

W. F. GAYRING

EXPLOSION PREVENTION CONTROL FOR DRY CLEANING MACHINES

Filed May 20, 1942

3 Sheets-Sheet 1

BY

Bodell and Thompson
ATTORNEYS

Oct. 26, 1943.

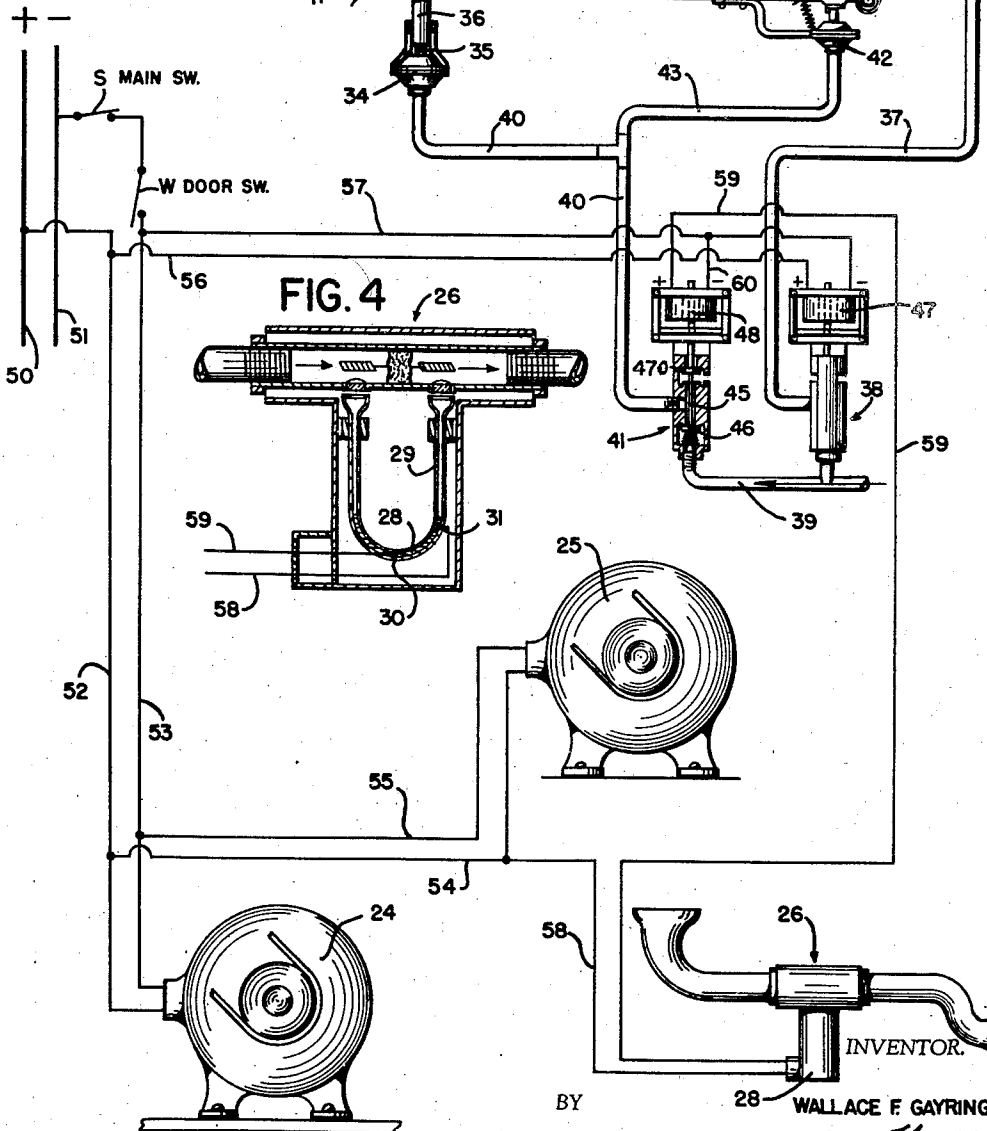
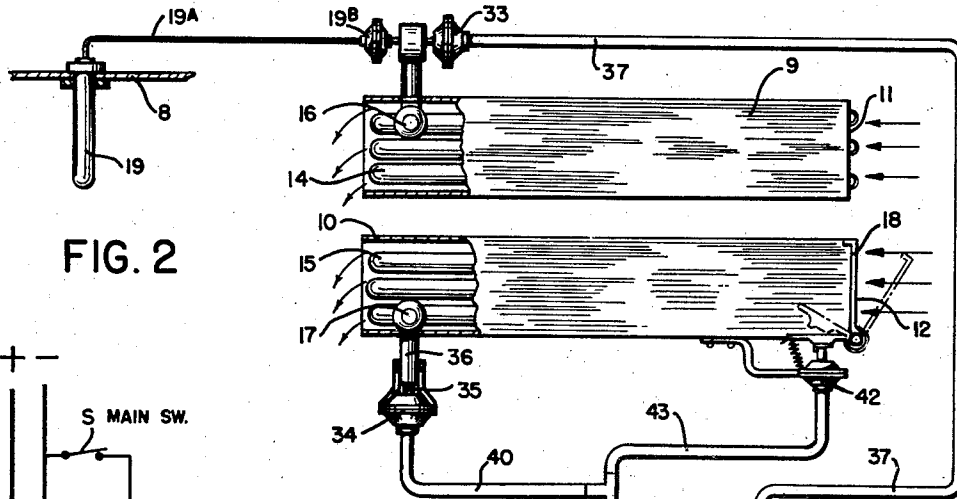
W. F. GAYRING

