter-current direction to the fabric travel. Further, during passage of the fabric through the tunnel, the fabric passes in close proximity to heating coils or in some instances into direct contact with heated surfaces such as heated cans. In general, the drying period is inordinately long. The drying principle is based on transfer of heat from the air and/or heating coils to the fabric and to the liquid, which is to be removed from the fabric, in sufficient quantities to raise the liquid to its boiling point and convert it to a vapor. Several phenomenon contribute to the poor economics of this method. Firstly, the vapors which form at and near the surface of the nap or pile form an insulating barrier since these vapors are not good heat conductors and thus transfer of heat to the interior liquid is slow. Secondly, the total weight of the vapor which can be present in the air at saturation is generally very low. Further, air itself is not a good heat transfer medium since it has a low heat capacity. Great care must be exercised to control the temperature of surfaces over which the fabric passes because as the liquid is removed from the surface of the fabric, the fabric itself being a poor conductor of heat, the fabric surface is subject to scorching. In addition, when the heat is applied to the surface of the nap or pile to remove liquid from the surface, a "wicking" action occurs which moves liquid from deep in the pile to the surface, causing migration of dye which results in uneven color.

For some years, the use of low boiling organic solvents has been advocated as replacement for water as a carrier for the chemicals employed to treat fabrics. The use of these organic solvents has not gained widespread acceptance for several reasons. Those solvents inexpensive enough to be discharged into the atmosphere without recovery have generally been flammable, this necessitating extreme and costly measures to insure safe handling. Those substantially safe, insofar as fire hazard is concerned, usually must be recovered to provide an economic process. Recovery apparatus to date has not been efficient and is costly to operate.

The present invention provides a process which overcomes the aforementioned disadvantages and provides a compact, economical drying and recovery unit which can employ expensive solvents, reduce air pollution and substantially increase the scope of chemicals which can be employed to impart desirable properties to textile fabrics.

BRIEF DESCRIPTION OF INVENTION

The present invention comprises a unique and novel method for efficiently and economically removing liquid carriers from deep-nap or deep-pile fabrics such as rugs, carpets and the like. More particularly, the process consists contacting the deep-nap fabric with heated pins which penetrate into the nap while maintaining the fabric and pins in a zone filled with vapors of the liquid carrier. A convenient manner for carrying out the process comprises introducing the carrier-wetted fabric into zone filled with vapors of the carrier, contacting the nap of said fabric with a multiplicity of pins which penetrate the nap, heating the pins and maintaining the pins at a temperature which will provide sufficient heat to vaporize the carrier deep in the fabric, during the passage of the fabric through the vapor zone, withdrawing the pins from the fabric and removing the fabric from the vapor zone in a substantially carrier-free state.

The techniques for contacting the fabric with the pins and the methods for heating and maintaining the pins at a desirable temperature are not critical. Thus, one can employ pin studded cans, belts or blocks which move into and out of contact with the fabric during its passage through the vapor zone. Induction heating and conduction heating are the most economical methods for heating the pins although resistance heating as well as other well-known methods may be employed.

The process of the present invention can readily remove most volatilizable carriers which boil at a temperature below that at which some physical damage occurs to the fibers. The preferred class of carriers, and the ones most readily removed are the halogenated aliphatic and the halogenated aromatic hydrocarbons having boiling points between about 40° F. and about 300° F. Although other solvents boiling within the aforementioned range can also be removed efficiently and economically, e.g. water, the petroleum hydrocarbons, their high heat of vaporization or flammability materially effect the economies when compared to the preferred class of halogenated aliphatic hydrocarbons.

The recovery of the carrier removed from the fabrics is conveniently accomplished in the manner described in copending legislation Ser. No. 505,520, filed by Kenneth S. Surprenant on Oct. 10, 1965 and Ser. No. 585,893, filed by said Surprenant on Oct. 11, 1966, respectively, each entitled Method and Apparatus for Treating Fabrics. Other means can also be employed but are genenerally less economical than that described in said aforementioned application. Likewise many techniques are suitable for establishing and maintaining the vapor zone which is necessary to the effective and efficient operation of the present invention, but the techniques described in my copending applications Ser. Nos. 685,716, filed Nov. 24, 1967, entitled Drying and Recovery Process, and 720,257, filed Apr. 10, 1968, entitled Solvent Removal; and my U.S. Pat. No. 3,408,748, are also effective and economical.

