United States Patent [19]

Wisdom

[11] **3,775,053**

[45] **Nov. 27, 1973**

[54] **CONTINUOUS SOLVENT RECOVERY PROCESS**

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[52] **U.S. Cl.** ..... **8/142,** 15/302, 15/320, 15/322, 34/32, 68/18 C

[51] **Int. Cl.** **D06l 1/10**

[58] **Field of Search** ..... 8/142; 68/18 C; 15/30 L, 320, 322

[56] **References Cited**

UNITED STATES PATENTS

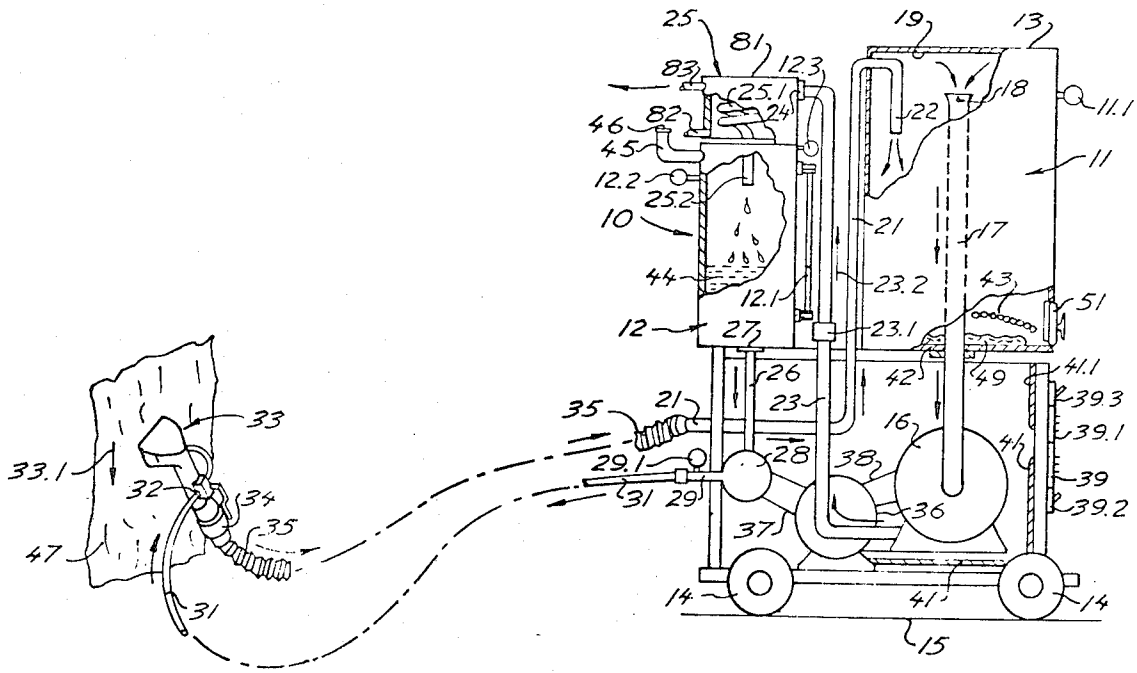
1,669,077	5/1928	Brewer	8/142 X
2,574,731	11/1951	Dapprich	15/302 X
3,177,126	4/1965	Charreau	68/18 C
3,262,146	7/1966	Hays	15/321
3,439,374	4/1969	Wisdom	15/322 X

Primary Examiner—Mayer Weinblatt
Attorney—Brian J. Wood

[57] **ABSTRACT**

A continuous process of recovering dirty non-flammable solvent after discharge from a remote applicator moving over a fabric being cleaned. Immediate vacuum extraction of the dirty solvent from the applicator with purification effected by boiling and condensation, condensate recirculated to applicator. Portable apparatus adapted for in-situ use includes an applicator to spray the solvent under pressure, vacuum pump structure for suction extraction and to provide some of the pressure which is augmented by a liquid pump, electric or combustible gas means to boil dirty extracted solvent, condensa to distil pure solvent introduced into a supply tank for recirculation through the applicator.

