Oct. 14, 1969 F. S. GENBAUFFE 3,471,937

CLOTHES DRIER CONTROL SYSTEM

Filed Nov. 12, 1958 5 Sheets-Sheet 1

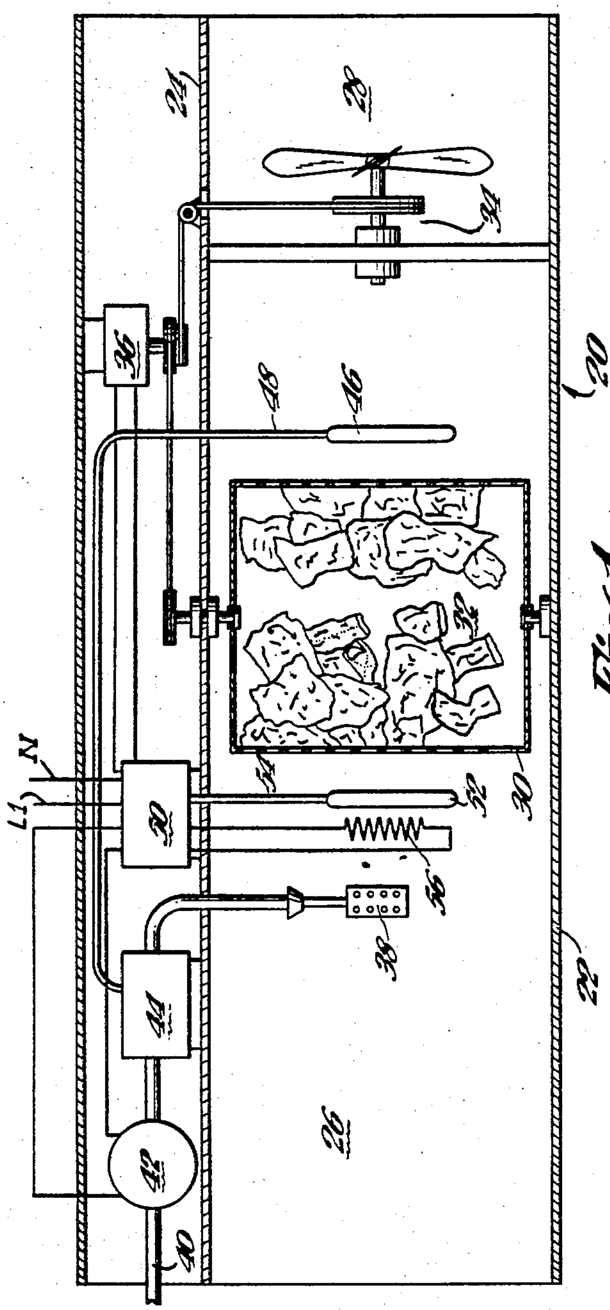


Fig. 1.

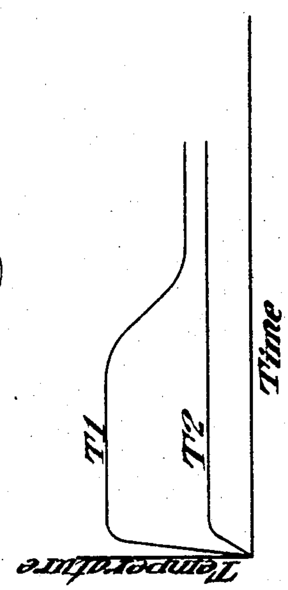


Fig. 2.

Oct. 14, 1969 F. S. GENBAUFFE 3,471,937

CLOTHES DRIER CONTROL SYSTEM

Filed Nov. 12, 1958 5 Sheets-Sheet 2

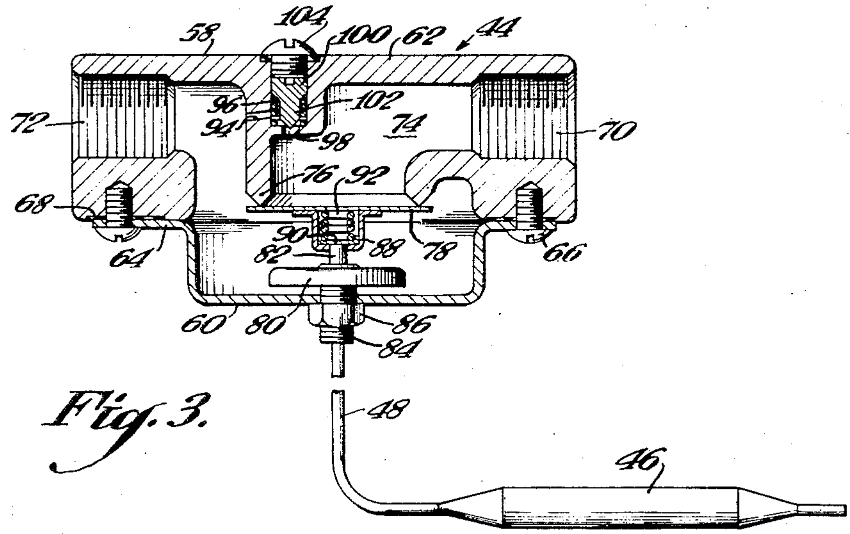


Fig. 3.

