

F. J. BROGLIE

DRYING APPARATUS

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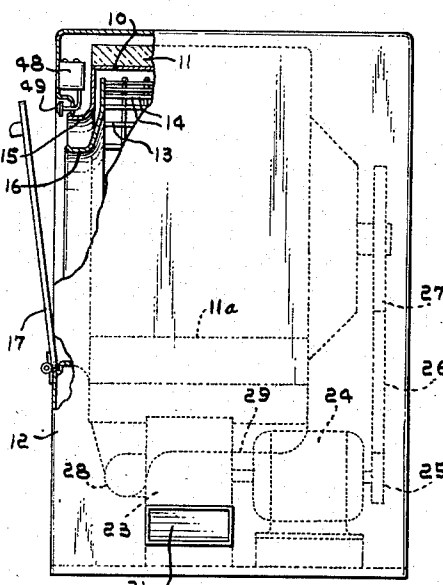


FIG. 1.

FIG. 2.

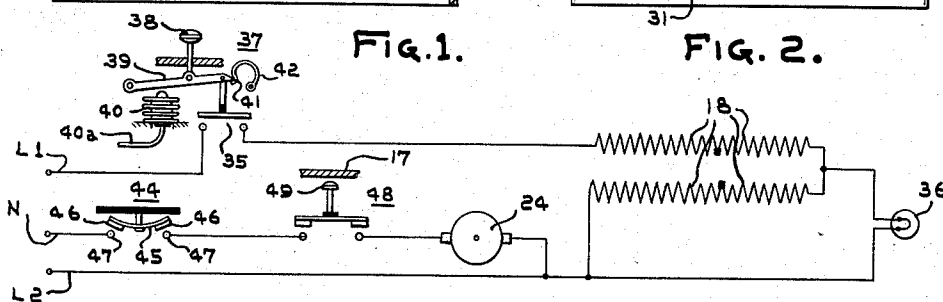
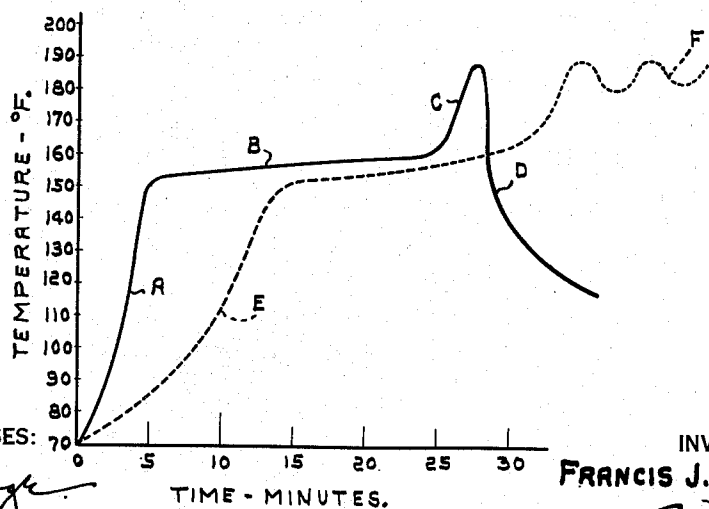


FIG. 3.



WITNESSES:

R. J. Ridge
E. H. Lutz.

TIME - MINUTES.

FIG. 4.

INVENTOR

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DRYING APPARATUS

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10 Claims. (Cl. 34-45)

My invention relates to apparatus for drying wet fabrics or the like and has for an object to provide improved apparatus of this kind.

A further object of the invention is to substantially reduce the period of time required for the drying of a batch of wet clothes in a drier of the domestic type having a heater for heating the fabrics and the air within the drier and a fan for translating air through the drier in contact with the fabrics.

It is a further object of the invention to initiate the circulation of the air within the drier only after the temperature of the air within the drying chamber has been elevated to a temperature optimum for drying whereby a substantial saving in heat is obtained.