9 Claims, 8 Drawing Figures



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SHEET 1 OF 3

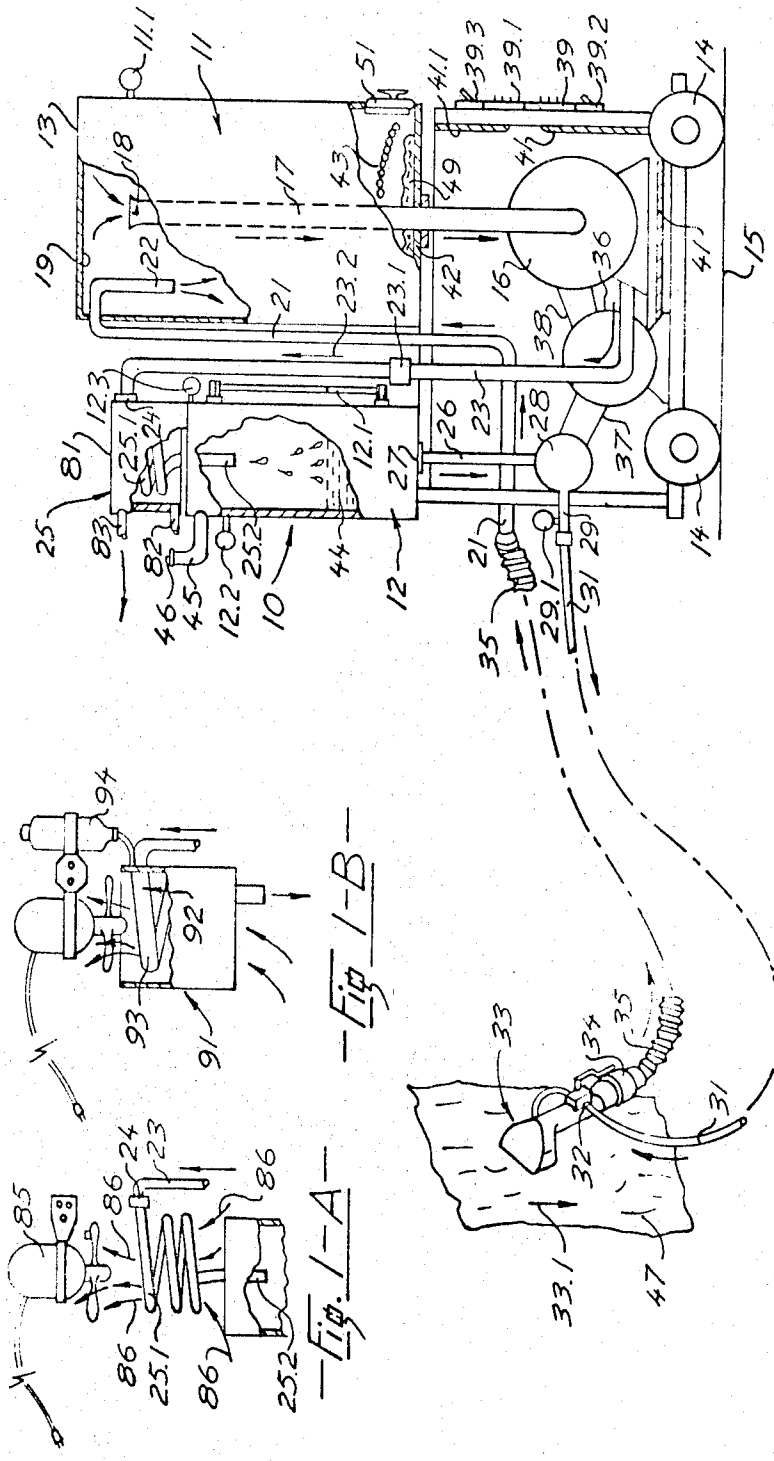
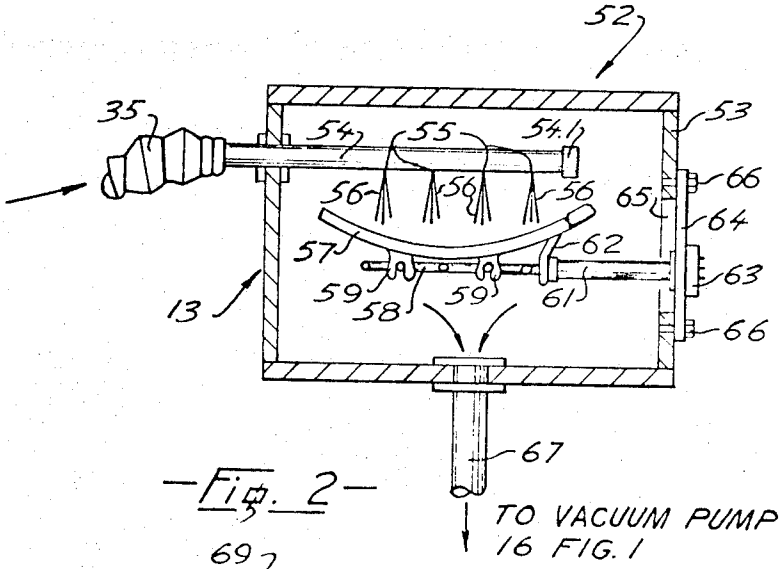