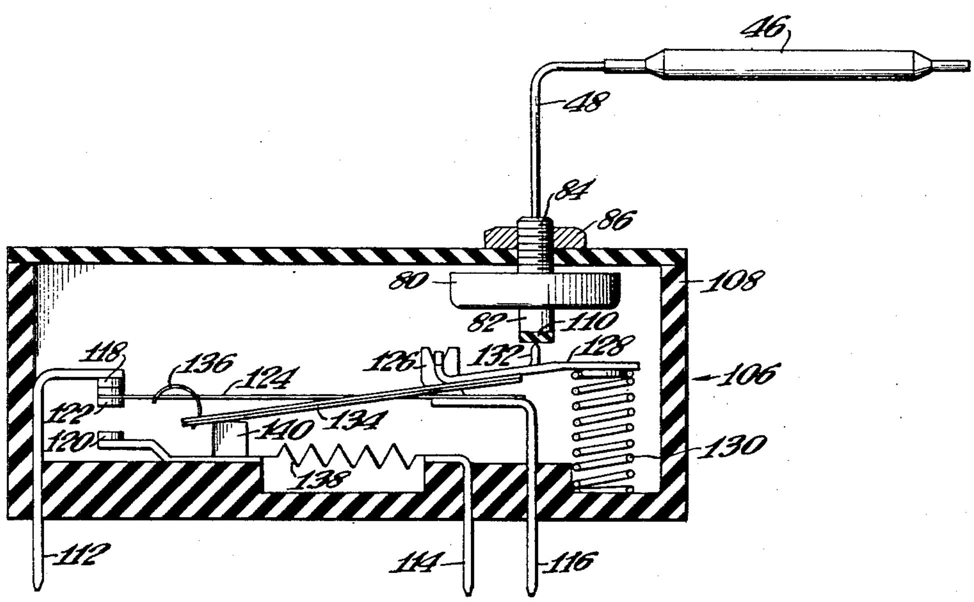


Fig. 4.

Oct. 14, 1969

F. S. GENBAUFFE

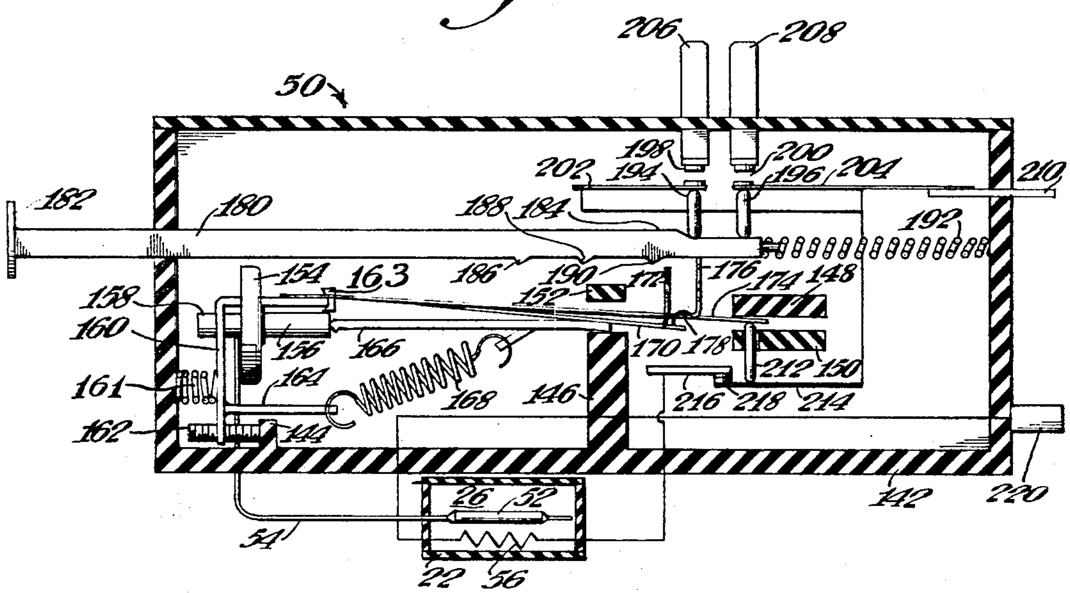
3,471,937

CLOTHES DRIER CONTROL SYSTEM

Filed Nov. 12, 1958

5 Sheets-Sheet 3

Fig. 5.