2,333,000

EXPLOSION PREVENTION CONTROL FOR DRY CLEANING MACHINES

Filed May 20, 1942

3 Sheets-Sheet 2



Oct. 26, 1943.

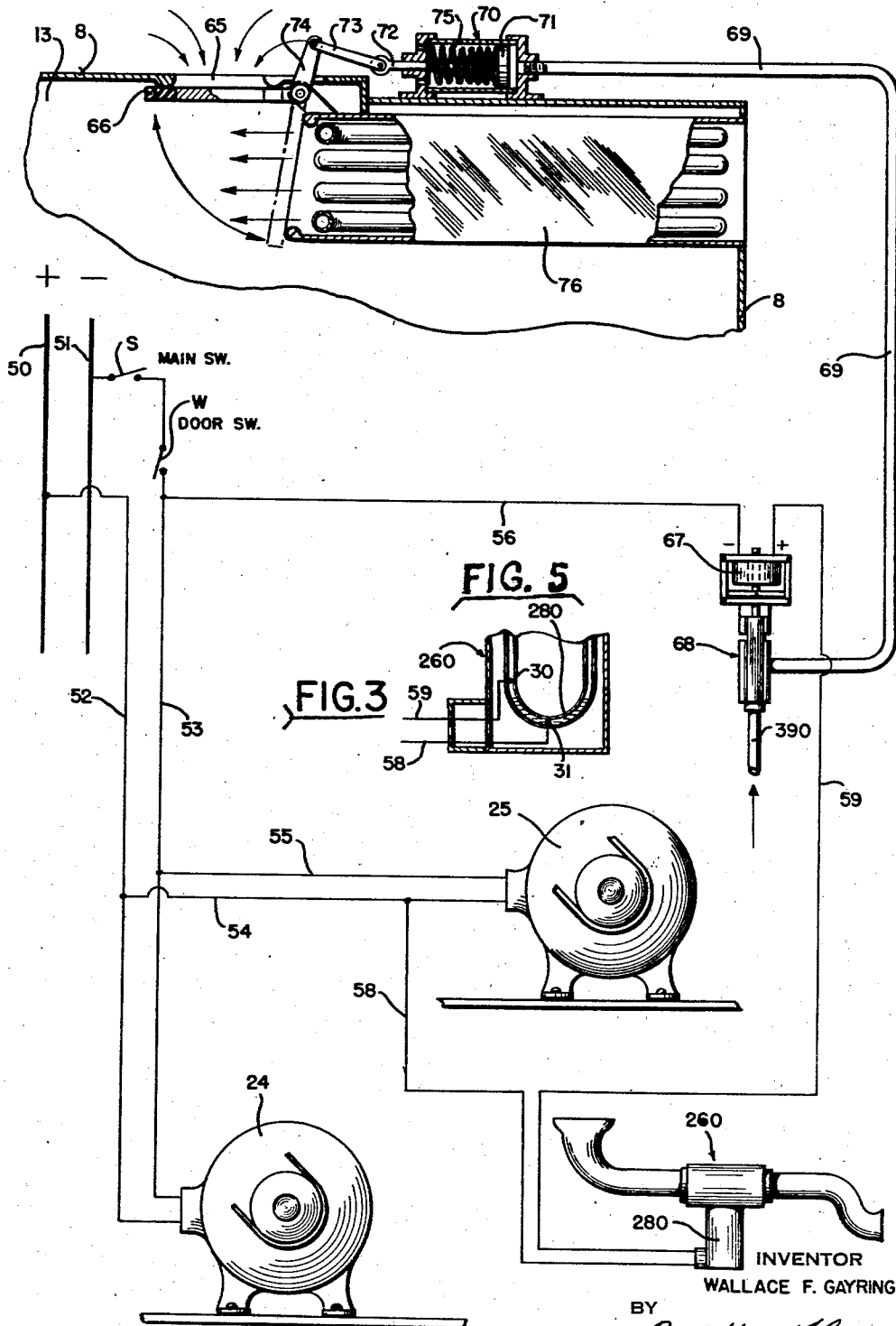
W. F. GAYRING

2,333,000

EXPLOSION PREVENTION CONTROL FOR DRY CLEANING MACHINES

Filed May 20, 1942

3 Sheets-Sheet 3



INVENTOR
WALLACE F. GAYRING

BY *Badell and Thompson*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,333,000

EXPLOSION PREVENTION CONTROL FOR
DRY-CLEANING MACHINES

Wallace F. Gayring, Minoa, N. Y., assignor to
The Prosperity Company, Inc., Syracuse, N. Y.,
a corporation of New York

Application May 20, 1942, Serial No. 443,757

3 Claims. (Cl. 34—48)

This invention relates to machines for removing the residual solvent from articles after being dry cleaned and the solvent for the most part removed, as by a centrifugal extractor. In removing the residual solvent and de-odorizing such articles, heated air is passed through the articles, while in the machine, to vaporize the residual solvent, while the articles are being agitated in the machine. Such a machine is usually called a drying tumbler. A mixture of air and vapor of known concentration, or proportion of air and vapor, is explosive at or above a known flash point. In removing the residual solvent at the beginning of the operation, when the articles contain a maximum of residual solvent, the mixture at the proper concentration of air and vapor to be explosive is liable to form immediately. Therefore, the temperature of the incoming air is below the lowest known flash point of the mixture of air and vapor. As the removal of the residual solvent continues and the proportion of air to the vapor increases, the concentration point is not readily reached. Hence, air at a higher temperature than the flash point may be used to facilitate the removal of the residual vapor and the de-odorizing of the article.