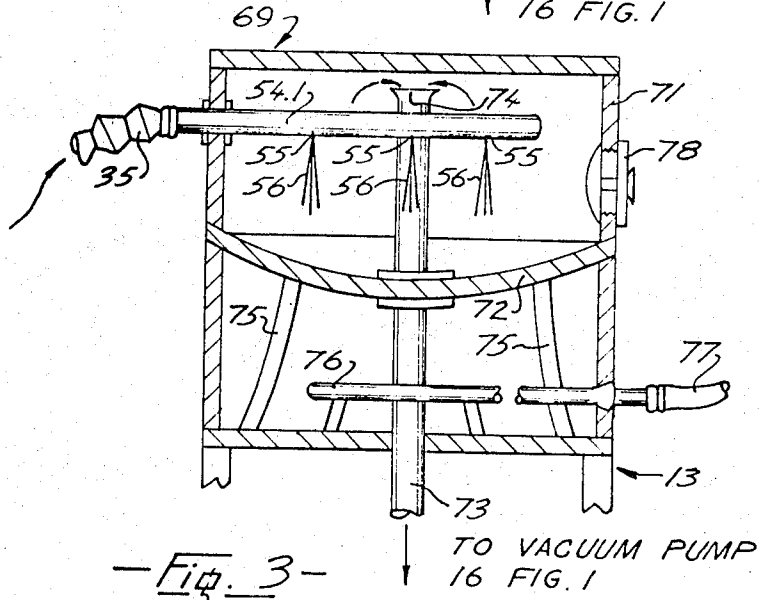
Fig. 1

Fig. 1-A

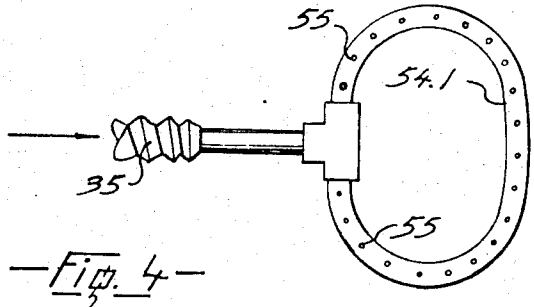
Fig. 1-B



—Fig. 2—



—Fig. 3—



—Fig. 4—

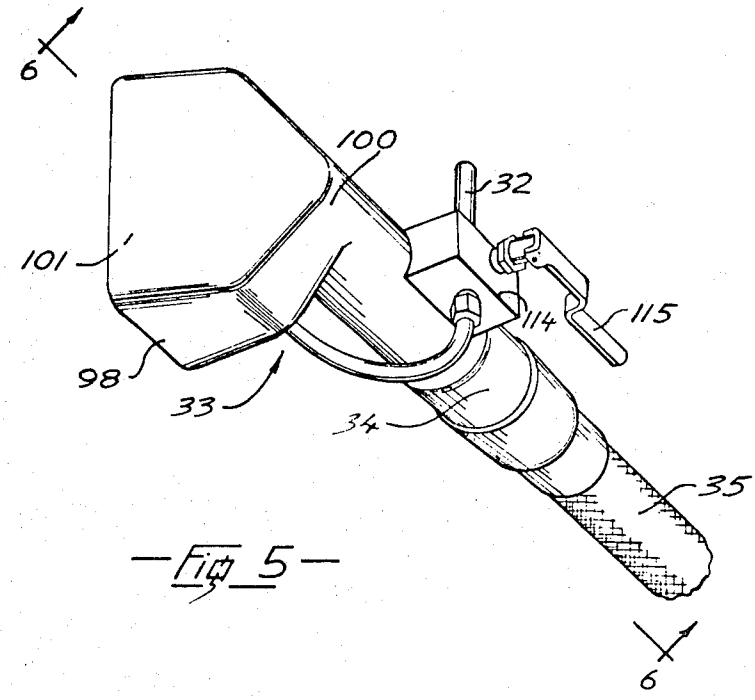

6
100
32
101
114
115
98
33
34
35
6

Fig. 5

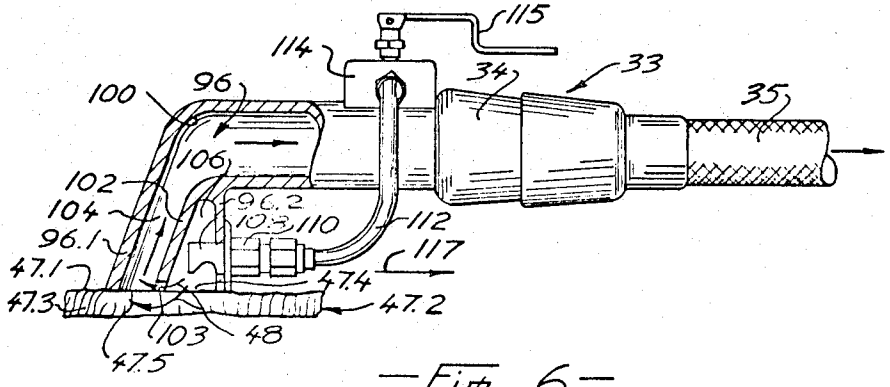

115
114
34
33
35
100
96
106
102
104
96.2
110
112
96.1
117
47.1
47.4
47.3
47.2
103
48
47.5

Fig. 6

CONTINUOUS SOLVENT RECOVERY PROCESS

FIELD OF THE INVENTION

The invention relates to a continuous process of recovering soil laden solvent as it is being used with a remote applicator for cleaning drapes, upholstery, rugs, and like fabrics, with the solvent being purified and recycled to the applicator. The invention also provides apparatus expressing the process.