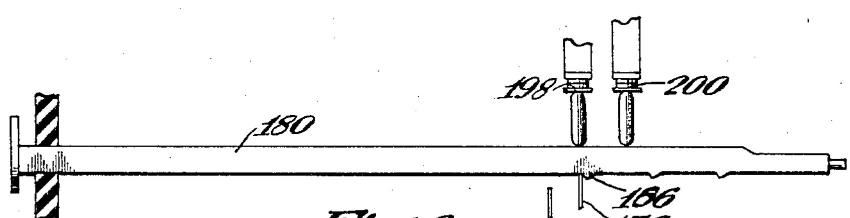


Fig. 6.

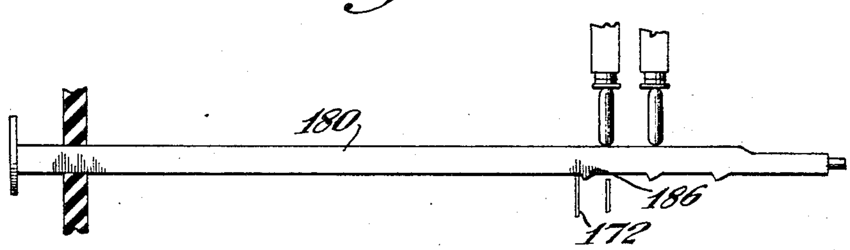


Fig. 7.

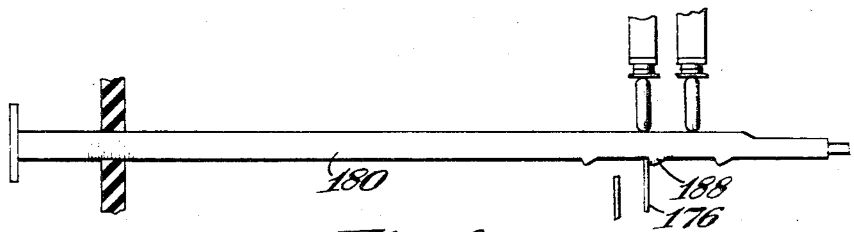


Fig. 8.

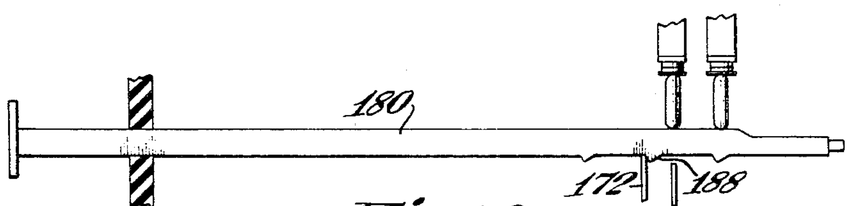


Fig. 9.

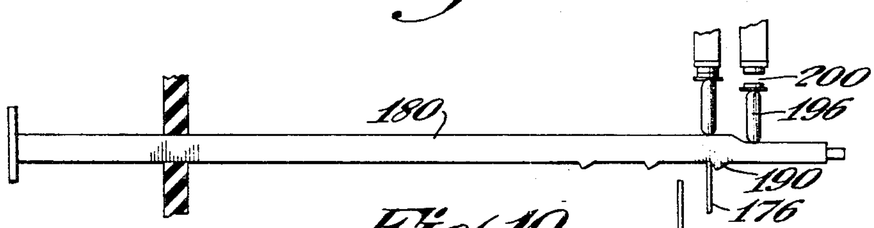


Fig. 10.

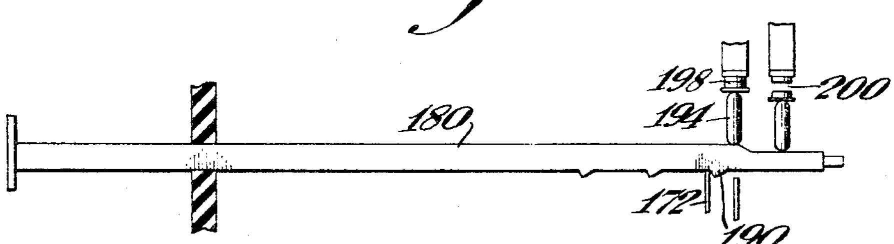


Fig. 11.