A further object of the invention is to provide an automatically controlled clothes drier of the domestic type wherein the drying cycle is initiated by the actuation of a single control device and wherein the drying operation is terminated when the fabrics being treated are dry.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a vertical sectional view of a domestic drier constructed and controlled in accordance with my invention; portions of the apparatus being shown in elevation;

Fig. 2 is a side elevation of the apparatus shown in Fig. 1 with a portion broken away to illustrate a door actuated switch;

Fig. 3 is a diagram of the electrical apparatus and the control mechanism therefor; and

Fig. 4 illustrates a time-temperature curve for the apparatus disclosed.

Clothes driers of the domestic type employed heretofore have included a casing, a rotatable basket therein for tumbling the fabrics, a heater for heating the air in the casing and a fan for circulating air through the casing. Two methods have been employed for controlling the operation of the driers, one of which includes a simple "on and off" switch for starting and stopping operation of the heater and the fan and a temperature limiting thermostat for preventing over-temperature in the drier. The second control method is similar except that a time switch is employed for the heater and fan which terminates operation of both after a preselected period of operation. With both methods, the operator must estimate the period of drying and, as will be obvious, such estimation is difficult as different

kinds of fabrics require different periods of drying. Accordingly, the fabrics may be underdried or the apparatus may be operated longer than necessary. Since drying apparatus of this kind consumes approximately 4500 watts, it will be apparent from an economical standpoint, that the drier should be operated no longer than is absolutely necessary.

In accordance with my invention, a single push button control device is employed for energizing the main heater when initiating operation of the drier. When the temperature within the drier casing has been elevated to an efficient drying temperature, such as, for example, 150° F., the circulation of air through the casing is started by a thermostat arranged in the casing. During drying of the fabrics, the majority of the heat generated is converted to latent heat of vaporization so that the temperature rise within the cabinet at this time is small. As the fabrics become dried, less heat is converted to latent heat and more as sensible heat so that the temperature of the air rises. When the temperature of the air increases to a value of, for example, 190° F. at which time the fabrics are dry, the push button device is thermostatically moved to its "off" position for deenergizing the heaters. The tumbling of the fabrics and the circulation of the air continue for preventing wrinkling of the fabrics and for reducing the temperature within the drier. Since operation of the heaters is manually initiated, they are not reenergized. Operation of the basket and fan is automatically terminated when the temperature in the casing is reduced to 150° F. The entire drying cycle is automatic after the push button has been operated for initiating operation. Since operation is terminated by temperature, the different periods of drying required by different loads are automatically effected.

Since the circulation of air is initiated only after the efficient drying temperature is attained in the casing, more efficient operation is obtained and less heat discharged to the ambient atmosphere than where circulation of air accompanies the starting of the heaters. The drying time for a load of fabrics having a 9 lb. dry weight is reduced approximately eight minutes when dried according to my invention, compared to the time required in driers of the type wherein circulation of air and heating of the same are simultaneously started.

Reference will now be had to Figs. 1 and 2 of the drawing, wherein I have shown my invention applied to a domestic type clothes drier, in-

cluding a generally cylindrical casing 10 partially covered by heat insulating material 11 and supported in any well understood manner such as, for example, by means of brackets 11a within a housing 12. A perforate container or basket 13 is rotatably supported within the casing 10 and encloses the fabrics to be dried. As shown, the basket 13 may be partially of wire mesh construction, a number of the wires being shown at 14. The front end of the casing 10 is open, as shown at 15, to provide access to a front opening 16 in the basket 13, said openings providing for the ingress and egress of the fabrics. The opening 15 is closed by a suitable door 17 which is hinged to the housing 12.

Heat is imparted to the air within the casing 10 by means of a plurality of electric heaters 18 arranged within a cove 19 which may define a portion of the casing 10 and which is provided with air inlet openings 21. Preferably a reflector 22 is employed for reflecting heat, radiated backwardly by the heaters 18, to the interior of the casing 10.

Air from the ambient atmosphere is translated through the casing 10 by a blower 23 which is driven by an electric motor 24, the latter also serving to rotate the basket 13 at its proper tumbling speed of, for example, 50 R. P. M. The motor drives the basket 13 by means of a pulley 25 carried by the motor shaft and belted, as shown at 26, to a sheave 27 which is rotatable with the basket 13. The inlet of the blower 23 is connected by means of a duct 28 to a bottom opening 29 formed in the casing 10. Air discharged by the blower passes through an outlet opening 31 formed in the housing 12 to the ambient atmosphere. Air from the ambient atmosphere enters the housing 12 through a plurality of air inlet openings 32 which are arranged adjacent the air inlet openings 21 formed in the casing 10.