The invention has for its object means for controlling the temperature of the air passing into the machine in accordance with the explosive concentration point of the mixture, or specifically by a device sensitive to an explosive mixture, which, when the vapor approaches explosive concentration at any time in the operation, immediately lowers the temperature of the incoming air to below the point of danger of explosion, or means for automatically controlling the heating and cooling of the air by a device sensitive to the explosive vapor in the air stream.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

Figure 1 is a vertical sectional view of a drying machine embodying this invention.

Figure 2 is a diagrammatic view illustrating the control of the air by the explosive sensitive device.

Figure 3 is a diagrammatic view similar to Figure 2 of a slightly modified form of the invention.

Figure 4 is a sectional view of one form of device sensitive to an explosive mixture.

Figure 5 is a sectional view of the said device as used in the arrangement shown in Figure 3.

1 designates the drying tumbler including an outer casing having a perforated drum 2 there-

in mounted to move or oscillate about a horizontal axis in the casing, it being shown as mounted upon a shaft 3 journaled in any suitable manner in the casing. The outer casing and the drum 2 have doors 4, 5, respectively, for loading and unloading the articles, it being necessary to move the drum into such radial position that the door 5 is alined with the door 4 when loading and unloading. The casing is provided with an inlet 6 at its upper portion for air, and with a contracted outlet 7 at its lower end, the air passing through the perforations of the drum and through the articles or clothes C therein and out through the outlet 7, while the drum 2 is being oscillated to tumble the clothes. The machine and parts pertinent thereto, to be described, are enclosed in a suitable cabinet 8.