DETAILED DESCRIPTION OF INVENTION

The following description of specific embodiments of the present invention will have reference to the drawings of which:

FIG. 1 represents in cross-section an apparatus within the scope of the present invention for continuously drying

or removing volatilizable carriers from deep-nap fabrics employing a metal pin studded belt brought into intimate contact with the deep nap, which pins are heated by inductive means;

FIG. 2 represents a modification which utilizes a series of heated cans studded with pins replacing the belt of the apparatus of FIG. 1;

FIG. 3 represents a modification of FIG. 1 wherein the metal pin studded belt is replaced by a series of blocks containing the pins; and

FIG. 4 illustrates in large scale the manner in which the pins penetrate a loop-pile carpet to provide heat interior of the carpet surface to achieve the good results of the present invention.

The apparatus illustrated in FIG. 1 for carrying out the process of the present invention comprises a box-like structure **10** which has a bottom **11**, top **12** and four walls, two of which, **13** and **14**, are shown. The box-like structure **10** is provided with two openings **15** and **16** through side walls **13** and **14** for ingress and egress of a heavy nap fabric **17** to and from the interior of the box-like structure **10**. Surrounding the interior of each wall, and as illustrated on walls **13** and **14**, are a series of coils **18** which are hung or otherwise positioned as illustrated, below the inlet **15** and outlet **16**. Similar coils or continuations of these coils **18** extend across the two walls not shown. These coils **18** are designed to carry a cooling medium. Located immediately below the coils **18** is a trough **19**. The trough is conventionally, although not necessarily, integral with the side walls, as illustrated, one wall of the trough **19** being the side wall **13** or **14** of the structure **10**. The trough **19** is provided with a drain **20** to conduct liquid condensate to a storage tank, not shown. The cooling coils **18** divide the interior of structure **10** into two zones, one zone **21** above the coils **18** and another zone **22** below the coils **18**. For purposes of ease of illustration, structure **10** is provided with a sump **23** located in the bottom **11**.

The sump **23**, designed to contain a quantity of volatile liquid solvent, obtained from a storage tank not shown, is provided with heater **24**, illustrated as steam coils. The sump provides a source of vapors to fill zone **22**.

Located within the interior of the structure **10** are a series of idler rollers **25** which provide the means for directing a fabric **17** entering the interior through inlet opening **15** into zone **22**, across zone **22**, and to outlet opening **16** along the path **26**.

Positioned along and below the horizontal path **26** of the fabric **17** in a manner to intimately contact the fabric **17** during its passage is a belt **27** which is studded with a multiplicity of metal pins **28**. The belt **27** is supported along its path while in contact with the fabric **27** by a support **29**. Defining the end travel of belt **27** and providing a means of directing the belt **27** in its endless path are a pair of rollers **30** and **31**, either one or both of which may be driven. The drive mechanism is not shown as it is considered to be so conventional and well known and does not constitute a part of this invention apart from its utility to move belt **27**.

Within the structure **10** and preferably in close proximity with the belt **27** are a series of heating means **32** which are shown as induction heaters which heat the metallic pins **28**.

In operation of the apparatus illustrated in FIG. 1, a textile fabric **17** having a heavy nap, for example, a carpet, is treated with a chemical dissolved or dispersed in a volatile organic solvent, which chemical if it remains on or in the fabric will impart some desirable property to the textile fabric. The so-wetted fabric **17** is introduced into structure **10** through inlet **15**, passes around idler roller **25** and into zone **22** of structure **10**. Zone **22** has previously been filled with vapors of a volatile organic solvent, preferably the same solvent as employed as a carrier for the chemical used to treat the fabric **17**. Cooling coils **18** have previously been placed in operation, that

is, a cooling medium has begun to flow therethrough lowering the temperature of the coils **18** to below the condensation temperature of the solvent vapors which fill zone **22**. Condensate falling from coils **18** collects in trough **19** and is drained to storage. Solvent from storage is fed continuously to sump **23**, the heating means **24** is activated and solvent vapors are generated to fill zone **22**.

