

[54] MEANS FOR CONTROLLING THE DRYING OF TEXTILES AND RECLAIMING THE LIQUID THEREFROM

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[58] Field of Search 34/72, 73-77, 34/130, 131, 242, 140, 126, 127; 68/18 C, 18 F

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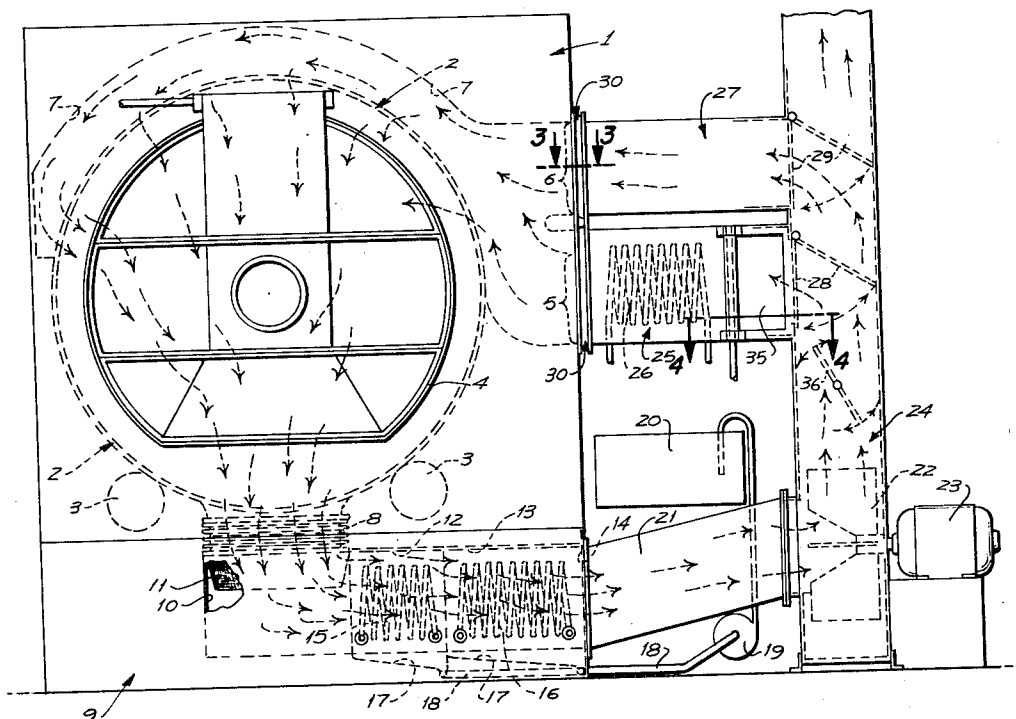