BACKGROUND OF THE INVENTION AND PRIOR ART

The present invention is particularly, but not exclusively, directed to cleaning of drapes, rugs and carpets, upholstery, and like fabric, whilst the same are in place. That is to say for example light and, particularly, heavy drapes can be cleaned by the instant process without taking them down, and are dry in a few hours.

Fluorocarbon solvents are commonly used for such cleaning purposes, and are expensive; consequently they are often reclaimed and regenerated. A classical method of regenerating solvents is by boiling and subsequent distillation, with or without filtering. U.S. Pat. No. 3,177,126 issued to Charreau in 1965 teaches process and apparatus for purifying solvents by evaporation at a temperature substantially below boiling point in an atmosphere swept by a hot inert gas. A mixture of gas and vapors is cooled and the solvent recovered in a liquid state. This is a process adapted to operate continuously, the regenerated solvent being returned to a cleaning machine and reused. This ingenious process is well adapted for use with a stationary cleaning machine such as is commonly used in a dry cleaning establishment.

U.S. Pat. No. 2,924,557 of which De Furia is the inventor, is directed to a closed filter and distillation system particularly well adapted for use with a solvent having noxious fumes, the apparatus being directly connected to existing systems of a dry cleaning plant.

A process capable of expression in portable apparatus which can be taken, for instance, to the home of a customer for cleaning drapes and upholstery in-situ without taking down the drapes, and without removing the upholstery fabric, which apparatus is also capable of cleaning rugs and carpets and, at the same time of effecting a continuous withdrawal and cleaning of soil laden solvent with recycling for continuous use, is not known to the present inventor.

OUTLINE OF THE INVENTION

In the contemplated uses the solvent is sprayed upon the fabric. While, in one expression of the invention, the spray is confined in an applicator, this is not a closed circuit since at least some of the sprayed solvent escapes into the atmosphere. Consequently, and because of heat later applied effects change of state, use of a nonflammable solvent is required, and it is in a practical sence required that the solvent have little or no odor or, at least, have an odor which quickly disappears.

Broadly the method withdraws soil laden solvent from the fabric as it is being cleaned, the withdrawn solvent being then in a liquid state with the soil in solution. A first change of state is effected changing the liquid solvent to a gas. In the first change of state the soil in solution does not pass over, and means are provided for collecting, and for disposing of, the soil. A second change of state follows wherein the gas, now without material soil content, is changed to clean liquid solvent. The clean solvent is collected and introduced into a tank for recirculation and spraying. This completes a continuous cycle.

An embodiment of the apparatus includes vacuum means for withdrawing the soil laden solvent from an applicator used to clean the fabric, means to effect the first change of state by adding heat to change the liquid to gas, means to effect the second change of state condensing the gas to clean solvent, the clean solvent then being introduced into a solvent tank supplying clean solvent under pressure to be sprayed on the fabric by the applicator.

A detail description following related to drawings, exemplifies apparatus by means of which the process is accomplished, the detail description also sets forth further particulars of the process. The invention can be expressed in process and in apparatus other than particularly described below.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows means effecting recovery of soil laden solvent and removal of the soil therefrom by a continuous process according to the invention, recovery and removal being concurrent with cleaning, the means aforesaid being shown in side elevation with parts broken away to show interior construction, and an applicator being shown in perspective.

FIG. 1-A is an alternative means for extracting heat to change state of the solvent from gas to liquid, being an elevation of an air cooled condenser.

FIG. 1-B is a further alternative means for extracting heat, being an evaporation condenser with parts broken away to show interior construction.

FIG. 2 is an alternative means for changing state of the solvent from liquid to gas, heat being supplied by an electrical heating element, the said means being shown in vertical section with some parts not sectioned.

FIG. 3 is a change of state means alternative to FIG. 2, heat being supplied by a combustible gas.

FIG. 4 is a top plan of an intake pipe of the FIG. 3 means.

FIG. 5 is a perspective detail of the applicator.

FIG. 6 is a side elevation of the applicator viewed from 6—6 FIG. 5, with parts broken away to show interior construction.

PREFERRED EMBODIMENT, MEANS

DESCRIPTION OF FIG. 1

Apparatus means designated generally **10**, has a solvent recovery tank **11** having a vacuum gauge **11.1**, and a solvent tank **12** having a liquid gauge **12.1**, a pressure gauge **12.2**, and a pressure relief valve **12.3**. The tanks are secured to a frame **13** having wheels **14** for movement on a floor **15**.

A vacuum pump **16** is secured to lower members of the frame **13**, and an intake pipe **17** extends vertically upwards through the tank **11** as shown. The pipe **17** has an upper open bell mount **18** spaced below a top wall **19** of the tank. A solvent recovery intake pipe **21** extends inwards through a side wall of the tank, the intake having a downturned inner discharge end **22**.