The means for heating the incoming air may be of any suitable construction, and as here shown, two heat exchangers 9, 10 are provided in the upper portion of the cabinet, these opening at their outer ends at 11 and 12 to the outer air and opening at their inner ends into a chamber 13 at the top of the cabinet which communicates with the air inlet 6 of the casing 1. The heat exchangers 9, 10 may be of any suitable construction, and as here illustrated includes suitable heating elements, here shown as steam coils 14, 15 respectively. The flow of steam through the coils 14, 15 is controlled by valves 16, 17 respectively. These valves are controlled in their operation by devices sensitive to an explosive mixture to be presently described, and also the flow of air through the heat exchanger 10 is controlled by a damper or closure 18 also controlled by said device. One of the valves, as 16, is initially controlled by a thermostat 19 arranged in the chamber 13 to partly open the steam valve 16 to maintain a temperature when the machine is in operation at a point below the known lowest flash point of the mixture of air and solvent, for instance, assume that the lowest flash point is 140° F., the thermostat 19 operates to close the valve 16 at 130° F. The mixture of air and solvent is caused to pass out the casing 1, as through the contracted outlet 7 by means including a blower 20, the inlet side of which is connected to the outlet 7 of the casing 1, and the discharge side of which communicates with a suitable outlet pipe 22. The rotor 23 of the blower is actuated by a suitable electric motor 24. Also, the drum 2 is actuated by a suitable electric motor 25.

The temperature of the air passing into the casing 1 is controlled by mixture sensitive device 26 having an intake arranged to receive the mixture, preferably as near as possible to the outlet 7, said device controlling the opening and closing of the steam valves 16, 17 and the damper 18. The valves 16, 17 and also the

damper 18 are operated by compressed air motors or instrumentalities controlled by the mixture sensitive device.

The mixture sensitive device operates on the principle of explosion meters and the specific construction thereof forms no part of this invention. It is arranged so that portions or samples of the vapor are being continuously forced through it by the draft created by the blower 20. The device here shown is fully described in Patent Number 1,779,569 issued October 28, 1940. When there is an explosive concentration passing through the device 26, it operates to open a normally closed switch 28 including mercury located in the bend of a U-shaped tube 29 and normally bridging two contacts 30, 31 in an electric circuit in the embodiment of the invention shown in Figures 1, 2 and 4. When there is an explosive concentration in the device, the column of mercury is shifted out of contact with one of the contacts 30, so that the circuit controlled by the mixture sensitive device is opened. Thus, when there is no explosive concentration passing through the device, the circuit controlled by the switch 28 is closed. When the switch 28 is closed, the heat generated in the mixture sensitive device and the tube 29 opens the switch 28. This switch is located in a circuit including electro-responsive devices, which operate the steam valves, causing the steam valves to close and permit cold air or air in this instance not above 130° to pass into the casing 1 and the tumbler. The purpose of the damper 18 is to close the heat exchanger 10 to the passage of air therethrough over the steam coils 15, which remain hot for a period after the steam valve 17 is closed, so that when the damper 18 is closed, even though the steam coils 15 are hot, the air is not being circulated over the coils by the blower 20. Thus, when the damper 18 is closed, the casing of the heat exchanger 10 is closed to the inlet of air, and hence the air passing into the tumbler is heated only by the air passing through the heat exchanger 9, the steam valve of which is closed, except that it may be partly open under the influence of the thermostat 19. The thermostat 19 merely acts, when heated, to expand the fluid through pipe 19^a connecting the end of the diaphragm chamber 19^b with sufficient pressure to partly open the valve 16 when the diaphragm chamber 33 is not energized.

The air operated mechanism for operating the valves 16, 17 and the damper 18 will now be described.