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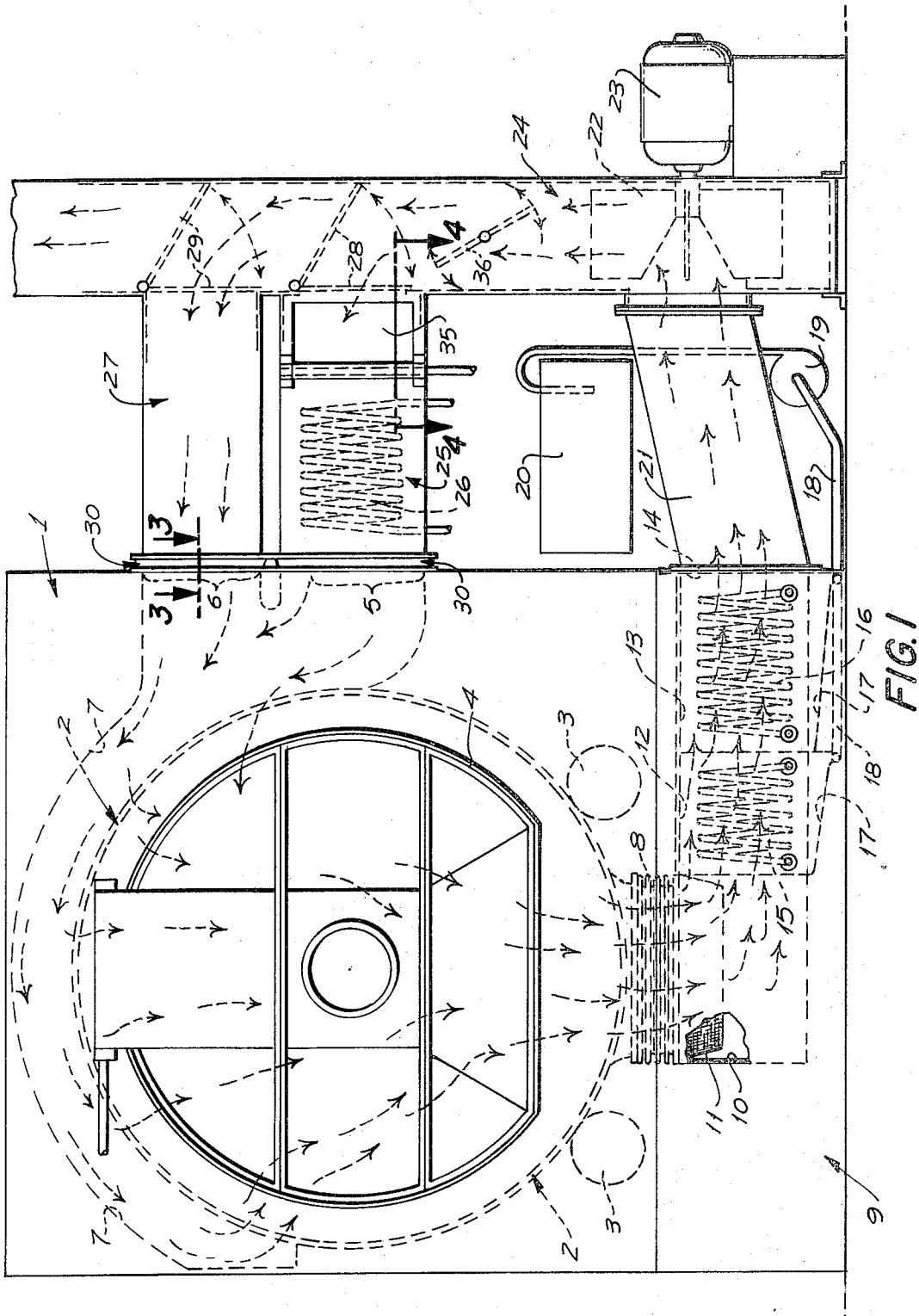
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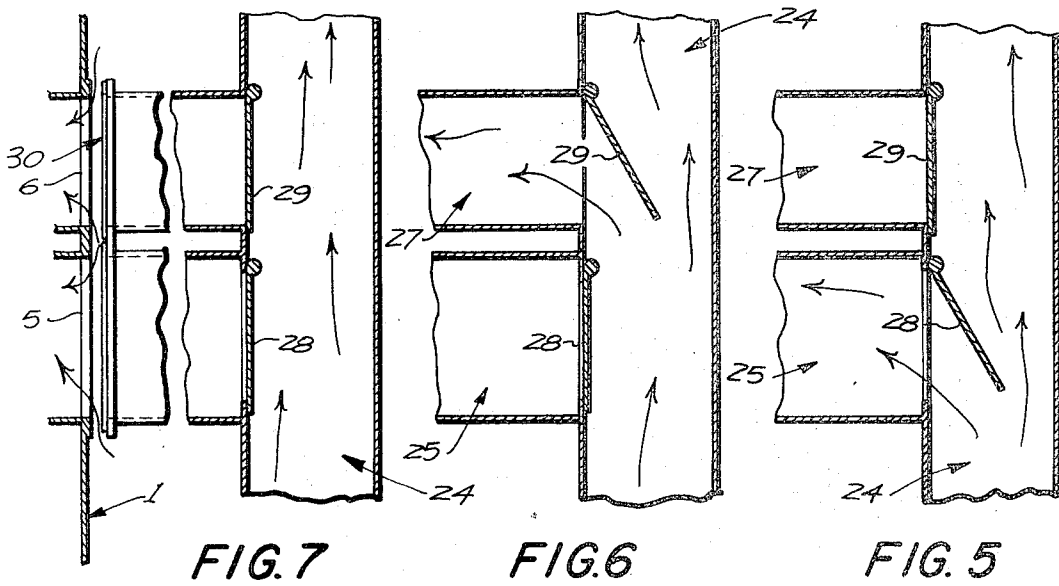
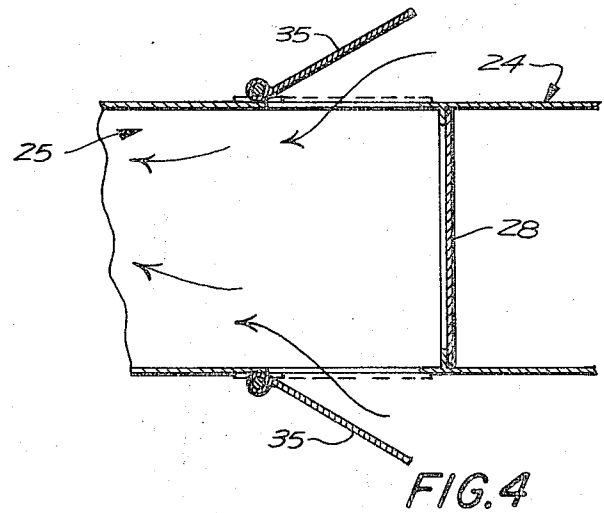
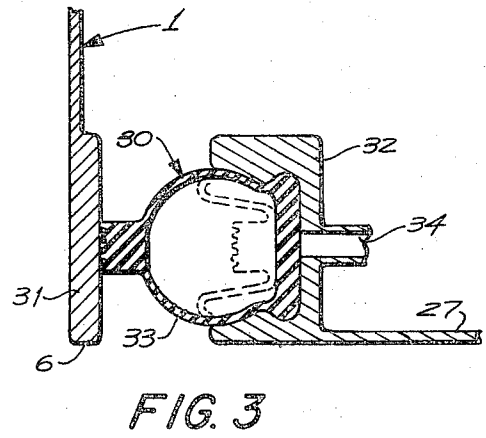
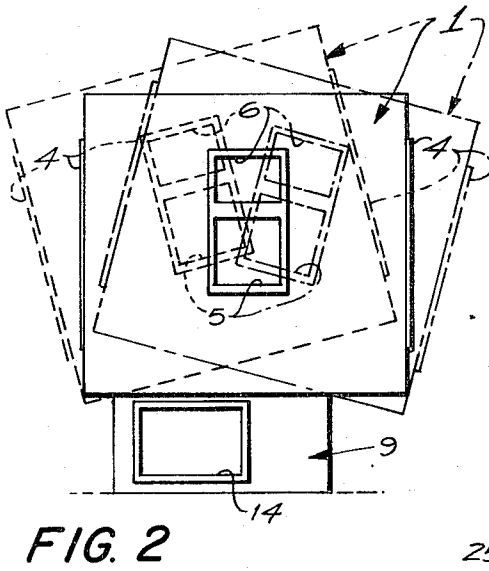
[57] ABSTRACT