The vacuum pump **16** has a discharge pipe **23** leading from a discharge port of the pump to an inlet port **24** of a condenser **25**. A check valve **23.1** of the discharge pipe permits flow only in a direction shown by an arrow

23.2. The condenser has a helical coil **25.1,** and a discharge pipe **25.2** extends centrally downwards within the solvent tank **12** as shown, with the condenser being disposed centrally above the solvent tank.

A solvent outlet pipe **26** leads downwards from an outlet port **27** of the tank **12** to an inlet port of a liquid pump **28** a discharge line **29.** A pressure gauge **29.1** is provided in the discharge line **29** as shown, an outer end of the line being adapted for securing a flexible hose **31** thereto. The flexible hose **31** extends to a fluid inlet connection **32** of a remote applicator **33.** The applicator shown is a known two chamber hand tool, later described. A fluid outlet, or vacuum, connection **34** of the applicator is adapted for securing a second flexible hose **35** thereto, the hose **35** being of a relatively large diameter extending to the recovery intake line **21** aforesaid, and being attached to an outer end thereof.

An electric motor **36** is secured to lower members of the frame **13** as shown, and is operatively connected by drive means **37** and **38** adapted to drive, respectively, the liquid pump **28** and the vacuum pump **16.** A male receptacle **39** is provided on an end member of the frame, with a three conductor cable **41** extending from the motor to the receptacle.

A bottom wall of the recovery tank **11** is designated **42,** closely spaced heating elements severally **43** being provided as shown spaced above the tank bottom wall **42.** A second male receptacle **39.1** and a second three conductor cable **41.1** supply the heating elements, switches **39.2** and **39.3** are provided to control the motor and the heating elements respectively.

MECHANICAL OPERATION

Mechanical operation of the apparatus **10** is as follows.

A solvent **44** is introduced into the solvent tank **12** through a filler spout **45** having a removable pressure cap **46.** The solvent has particular properties exemplified later herein. With power lines (not shown) plugged into each of the receptacles **39** and **39.1,** when the switches **39.2, 39.3** are on the motor drives the liquid pump **28** and the vacuum pump **16,** and the heating elements **43** are energized.

Flow of fluid is indicated by unreferenced arrows. The solvent from the tank **12** passes down the line **26** and is driven by the liquid pump **28** outwards through the discharge line **29** as shown by the arrows, and enters the applicator **33.** The discharge line **23** of the vacuum pump **16** is connected to the condenser, consequently there is a pressure urging the fluid out of the tank through the line **26** aforesaid, which pressure augments that of the liquid pump **28** — so that pressure at the applicator is the sum of these less line drop.

The fluid outlet connection **34** of the applicator **33** is connected by the flexible hose **35,** which is a suction line, to the recovery tank **11.** FIG. **1** shows a hanging fabric **47,** for instance a heavy drape, being cleaned in position. The applicator is moved downward by hand in a direction shown by an arrow **33.1,** while being held against the fabric. Solvent under pressure discharges from the applicator as a spray impinging directly against the fabric **47** being cleaned as indicated by arrows **48,** seen in FIG. **6** only. Because of suction from the vacuum pump **16,** the solvent impinging the fabric **47** is in major part withdrawn to pass outwards of the fluid outlet connection **34** and, at this stage, the solvent is dirty being laden with soil in solution extracted from the fabric. The soil laden solution now passes through the hose **35** and discharges from the inner end **22** of the pipe **21** in liquid form, as small droplets, or as a mist, discharging on the heating elements **43** and changes state from liquid to gas. Suction from the vacuum pump **16** maintains pressure within the tank **11** somewhat below atmospheric, thus depressing boiling point of the liquid solvent. This results in less energy required to vaporize the liquid and facilitates condensation back to liquid. The elements **43** are means to supply heat to the withdrawn solvent changing its state from liquid to gas, a first change of state. With this change of state, the soil in solution with the solvent is in part deposited on the tank bottom wall **42** as indicated at **49,** with some adhering to the heating elements **43** as a crust. At least one cleanout port **51** is provided, opening into the tank side wall above the base in a position convenient for insertion of a cleaning tool to remove the deposited soil **49,** and to clean the crust off the heating elements **43.**

In the change state from liquid to gas, the soil does not pass over but is deposited as above. A proportion of the gas, depending upon conditions, may change state back to liquid. The liquid being of soil free gas is, as it forms, clean or free of soil. The solvent which has changed its state from liquid to gas, together with any liquid produced as above, are drawn upwards and enter the bell mouth **18** of the vacuum pump intake pipe **17,** being drawn downward to and pass through the pump **16.**

This gas and any liquid droplets or mist are now driven by the pump to pass as shown by the directional arrows upwards through the discharge pipe **23** and enter the condenser **25** through its inlet port **24,** passing through the condenser coil **25.1.** Liquid condensate discharges at **25.2,** as shown; as recovered liquid. The recovered liquid, which as explained is soil free or substantially so, will thus be added to the unused solvent **44** in the tank. The condenser is a means to extract heat from the solvent gas, adapted to effect a second change of state viz from gas to liquid, the tank being a collecting means for the recovered or cleaned solvent.