The steam valves 16 and 17 are operated by air pressure to open position, and the means for operating them comprises diaphragm chambers 33, 34, one for each, the movement of the diaphragm in the chamber transferring the motion to the movable member of the valve 16 or 17 through suitable motion transmitting means including a rod 35 movable in a guide 36 and connected to the movable member of the valve. The pressure side of the diaphragm chamber 33 for the valve 16 is connected by a conduit 37 to the casing 38 of a combined intake and exhaust valve, the casing being connected to a supply pipe 39. The pressure side of the diaphragm chamber 34 for the steam valve 17 is connected by a conduit 40 to the casing 41 of a combined intake and exhaust valve, this casing being connected to the supply pipe 39. The damper 18 is also operated by a diaphragm in a similar diaphragm chamber 42, the pressure side of

which is connected by a pipe 43 to the casing 41 of the combined intake and exhaust valve. The valves 38, 41 are of the same construction, and in the construction here shown, 45 designates the movable valve member having a normally closed, spring pressed, intake head 46 and a normally open, exhaust valve head 47, these being connected so that they act as a unit. When the members 45 in the casing 38 and 41 are operated to open the intake head and close the exhaust head, air passes from the main line 39 through the valve 38 and pipe 37 to the diaphragm chamber 33 to open wide the steam valve 16 and through the valve 41, pipe 40 to diaphragm chamber 34 for the steam valve 17, and pipe 43 to diaphragm chamber 42 to open the damper 18.

The valves are electrically operated by electro-responsive devices, as solenoids 47, 48, the core of which is connected to the movable member of the valve 38 or 41.

The motor 24 is connected in feed wires 50 and 51 as follows: Through wire 52 and return wire 53. The motor 25 is connected in the feed circuit through wires 52, 54 and return wire 55. The windings of the solenoid 47 are also connected in the feed circuit through wire 52, wire 56, and return wire 57 to the other feed wire 51. The windings of the solenoid 48, which controls the steam valve 17 and damper 18, are connected in the feed circuit through the circuit in which the switch 28 of the mixture sensitive device is located, this circuit being as follows: Feed wire 50, wire 52, wire 54, wire 58 to contact 31 of the switch 28, wire 59 leading from the contact 30 of the switch 28 of the mixture sensitive device to the windings of the solenoid 48, wire 60 to return wire 57. Suitable control switches S—W are located in series in the feed line, one operated by hand, and the other by the door 4 of the casing 1.

The valve 16 is opened by the operation of the solenoid 47, the windings of which are connected directly in the feed circuit through wires 50, 57 so that when the feed circuit is closed by the switches S—W, the solenoid 47 is immediately energized and the valve 16 opened.

At the start, the switch 28 of the mixture sensitive device is normally closed. The vapor from the clothes, when first placed in the drum 2, is usually at or above the concentration point. The opening of valve 16 is controlled by the action of the thermostat 19 to heat the air up to 130°, that is, up to a point below the flash point of the vapor from the solvent, this being about 140°. Upon the closing of the door, the motors 24, 25 are energized, and hence, as the blower 23 is now in operation, the vapor is drawn from the casing 1 through the outlet 7 and a part or sample of it forced continuously through the mixture sensitive device. As this vapor is near, at or above the concentration point, the switch 28 of the mixture sensitive device is opened, and hence the circuit through the solenoid 48 broken, and the valve 17 and damper 18 closed, and the heating of the air passing through the casing 1 is the heat generated in the 130° heat exchanger 9 only. When both switches S—W are closed, upon the closing of the door, the solenoid 47 is immediately energized, permitting compressed air to flow to the diaphragm chamber 33, so that the valve 16 is now open, but the extent to which it is opened is blocked by the thermostat 19, which limits the opening of the valve, and hence the temperature to 130° or

below the flash point of the solvent vapor, which, say is 140°. Thus, while the solvent vapor passing through the mixture sensitive device is at or above the concentration point, the temperature is held by the thermostat to below the flash point. During continued operation, and as the solvent falls below the concentration point, the switch 28 of the mixture sensitive device closes, and hence establishes a circuit through solenoid 48 and the valve 41 opened to permit air to flow to the diaphragm chambers 34 and 42 and open the steam valve 17 of the heat exchanger 10 and open the damper 18 to permit the air to pass through the casing of the exchanger 10. Hence, while the concentration is below the explosive point, the temperature of the vapor is above the flash point, so that the vapor can be quickly withdrawn from the clothes in the drum 2. If, at any time, the explosive concentration should be again reached, the switch 28 operates to cut out the heat exchanger 10, so that the air is heated only by the 130° exchanger 9.