A means for controlling the drying of textiles which contains a cleaning solvent or a mixture of cleaning solvent and water, the textiles being placed in a rotatable tumbling drum, then subjected to air maintained below atmospheric pressure, the air passing through the drum and subsequently through cooling units which condense the vapor removed by the air. Means are provided for varying the drying procedure such as heating the air; recirculating and reheating a preselected portion of the air; recirculating selected portions of the air without heating; introducing ambient air; and controlling the total volume of the air.

5 Claims, 7 Drawing Figures







MEANS FOR CONTROLLING THE DRYING OF TEXTILES AND RECLAIMING THE LIQUID THEREFROM

BACKGROUND OF THE INVENTION

The drying of textiles containing a cleaning solvent, or a mixture of a cleaning solvent and water, has been accomplished in essentially the same manner as the drying of water soaked textiles; namely, by passing heated air through textiles contained in a tumbler drum and then discharging to atmosphere. The entrained water vapor, being a natural ingredient in the air mixture, poses no problem; however, the various cleaning solvents (a commonly used one is perchlorethylene) are sources of contamination. Furthermore, cleaning solvents are comparatively expensive. It would thus seem that recovery of the cleaning solvents would be a common practice; whereas, the reverse is true. This is due to the fact that heretofore solvent recovery systems, to be efficient, were necessarily large, too large for individual tumbler dryers, and quite expensive; hence, the present practice of wasting the solvent and contaminating the atmosphere.