In accordance with my invention, the electrical heaters diagrammatically shown at 18 in Fig. 3 are energized and deenergized under control of a switch 35. Preferably, the heaters and the motor 24 are energized by a three-wire Edison circuit, the main or high voltage conductors of which are indicated at L₁ and L₂ and the neutral by the reference character N. It will be assumed that the voltage across the conductors L₁ and L₂ is approximately 230 volts and that the voltage drop across either conductor L₁ or L₂ and the neutral N is 115 volts. As shown, one terminal of the heaters 18 which are connected in series is connected to the conductor L₁ through the switch 35, while the opposite terminal of the heaters 18 is directly connected to the line conductor L₂. A signal lamp 36 is connected from the line conductor L₂ to an intermediate terminal of the heaters 18, as clearly shown in Fig. 3. At any and all times that the heaters 18 are energized, the lamp 36 will be illuminated.

The switch 35 defines an element of a control mechanism generally indicated at 37 and carried in a convenient location, preferably on the front of the housing 12, as shown in Fig. 1. The signal lamp 36 may be also carried by the housing 12 adjacent the control mechanism 37. The mechanism 37 includes a handle or push button 38 for manually closing the switch 35 and connected thereto by means of a pivoted lever 39, as clearly shown in Fig. 3. The movable end of the lever 39 is connected, preferably by a knife edge 41, to one end of a pivoted horseshoe spring 42. The arrangement is such that the spring 42

will either bias the lever 39 to its switch-open position or to its switch-closed position, depending upon whether the lever 39 is above or below its dead center position, as is well understood. The switch 35 may be manually opened, if desired, by pulling up on the push button 38, but in normal operation the switch 35 is opened by a thermostat, including an expansible bellows 40 connected by means of a tube 40a to a heat responsive bulb 43 arranged within the casing 10, where it reflects the temperature of the air within the casing 10 and basket 13. The bellows 40, the tube 40a and the bulb 43 are filled with fluid which expands and contracts with increases and decreases in the temperature of the fluid within the bulb 43.

Operation of the motor 24 is under control of a thermostat 44 supported within the casing 10, as shown in Fig. 1, where it responds to the temperature of the air within the casing 10 and the basket 13. Preferably, the thermostat 44 is of the bimetal disc type and includes a snap-over bimetal disc 45 carrying movable contacts 46, the latter being engageable with stationary contacts 47 arranged in the neutral conductor N. Preferably, energization of the motor 24 is also controlled by a door-operated switch 48 which is actuated to its closed position by the door 17 when the latter is closed. The switch 48 includes an arm 49 engageable with the door in the closed position, as shown in Figs. 2 and 3.

Operation

In operating the drier, the damp fabrics as they come from the wringer or a centrifuge of a washing machine, are deposited in the basket 13 through its access opening 16, after which the door 17 is closed. The closing of the door closes the door-operated switch 48 and thereby conditions the circuit of the electric motor 24 for energization. At this time, however, the motor 24 is not energized as the thermostat 44 is in its open position. The operator then depresses the push button 38 for closing the switch 35 and energizing the heaters 18 and the signal lamp 36. Since the motor 24 at this time is deenergized, the basket 13 and fan 23 are inactive.

Heat is imparted to the air and to the drier structure within the casing 10 at this time, so that the temperature of the air is rapidly increased as shown at A in the solid curve (Fig. 4). This temperature rise is rapid due to the fact that there is no circulation of air through the casing 10 at this time. When the temperature of the air within the casing 10 has been increased to an efficient drying temperature, such as, for example, 150° F., the thermostat 44 engages the contacts 46 and 47 so that the motor 24 operates to rotate the basket 13 and to drive the fan 23. The air entering the inlet openings 21 is rapidly heated as it passes over the heaters 18 and the air within the casing 10 is heated radiantly by the heaters 18. At this elevated drying temperature, the air has a high capacity for vaporizing and absorbing moisture from the fabrics, so that the majority of the heat generated at this time is converted to latent heat of vaporization. Accordingly, the rise in the temperature of the air during the drying period, which I have indicated at B in Fig. 4, is relatively slow until such time that a substantial portion of the moisture has been vaporized and discharged to the ambient atmosphere. After about twenty-four minutes of operation, the rise in temperature of the air within the basket 13 becomes rapid due to the

fact that very little moisture is contained within the fabrics. This increase in temperature is shown at C on the curve.