In Figure 3 an apparatus is shown in which the drop in temperature is effected by letting cold air into the cabinet 1 or the chamber 14 thereof immediately when the explosive concentration point is approached or reached. In this form of the invention, the switch 280 of the mixture sensitive device 260 is normally open instead of being normally closed, and the cabinet 1 is provided with an air inlet 65 opening directly into the cabinet 8 or the chamber 14 thereof. The inlet 65 is normally closed by a damper or closure 66. The damper is opened by the closing of the switch 280 of the mixture sensitive device, this closing when an explosive concentration is being approached or reached. The damper 66, when operated from its normal or closed position to open the inlet 65, thus renders ineffective the heat exchanger 16 by by-passing said heat exchanger, so that the air circulated comes in from outside of the casing instead of passing through the heat exchanger. Also, the damper 66, when operated out of its normal position closes, as indicated in dotted lines in Figure 3, the heat exchanger, so that air from the heat exchanger does not mix with the colder air coming in through the inlet 65. The damper is here shown as opened by a pressure fluid motor controlled by an electro-responsive device or solenoid 67 similar to the solenoids 47 and 48 and operating a valve 68 similar to the valves 38 and 41. When the switch 280 of the mixture sensitive device is closed, the solenoid 67 is energized, thus opening the valve to the intake of air from the feed pipe, as 390, through pipe 89 to a pressure operated motor, which acts to open the closure 66. This motor is here shown as a cylinder 70 having a piston 71 therein, the stem 72 of which is connected by a link 73 to an angular crank arm 74 on the closure 66. The motion of the piston 71 is against a returning spring 75. Thus, when the switch 280 of the mixture sensitive device closes, as it does in this instance, when an explosive concentration is reached, the circuit through the solenoid 67 is closed, and hence a pressure fluid, as air, flows to the cylinder 70, actuates the piston 71, to open the closure 66 and immediately lets a large quantity of cold air in to the cabinet 1 to reduce the temperature below the flash point of vapor. In this construction shown in Figure 3, the air is being heated by a heat exchanger 16 with no automatic control and the

air passing through the air inlet 65, when the closure 66 is open, is of such volume as to immediately reduce the temperature of the air heated by the heat exchanger 16 to below the flash point.

In either form of the invention, the operation is automatically controlled and the temperature of the air and the vapor kept below the flash point of the vapor, when an explosive concentration is being approached and the temperature permitted to rise above the flash point when the concentration is below an explosive concentration. As the control is entirely automatic, the removal of residual solvent from the clothes and deodorizing of the clothes is greatly facilitated, or this operation performed in a relatively short time.

What I claim is:

1. In a drying machine for removing from articles residual solvent which vaporizes and forms an explosive mixture with air, said machine including a casing having an air inlet and an outlet through which the vapors are passed, means for heating the air passing through the inlet, means for passing the mixture of air and vaporized solvent through the outlet, a device sensitive to the chemical re-action between the solvent vapor and the air and arranged to continuously receive samples of the mixture from the outlet, and means rendered operative as a result of said chemical action between the solvent vapors and the air passing through said device, to render the heating means ineffective to heat the air passing through the inlet, when the mixture is approaching an explosive concentration.

2. In a drying machine for removing from articles residual solvent which vaporizes and forms an explosive mixture with air, said machine including a casing having an air inlet and an outlet through which the vapors are passed, means for heating the air passing through the inlet, means for passing the mixture of air and vaporized solvent through the outlet, a device sensitive to the chemical re-action between the solvent vapor and the air and arranged to continuously receive samples of the mixture from the outlet, and means rendered operative as a result of said chemical action between the solvent vapors and the air passing through said device, to shut off the heating means when the mixture is approaching an explosive concentration.

3. In a drying machine for removing from articles residual solvent which vaporizes and forms an explosive mixture with air, said machine including a casing having an air inlet and an outlet through which the vapors are passed, means for heating the air passing through the inlet, means for passing the mixture of air and vaporized solvent through the outlet, a device sensitive to the chemical re-action between the solvent vapor and the air and arranged to continuously receive samples of the mixture from the outlet, a second air inlet of outer air, a closure normally closing the second inlet, and means operative as a result of said chemical re-action between the solvent vapors and the air passing through said device, to open said closure to the second inlet of outer air and thus cut out the heating means by by-passing the air away from the heating means, when the mixture is approaching an explosive concentration.

WALLACE F. GAYRING.