SUMMARY OF THE INVENTION

The present invention is directed to a means for controlling the drying of textiles and reclaiming the liquid therefrom, which may be a solvent other than water or a mixture of such solvent and water, and is summarized in the following objects:

First, to provide a means for controlling the drying of textiles which may be adapted for use with various types of tumbler dryers to permit their use for drying textiles containing a cleaning solvent as well as water or in place of water; the controlling means being particularly adapted for use in conjunction with the type of tumbler dryer disclosed in my previous U.S. Pat. No. 3,601,903.

Second, to provide a means for controlling the drying of textiles which facilitates low temperature drying of the textiles to prevent damage, particularly to synthetic fabrics, and to minimize wrinkling the material.

Third, to provide a means for drying textiles containing cleaning solvent wherein the tumbler dryer need not be sealed to prevent escape of solvent vapors; instead, the interior of the tumbler dryer is maintained at a reduced pressure whereby surrounding air flows inwardly through any openings that may be present.

Fourth, to provide a drying means as indicated in the preceding object wherein, by maintaining a negative pressure in the drying drum, the water or solvent is more readily vaporized at a lower temperature.

Fifth, to provide a means of drying textiles as indicated in the other objects, wherein the air and entrained water or solvent vapors are, on issuing from the tumbler dryer, passed through cooling means to condense the vapors for removal or collection for reuse.

Sixth, to provide a means for drying textiles, as indicated in the other objects, wherein a preselected proportion of the air from which the liquids have been removed may be recycled; and wherein the recycled air may be divided into a heated portion and non-heated portion for temperature control or, if desired, all the recycled air may be received from the cooling means thereby to accomplish a cool-out cycle.

Seventh, to provide a means for drying textiles which may be operated as a single pass system; that is, the air may pass only once through the drum, then chilled to remove vapors, then discharged; the discharged air having minimal contamination, and also being cooled, may be passed through activated carbon beds for efficient final cleaning with minimal effect on the activated carbon bed.

DESCRIPTION OF THE FIGURES

FIG. 1 is an essentially diagrammatical front view of the means for drying textiles showing the path of movement of the air.

FIG. 2 is a side view of the tumbler dryer unit at a reduced scale taken from 2—2 of FIG. 1 and indicating various typical positions thereof.

FIG. 3 is an enlarged fragmentary sectional view of the inflatable seal means taken through 3—3 of FIG. 1.

FIG. 4 is a fragmentary sectional view taken through 4—4 of FIG. 1 showing the ambient air inlet gates.

FIG. 5 is a fragmentary diagrammatical view showing the system arranged for recirculating and heating the air.

FIG. 6 is a similar fragmentary diagrammatical view showing the system arranged for the recirculating of cooled air.

FIG. 7 is a similar diagrammatical view showing the system arranged for drawing in ambient air at ambient temperature.

SPECIFICATION

The means and method of drying textiles and reclaiming the liquid therefrom comprising the present invention is preferably arranged to utilize the tumbler dryer disclosed in U.S. Pat. No. 3,601,903 and reference is made thereto concerning the details of construction. The tumbler dryer unit includes a tumbler housing 1 having a tumbler drum 2 mounted on supporting and driving rollers 3 or separately driven by means not shown. Each end of the tumbler housing is provided with an access door 4, disposed coaxially with the center of rotation of the tumbler drum.

One side of the tumbler housing is provided with a heated air inlet 5 and a cooled air inlet 6, which communicate with an arcuate delivery duct 7 extending over the tumbler drum 2. Below the tumbler drum there is provided a bellows 8, which forms a discharge duct. As more fully described in the above-mentioned patent, air flows from the delivery duct 7 into the end portions of the tumbler drum, then travels to the central portion thereof for discharge through the bellows 8.

The tumbler housing 1 is mounted on a base structure 9 and is supported in such a manner that it may be tilted, as suggested in FIG. 2. The base structure is provided with a chamber 10 communicating with the bellows 8 and provided with a lint screen 11. The chamber 10 communicates laterally with a first cooling chamber 12 which, in turn, is joined to a second cooling chamber 13. The second cooling chamber communicates with an outlet 14, situated in the side wall of the base structure 9 corresponding to the side wall of the housing having the inlets 5 and 6.