Flurocarbon solvents which are non-flammable and are suitably odorless are well known being used in the trade for cleaning of this general kind. For instance an intermediate grade of trichlorotriflouroethane is suitable for use in the instant process and apparatus, or a mixture of such solvents can be used. These solvents are characterized by relatively low boiling points and latent heats, 118° and 63 BTU/lb being the boiling point and latent heat at atmospheric pressure of a particular trichlorotrifluouroethene suitable for use herein, namely ISOTRON T produced by Pennusalt Cehmicals Corp. of Philadelphia. Solvents and mixtures of solvents required for optimun cleaning in particular cleaning operations are well known in the trade and, therefore, are not further discussed in that aspect herein.

ALTERNATIVE MEANS FOR EFFECTING THE FIRST CHANGE OF STATE

DESCRIPTION OF FIG. 2

In FIG. **2** an alternative recovery tank **52** has a cylindrical side wall **53** through which a recovery pipe **54** extends, the pipe having a capped inner end **54.1.** An outer end of the recovery pipe is adapted for attachment of the flexible hose **35,** FIG. **1.** The pipe **54** has perforations **55** adapted to discharge solvent as shown at **56** to impinge a saucer like member **57** supported

above a heating element **58** on forked brackets **59.** The heating element **58** shown is a common Calrod unit of suitable wattage.

An electrical conduit pipe **61** containing a conductor cable is secured in a bracket **62** of the member **57,** an outer end of the conduit having a male receptacle **63** as the receptacles **39** and **39.1** FIG. **1.**

The soil laden solvent from the applicator enters the flexible hose **35,** passes to discharge through the perforations **55** of the recovery intake pipe **54,** and impinges the shallow saucer **57** heated by the heating element **58.** Thus upon impingement the dirty solvent changes state from liquid to gas, with the soil being deposited in the saucer **57.** An inspection plate **64** is secured over a clean out port **65** of the side wall **53** by bolts **66.** The conduit **61** has an outer end secured in the plate **64,** thus by removing the bolts **66,** the heating elements, saucer, and conduit, can quickly be removed together as a unit. The bracket **62** is also forked so that the saucer **57** is readily removable, either for cleaning or for replacement with a clean saucer. The soil in the dirty solvent entering the flexible hose **35** collects in the saucer **57** as explained, and the solvent in the form of a gas passes downwards through an intake **67** to the pump **16** as before. Note that the boiling point of the exemplified solvent is under 120° F.

DESCRIPTION OF FIGS. 3 AND 4

In FIG. **3** tank **69** has a cylindrical side wall **71** and a concave upwards saucerlike base **72.** An intake pipe **73** with an open upper bell mouth **74** (similar to the intake pipe **17** FIG. **1**) leads to the vacuum pump **16** FIG. **1.** The base **72** is spaced upwards from the frame **13** FIG. **1** by legs **75** to provide space for a burner **76** supported by the said frame. The legs are secured to the frame **13** and to the base **72.** The burner **76** is adapted for attachment of a gas supply line **77,** providing propane or other combustible gas. Discharge of the dirty solvent is as before, and the action of the FIG. **3** boiler is as described with reference to FIG. **2.** A cleanout port **78,** as the cleanout port **51** FIG. **1,** is provided for cleaning of the soil accumulated in the concave bottom wall of the tank.

The recovery intake pipe **54** can have a generally circular shape as seen in FIG. **3.** In FIG. **2** the intake pipe **54,** which is there shown as a straight perforated pipe, can be an intake pipe as **54.1** FIG. **4.** A straight pipe **54** FIG. **2** can be used in the FIG. **3** alternative with a suitable positioning with reference to the pump intake pipe **73** to avoid interference therewith.

MOTOR AND PUMPS

The motor **36** FIG. **1** draws not over **15** amps, so that it can be connected to one ordinary household circuit and, as later will be explained, an applicator can require further power. Thus three circuits might be required. Where these are not conveniently available, suitable connection is made to the distribution box. In the three conductor cables referred to above, the third conductor is a ground, wiring of the apparatus is according to code requirement, and is well grounded to the frame **13.**

The vacuum pump **16** FIG. **1** is a positive feed blower as used in positive extraction systems. **1** to **1** ¼ HP is adequate. The liquid pump can be an impeller type, ¼ HP will suffice an automative-type water circulation liquid pump. being suitable. In some circumstances the fluid pump can be dispensed with. Obvious by-pass means (not shown) can be provided to isolate the pump in these circumstances.