When the temperature of the air has been increased to 190° F., as shown on the curve, the fabrics will be completely dried and, at this temperature, the bellows 40 will have expanded sufficiently to trip the switch 35 to its open position for deenergizing the heaters 18. At this time, the signal lamp 36 is deenergized, indicating that the drying operation has been completed. Circulation of air and the tumbling of the fabrics continues, however, until the temperature of the air has been depressed to approximately 150° F. at which time the thermostat 44 is actuated to its open position for deenergizing the motor 24. The decrease in air temperature subsequent to the deenergization of the heaters and during the continued operation of the fan 23 is shown at D on the solid curve (Fig. 4).

The operator may remove the fabrics at any time subsequent to the deenergization of the heaters and the signal lamp 36. However, if tumbling and air circulation is permitted for a minute, the temperature of the fabrics will be reduced so that they may be more comfortably handled. It will be understood, of course, that the door switch 48 will terminate rotation of the basket 13 as soon as the door 17 is opened in order to prevent injury to the operator and facilitate the removal of the fabrics.

In the description of operation of the drier set forth heretofore, it is to be assumed that a load of fabrics having a dry weight of 9 pounds is dried and that these fabrics contain 9 pounds of water when admitted to the drier. A further assumption is that 4400 watt heaters are employed and that approximately 150 cubic feet of air per minute is circulated.

The curve shown in broken lines indicates operation of the drier in the manner employed heretofore, wherein circulation of air and energization of the heaters are simultaneously initiated. It will be apparent that the heating-up portion of the cycle shown at E, to the efficient drying temperature of 150° F., is much slower than where the circulation is delayed, as described, and that the entire drying cycle is lengthened by about eight minutes. The undulating portion of the curve shown at F represents the temperature fluctuation when a cycling type over-temperature thermostat is employed for the control of the heaters.

It will be apparent from the foregoing description that I have provided an improved drier for fabrics wherein the drying time for a given load is substantially reduced. The drier is automatically controlled and compensation for different loads is obtained so that no estimate of the duration of the drying period is required on the part of the operator.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In apparatus for drying fabrics or the like, the combination of a perforate container for receiving the fabrics to be dried and movable about an axis, means for actuating the container about its axis for tumbling the fabrics therein, means

for translating air through the container in contact with the fabrics, means for heating the air in the container, a thermostat responsive to the temperature of the air in the container for controlling operation of said heating means and effective in response to a predetermined high temperature of the air for terminating substantially, the heating effect of said heating means, and a second thermostat controlling operation of the air translating means in response to the temperature of the air in the container, said second thermostat responding to a temperature of the air lower than said first-mentioned high temperature for initiating operation of the air translating means.

2. In apparatus for drying fabrics or the like, the combination of a perforate container for receiving the fabrics to be dried and movable about an axis, means for actuating the container about its axis for tumbling the fabrics therein, means for translating air through the container in contact with the fabrics, means for heating the air in the container, manually operated means for initiating operation of the heating means, means responsive to a predetermined high temperature of the air in said container for terminating operation of the heating means, and thermostatic means responsive to the temperature of the air in the container for controlling operation of the air translating means; said thermostatic means being effective to start and stop operation of the air translating means in response to temperatures lower than said predetermined high temperature.

3. In apparatus for drying fabrics or the like, the combination of a perforate container for receiving the fabrics to be dried and movable about an axis, means for actuating the container about its axis whereby the fabrics are tumbled therein, means for translating air through the container in contact with the fabrics, a heater for imparting heat to the air in the container, manually operated means for initiating operation of the heater, means responsive to a predetermined high temperature of the air within the container for terminating operation of the heater and thermostatic means responsive to the temperature of the air in the container for controlling operation of the container actuating means and the air translating means, said thermostatic means being effective in response to temperatures lower than said predetermined high temperature for initiating and terminating operation of the container actuating means and the air translating means.