The cooling chambers 12 and 13 are provided, respectively, with condensing coils 15 and 16, each having a condensate sump 17. The first cooling chamber

and its condensing coil reduces the air temperature to a point to cause condensation of water vapor from the air but not to freeze the water. The second cooling chamber and its condensing coil operates at a somewhat lower temperature than the first coil, but still above a freezing temperature, to condense from the air cleaning chemicals present in the textiles.

A common condensate line 18 is connected to both sumps for receiving water and the cleaning chemical, which is raised by a pump 19 to a collecting and separating vessel 20. The water and cleaning chemical are immiscible in their liquid phase and have different densities so that they may be drawn separately from the vessel 20 to permit reuse, particularly reuse of the cleaning chemical.

The outlet 14 communicates with an air receiving duct 21 which is connected to a blower 22, having a motor 23. The blower is so arranged as to produce a negative or subatmospheric pressure at its intake and a positive pressure or ambient pressure at its outlet. As a result, the air in the tumbler drum and the entire ducting within the tumbler housing 1 is maintained at a sub-atmospheric pressure.

The blower 22 discharges into a stack 24, which discharges the air to atmosphere or into appropriate filters. By reason of the removal of the water and cleaning liquid, particularly the latter, the discharged air is almost free of contaminants. The residual contaminants are so low that complete removal may be attained by use of a conventional activated carbon filter at minimal expense.

A heated air entrance duct 25 branches from the discharge stack 24 and communicates with the heated air inlet 5. The duct 25 is provided with a heating coil 26. A cooled air entrance duct 27 communicates between the discharge stack 24 and the cooled air inlet 6. At their junctures with the discharge stack 24, the ducts 25 and 27 are provided respectively with inlet gates 28 and 29, which move into the discharge stack so as to deflect air discharged from the blower 22 into the ducts 25 and 27.

In order to permit tilting of the tumbler housing 1 and also to provide a source of ambient air, each duct 25 and 27 is provided with an inflatable seal 30, as shown in FIG. 3. Each seal includes an inlet margin 31 surrounding a corresponding inlet 5 or 6 and a confronting flange 32 carried by the duct 25 or 27. Each flange 32 carries an inflatable seal tube 33 which, when inflated, engages the corresponding margin 31. A supply line 34 supplies fluid under pressure to the corresponding seal tube 33, when it is desired to connect the ducts 25 and 27 to the respective inlets 5 and 6. When the seal tubes 33 are deflated, space is provided between the ducts 25 and 5 and between 27 and 6 for the entrance of ambient air into the delivery duct 7.

In addition to the entrances for ambient air provided by the inflatable seals 30, the heated air entrance duct 25 may be provided upstream from the heating coil 26 with a pair of ambient air inlet gates 35, as shown in FIG. 4. In order to control the total flow of air, the discharge stack 24 may be provided between the duct 25 and the blower 22 with a flow regulating gate 36.

The flow system provided by the various ducts and the control gates has several modes of operation so that it may be adapted to various cleaning procedures. In each case, the suction side of the blower draws air into the tumbler housing so that a negative pressure is main-

tained in the various ducts provided in the tumbler housing. As a consequence, there is no outward spilling of air to contaminate the surrounding area. Instead, at the various junctures between moving and fixed parts, ambient air is drawn into the system so as to prevent escape of solvent vapors in the work area. It is advantageous to draw in ambient air, for the need for seals is eliminated or at least minimized.

One mode of operation, as indicated in FIG. 5, involves closing the inflatable seals 30, closing the cooled air entrance duct inlet gate 29 and opening the inlet gate 28. With this arrangement a selected portion of the air is recirculated past the heating coil 26, and the complementary portion of the air is vented through the discharge stack 24 so as to regulate the temperature independently of temperature regulation by adjustment of the heating coil 26.

Another mode of operation is indicated in FIG. 6. Here the inflatable seals 30 are closed, the inlet gate 28 is closed and the inlet 29 is open, so as to recycle a selected portion of the cooled air discharged by the blower 22 to effect more efficient use of the air.

A third mode of operation involves the closing of both inlet gates 28 and 29, as well as gates 35 and opening the inflatable seals 30. In this case, the only air which enters the tumbler drum 2 is ambient air, which makes only a single pass through the drum before being vented through the discharge stack 24. If it is desired to heat the ambient air, the inlet gates 35 may be open and inflatable seals 30 left open or closed as desired. Again, the air makes a single pass through the tumbler drum. This mode of operation becomes feasible if the ambient air is sufficiently low in moisture content and is essentially free of contaminants.