HEAT EXTRACTIONS MEANS EFFECTING THE SECOND CHANGE OF STATE

The condenser **25** FIG. **1** is shown with an outer jacket **81** having an intake **82** and an outlet **83.** A cold water supply hose (not shown) can be attached to the inlet **82,** with a waste hose (not shown) attached to the outlet **83,** the hose leading to a sink drain. Cooling of the condenser coil can thus be effected.

Under some conditions, the jacket **82** can be dispensed with, leaving the coil **25.1** exposed to ambient air. Where this provides insufficient cooling, a common electric fan **85** FIG. **1-A** is used to cause a current of air **86** to flow over the coil **25.1** for cooling.

FIG. **1-B** shows a condenser **91** having a coil **92** with an outer lagging **93** of absorbent material, and means **94** for moistening the lagging. Evaporation of the moisture results in cooling — so that the coil **92** connected as before described — is also cooled extracting heat from the gas so as to condense it. Evaporation cooling as above is, as is well known, particularly effective in conditions of high ambient temperature and low humidity. Fan cooling means as FIG. **1-A** can be included to increase evaporization.

THE HAND APPLICATOR

DESCRIPTION OF FIGS. 5 AND 6

The applicator **33** has fluid inlet and vacuum connections **32** and **34** aforesaid, and includes a transversely extending elongated head portion **96** having a hollow interior enclosed by front and rear walls **96.1** and **96.2** respectively, opposite end walls **98,** and a top wall **100.** The head has an open flat bottom provided with a large mouth **101.** A baffle **102** is disposed within the mouth **101** extending transversely between the end walls **98,** so as to partition the interior of the head into two chambers, a front vacuum chamber **104** and a rear spray chamber **106.** A lower edge surface of the baffle **102** can have spaced notches **103** to minimize the gripping power of the vacuum when end walls of the mouth **101** are in contact with upholstery or other fabric.

At least one spray nozzle **108** is mounted in the rear wall **96.2** within the spray chamber so as to direct a liquid spray uniformly outwardly of the mouth **101.** The spray nozzle **108** has a coupling **110** at an exterior face of the rear wall **96,** to which coupling one end of a short length of flexible tubing **112** is attached. An opposite end of the tubing **112** is coupled to an outlet end of a shutoff valve **114** mounted on an upper portion of the head **96.** A lever **115** is provided so that the valve can be controlled by hand.

The applicator above is a hand tool as described in US Pat. No. 3,562,844, issued 16 Feb. 1971 in which the present inventor is named as co-inventor. This is adapted for use on drapes and upholstery being processed according to the present invention.

In FIG. **6** the applicator is shown with end walls of the mouth in contact with an outer surface **47.1** of a fabric **47.2** having as here illustrated, a nap **47.3.** The fabric is shown in section, with exaggerated depth. The hand tool is moved in a direction shown by an arrow **117,** the solvent spray from the nozzle **108** passing as shown by the arrows **48** passing through the nap **47.3** and over the surface **47.1** to the vacuum chamber **104.** In so

doing the solvent picks up soil from the fabric. It is seen that there is an incremental strip **47.4** of fabric being sprayed, and a contiguous incremental strip **47.5** being subjected to vacuum. The applicator thus provides a confined vacuum space defined by the vacuum chamber **104** and the incremental strip **47.5**, and a confined spray space defined by the spray chamber **106** and the strip **47.4**

A rug or carpet, or floor, tool (not shown) differs from the hand applicator **33** in size, and in obvious provision of handle means to move it along the rug or carpet. Because of the increased size, a plurality of spray nozzles is provided.

DESCRIPTION OF THE CONTINUOUS PROCESS

From the description of mechanical operation it is seen that the process therein expressed includes steps as follows.

The soil laden solvent is withdrawn from the fabric. The solvent as continuously withdrawn is in a liquid state although, having been discharged as a spray, it will be mainly small droplets with the soil being contained in the droplets.

The state of the solvent so withdrawn is then changed to gas. This is accomplished by adding heat, effected by the heating element **43**, FIG. **1**, or by one of the means illustrated in FIGS. **2** and **3**, or for instance by electronic means not shown.

It is now required to change the state of the soil free gas to liquid solvent. This is effected by extracting heat in a condenser according to FIG. **1**, **1-A**, **1-B**, or by suitable heat exchange means.

The first change of state above requires heat to be added according to the latent heat of the solvent — while the second change of state requires heat to be extracted in the like amount. The particular means used to effect the addition and extraction of heat are not relevant to the method.

Finally, the recovered cleaned solvent is collected. In the FIG. **1** apparatus it is introduced into the solvent supply tank **12** recirculated and reused — to have its soil removed as before. Thus there is a cycle in which the solvent is sprayed on the fabric, picks up soil, is removed, loses the soil in the first change of state, the second change of state results in clean solvent — and the cycle repeats.

With the FIG. **1** apparatus, pressure of discharge of the solvent through the nozzle **108** FIG. **2** is (when the pump is not by-passed) limited as aforesaid to somewhat less than pump plus vacuum pressure.