4. In a drier for fabrics or the like including a casing, a rotatable perforate basket arranged within the casing for receiving wet fabrics to be dried, means for rotating the basket, means for translating air through the basket in contact with the fabrics, means for heating the air within the basket, a thermostat for controlling operation of the heating means and manually actuated to a first position for initiating operation of the heating means, said thermostat being moved to a second position in response to a predetermined high temperature of the air within the casing for terminating operation of the heating means, and a second thermostat responding to predetermined temperatures of the air within the casing lower than the first-mentioned predetermined high temperature of the air, for starting and stopping operation of the basket rotating means and said air translating means.

5. In apparatus for drying wet fabrics or the like, the combination of a rotatable perforate container for receiving the fabrics to be dried, means including an electric motor for rotating

the container whereby the fabrics are tumbled therein, air translating means driven by said electric motor for circulating air through the container in contact with the fabrics, an electric heater for imparting heat to the air in the container, a switch for controlling energization of the electric heater and manually moved to a closed position for initiating operation of the heater, means responsive to a predetermined high temperature of the air within the container for opening said switch, and thermostatic means responsive to the temperature of the air in the container for controlling the operation of said motor; said thermostatic means being effective to initiate and terminate operation of the motor in response to temperatures lower than said predetermined high temperature.

6. In apparatus for drying wet fabrics or the like, the combination of a rotatable perforate container for receiving the fabrics to be dried, means including an electric motor for rotating the container whereby the fabrics are tumbled therein, air translating means driven by said electric motor for circulating air through the container in contact with the fabrics, an electric heater for imparting heat to the air in the container, a switch for controlling energization of the electric heater and manually movable to closed and open positions for respectively energizing and deenergizing said heater, means responsive to a predetermined high temperature of the air within the container for opening said switch, and thermostatic means responsive to the temperature of the air in the container for controlling the operation of said motor; said thermostatic means being effective to initiate and terminate operation of the motor in response to temperatures lower than said predetermined high temperature.

7. In apparatus for drying wet fabrics or the like, the combination of a casing structure having an access opening therein and a door for closing the opening, a perforate container for the fabrics rotatably supported within the casing structure, an electric heater disposed within the casing structure for heating, radiantly, the fabrics and the air within the casing structure, a motor for actuating the container, a fan driven by the motor for translating air through the casing structure in contact with the fabrics, a switch manually actuated to its closed position for energizing said heater, means responsive to a predetermined high temperature of the air within

the casing structure for opening said switch, and a thermostat responsive to the temperature of the air within the casing structure for controlling operation of said motor, said thermostat being effective to start and stop the motor in response to temperatures of the air in the casing structure which are lower than said predetermined high temperature.

8. The combination as claimed in claim 7 including a second switch actuated by said door and opened and closed therewith for controlling operation of the motor.

9. In apparatus for drying fabrics or the like, the combination of a perforate container for receiving the fabrics to be dried and movable about an axis, means for actuating the container about its axis for tumbling the fabrics therein, means for translating air through the container in contact with the fabrics, means for heating the air in the container, a thermostat responsive to the temperature of the air in the container for controlling operation of said heating means and effective in response to a predetermined high temperature of the air for terminating substantially, the heating effect of said heating means, and a second thermostat controlling operation of the air translating means and the container actuating means in response to a temperature of the air within the container lower than said predetermined high temperature to which the first-mentioned thermostat responds.

10. In apparatus for drying fabrics or the like, the combination of a perforate container for receiving the fabrics to be dried and movable about an axis, means for actuating the container about its axis for tumbling the fabrics therein, means for translating air through the container in contact with the fabrics, means for heating the air in the container, a thermostat responsive to the temperature of the air in the container for controlling operation of said heating means and effective in response to a predetermined high temperature of the air for terminating substantially, the heating effect of said heating means, and a second thermostat controlling operation of the air translating means and the container actuating means in response to the temperature of the air in the container, said second thermostat responding to a temperature of the air lower than said first-mentioned high temperature for terminating operation of the air translating means and container actuating means.

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