The fabric upon entering zone **22**, being at ambient temperature, causes a small amount of solvent vapors to condense thereon. The heat given up by this condensation is absorbed by the textile and begins to raise the temperature of the textile and its carrier to that of zone **22**. The textile **17** follows a path **26** around a second idler **25** where it comes into contact with the heated metal pins **28** of belt **27**. The pins penetrate the deep nap (as is shown in FIG. 4) and further heat the textile and liquid to the vaporization temperature of the solvent carrier. The pins **28** are maintained at the desired temperature by induction heaters **32**. During passage along the horizontal path through zone **22** and while in contact with the pins **28**, the entire textile **17** is rapidly raised to the boiling point of the solvent. Since the pins **28** penetrate the nap, the entire interior of the fabric is supplied with heat sufficient to vaporize the solvent and to raise and maintain at such temperature the textile and the solvent. When the textile **17** traverses the horizontal path of the belt, the textile passes around idler **25** disengaging it from the belt **27** and its associated pins **28**. The textile is directed through zone **22** around final idler **25** to outlet **16**. The textile exits from structure **10** free of solvent or carrier.

As is clearly illustrated in FIGS. 2 and 3, means other than a belt can be designed to introduce the pins into the interior of the deep-nap fabric; for example, as shown in FIG. 2, one or more cans **210** can replace the belt **26** of the apparatus of FIG. 1. The cans **210** are heavily studded with pins **211** which will enter the nap of the fabric **212** as it travels through vapor zone **213** of structure **214**. Cooling coils **215** and collecting trough **216** with its attendant drain **217** are similar in design and location as shown in FIG. 1. Cans **210** are heated with steam or other fluid or by electrical heating to provide the heat to pins **211**. In addition, pins **211** may be heated by induction.

Another convenient device for moving the pins and maintaining them in contact with the deep nap of the textile fabric is shown in FIG. 3. Blocks **310** are heavily studded with metallic pins **311** and are contacted with the nap of the textile fabric **312** while riding along and upon a table-like or track-like support **313**. The motive force to move the blocks **310** and their associated pins **311** is supplied by the textile fabric **312** as it is moved along its designed path. When the blocks **310** reach the terminus **314** of the track or table **313**, they drop from contact with the fabric and are picked up by a moving belt **315**, for example, which transports them to the opposite end **316** of the table or track **313**. The blocks **310** are then moved upwardly to contact the fabric **312**, moved horizontally onto the table or track **313** and proceed along with the fabric to the terminus **314**. The pins **311** can be heated by induction.

I claim:

1. A method for removing a volatile solvent from a deep-nap fabric which comprises:

passing the fabric into a zone of the vapors of said volatile solvent and into contact with a multiplicity of metal pins, which pins are associated with a surface which moves with the fabric through the zone;

heating said pins and maintaining said pins at a temperature at or above the boiling point of said volatile solvent;

removing said pins from contact with said fabric; and

withdrawing the fabric from the vapor zone substantially free of solvent.

2. A method for drying deep-nap or -pile fabrics wetted with a volatile liquid organic solvent which boils below

the deformation point of the fiber of said fabric which comprises:

passing said so-wetted fabric into a zone of vapors of a halogenated organic solvent having a boiling point at or above the boiling point of said liquid organic solvent;

contacting the nap or pile with a multiplicity of metal pins;

moving said pins and said fabric simultaneously through;

heating and maintaining said pins to a temperature at least as high as the boiling point of said liquid organic solvent;

removing said pins from said fabric; and

removing said fabric from said zone.

3. A method for drying deep-nap or deep-pile fabrics wetted with a volatile chlorinated hydrocarbon solvent which boils below the deformation temperature of the fabric fibers, which comprises:

introducing said fabric into a zone filled with the vapors of said halogenated hydrocarbon solvent;

contacting the nap or pile with metal pins which penetrate the nap to or near the backing of said fabric;

heating said pins at or above the boiling point of said solvent and maintaining the pins at said temperature;

maintaining said pins and said fabric in intimate contact for a time sufficient to vaporize substantially all of said solvent from said fabric;

removing said pins from said fabric;

removing said fabric from said zone substantially free from said solvent; and

recovering said solvent removed from said fabric.

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CHARLES SUKALO, Primary Examiner

U.S. Cl. X.R.

28—62; 34—22, 41; 219—275, 388