With this limited pressure, in order that the spray do its work rather than escape in material quantity and be dissipated in the open air, it is confined in a spray space defined by the spray chamber FIG. **6** and the incremental strip being sprayed. The vacuum too is confined in a vacuum space defined by the vacuum chamber FIG. **6** and the contiguous incremental strip. With relative motion of the applicator to the carpet as shown by an arrow **117** FIG. **6** the incremental strip after being sprayed is exposed to the vacuum. The exposure commences immediately and, the incremental strip having a finite width in the direction of travel exposure of the incremental strip to vacuum is substantially immediate — which term is used herein to describe the action above.

An applicator or head according to U.S. Pat. No. 3,436,787 or U.S. Pat. No. 3,439,374, both of which is issued to the present inventor, can be used upon rugs and carpets. As well as differing from the hand applicator in size, both heads have additional heating means. The first patent above has a heated head, and in the second lips of the nozzle are also heated. Each requires additional electric power.

These heads do not confine the jet as in the applicator **33**, but they provide means to increase the pressure of discharge. With the increased pressure confinement is not necessary. However, a lower limit of pressure for effective spray operation of the above heads is about 20 psi, and 30 to 40 psi is ordinarily used. This is higher than that required for satisfactory operation of the hand applicator 33 — which in some circumstances can work without a pump at all. Hence when either patented head is used with the FIG. **1** apparatus, the liquid pump **28** is capable of delivering 30 or 40 psi, This indicates a positive displacement pump such as e.g. a Roote pump or a piston pump.

It will be observed that, while spraying and exposure to vacuum occur simultaneously in time, as seen by the incremental strip there are two discrete actions, first exposure to the spray then substantially immediately thereafter exposure to the vacuum. Using the process as most of the solvent sprayed is readily recovered both with the hand applicator **33** and with either heated head above.

The process can also be expressed in an apparatus (not shown) wherein the fabric is caused to move with respect to a stationary applicator. This part of the process is expressed in any apparatus providing relative motion between applicator and fabric, whether the applicator moves as in the described apparatus, or whether the carpet moves as in apparatus for use in a fixed position, e.g. a cleaning plant.

With the hand applicator **33**, or using a heated head according to either patent above in lieu of the illustrated applicator, the process is restricted to use with a non-flammable solvent. While the process is operative with a solvent regardless of whether, or what, odor it have, for practical reasons the process is used with an odorless or nearly odorless non-toxic solvent, or at the lowest with a solvent having an odor which disappears rapidly after the fabric has been cleaned.

What I claim is:

1. A continuous process of recovering cleaned non-inflammable dry cleaning solvent from soil laden solvent, the solvent being used in a remote applicator for cleaning drapes, upholstery, rugs and like fabric having an outer surface, the applicator receiving clean solvent and returning soil laden solvent, there being relative motion between the applicator and the surface being cleaned, the process including steps of:

a. discharging clean solvent liquid under pressure from the applicator as a spray directed to impinge an incremental strip of the outer surface of the fabric, the solvent extracting soil from the fabric to form soil laden solvent,

b. substantially immediately thereafter exposing the incremental strip to a vacuum to withdraw the soil laden solvent from the fabric, the solvent being substantially liquid as it is withdrawn,

c. vaporizing the withdrawn soil laden solvent liquid into a soil free solvent gas to separate the soil from the solvent,

d. condensing the soil free solvent gas into liquid remote from the separated soil so as to obtain soil free solvent liquid,

e. collecting the recovered solvent liquid,

f. returning the recovered solvent liquid back to the applicator for recycling through the steps above.

2. A continuous process as claimed in claim **1** in which vaporization of the solvent is effected by heating.

3. A continuous process as claimed in claim **1** in which the exposure of the incremental strip to vacuum is effected by a vacuum produced in a confined space defined in part by the incremental strip.

4. A continuous process as claimed in claim **1** in which the discharge of solvent onto the incremental strip is effected from within a confined spray space defined in part by the incremental strip.

5. A continuous process as claimed in claim **1** in which the solvent has a relatively low boiling point and a relatively low latent heat.

6. A continuous process as claimed in claim **1** in which the condensation of the soil free solvent gas into liquid is effected by heat exchange between ambient air and the gas.

7. A continuous process as claimed in claim **1** in which the condensation of the soil free solvent gas into liquid is effected by heat exchange between a relatively colder liquid and the gas.

8. A continuous process as claimed in claim **1** in which the condensation of the soil free solvent gas into liquid is effected by heat exchange between evaporation of a second liquid and the soil free gas.

9. A continuous process as claimed in claim **2** in which the heating takes place under a pressure less than atmospheric.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,775,053 Dated November 27, 1973

Inventor(s) Dorothea R. Wisdom

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The name of the inventor is incorrect and should read:

-- [75] Inventor: William H. Wisdom, Deceased, by Dorothea R. Wisdom, Executrix, 23017 Kent Street, Torrence, Calif. 90505 --

Signed and sealed this 29th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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