By varying the positions of the various gates 28, 29 and 35, and by opening or closing the inflatable seal 30, the mode of operation may be adapted to meet virtually any desired condition and to adjust to various selected drying times and to adjust to various atmospheric conditions, so that the control system may be readily installed in various existing commercial laundry or cleaning systems.

In each case, this is accomplished with effective removal of the cleaning solvents for reuse.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the details of the constructions set forth, but instead, the invention embraces such changes, modifications and equivalents of the various parts and their relationships as come within the purview of the appended claims.

I claim:

1. A dryer means for textiles containing water and a cleaning solvent other than water, comprising:
 - a. a tumbler dryer including a housing structure, a rotatable tumbler drum mounted in the housing structure, an inlet to the drum and an outlet from the drum;
 - b. means defining a flow passage externally of the drum between the outlet and the inlet;
 - c. a blower in the flow passage means for recirculating air through the drum;
 - d. a heater in the flow passage means;
 - e. a first condenser unit mounted in the flow passage means downstream from the outlet of the drum, said first condenser unit being temperature ad-

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- justed to condense water vapor issuing from the drum;
- f. and a second condenser unit mounted downstream of the first condenser unit, said second condenser unit being temperature adjusted below the temperature of the first condenser unit to condense the non-water cleaning solvent vapor issuing from the first condenser unit.
2. A dryer means for textiles containing a vaporizable mixture including water and a cleaning solvent, comprising:
- a tumbler dryer including a housing structure and a drum thereby being restricted communication between the interior of the drum and the exterior of the housing structure for admission of ambient air, an inlet to the drum, and an outlet from the drum;
 - means defining a flow passage externally of the drum between the outlet and the inlet;
 - a blower in the flow passage means for recirculating air through the drum;
 - a heater in the flow passage means;
 - a first condenser unit mounted in the flow passage means upstream of the blower, said first condenser unit being temperature adjusted to condense water vapor issuing from the drum;
 - a second condenser unit mounted downstream of the first condenser unit, said second condenser unit being temperature adjusted below the temperature of the first condenser unit to condense the non-water cleaning solvent vapor issuing from the first condenser unit;
 - a vent stack communicating with the flow passage means between the blower and the inlet;
 - and valve means for proportioning the air discharged through the vent stack and the air returned to the drum, the returned air supplementing the ambient air received in the drum to maintain a predetermined subatmospheric pressure in the drum thereby to minimize escape of solvent vapors from the tumbler dryer.
3. A dryer means for textiles containing a vaporizable cleaning solvent mixture, comprising:
- a tumbler dryer including a housing structure and a drum, and means providing restricted communi-

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- cation between the interior of the drum and the exterior of the housing structure for admission of ambient air, an inlet to the drum, and an outlet from the drum;
- means defining a flow passage externally of the drum between the outlet and the inlet;
 - a blower in the flow passage means for recirculating air through the drum;
 - a heater in the flow passage means between said blower and said inlet;
 - a condenser means mounted in the flow passage means downstream from the outlet of the drum, for condensing cleaning solvent vapors issuing from the drum;
 - a vent stack communicating with the flow passage means between the blower and the inlet;
 - a vent stack flow control valve and a heater flow control valve in said flow passage between said blower and said stack; and
 - an ambient air flow control valve adjacent said inlet;
 - said valves being individually adjustable to proportion the air discharged through the vent stack and that returned to the drum to maintain a predetermined subatmospheric pressure in the housing structure and drum thereby to maintain a flow of ambient air through the restricted communication to minimize escape of cleaning solvent vapors from the drum.
4. A dryer means for textiles as defined in claim 3, wherein:
- the said valves are operable to close-off backflow to the drum and discharge air from the drum through the vent stack, while ambient air is drawn into the drum.
5. A dryer means for textiles as defined in claim 3 wherein said ambient air flow control valve comprises:
- an axially extensible and retractable valve device disposed between the air inlet and flow passage means for admission, when retracted, of ambient air into the inlet and for sealing, when extended, the inlet with respect to the flow passage means.

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