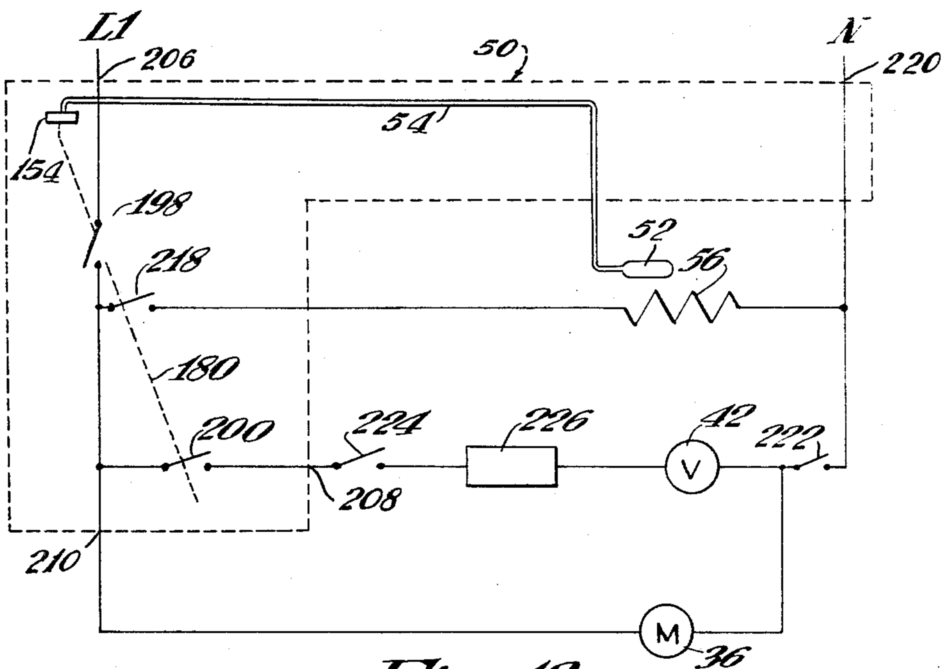

L1
206
50
N
220
54
154
198
52
56
218
180
200
224
226
42
V
222
208
210
M
36

Fig. 12.

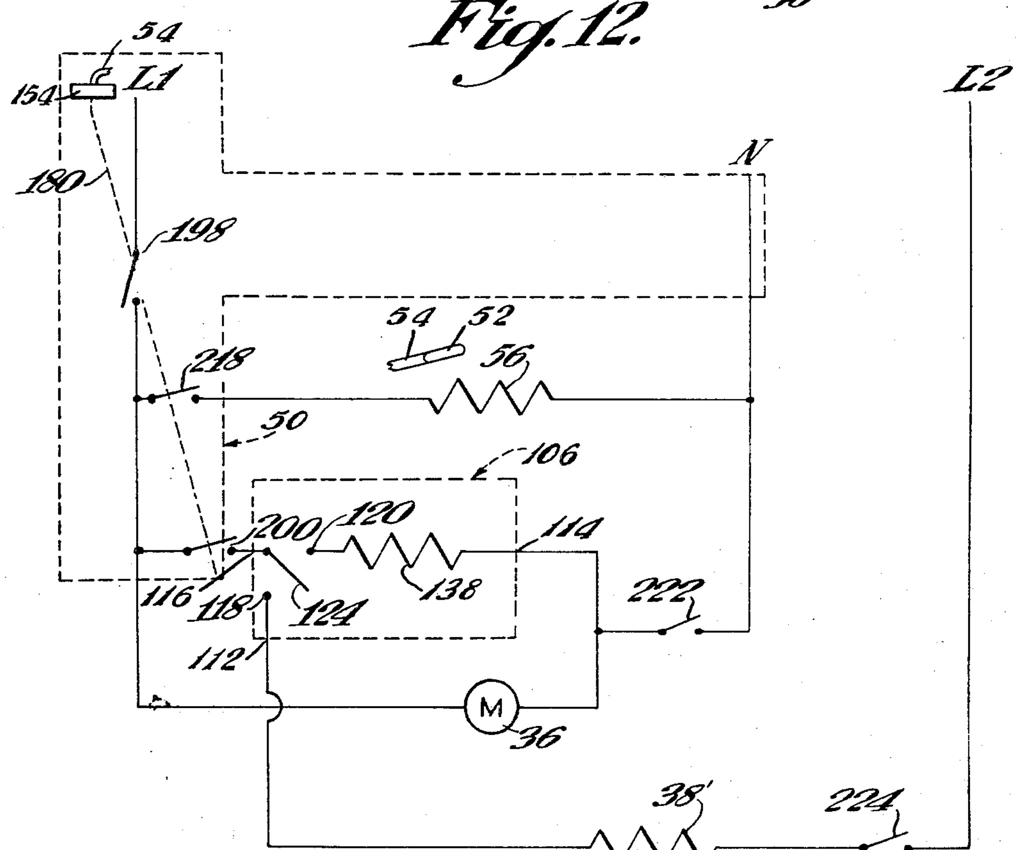

54
154
L1
L2
180
N
198
54
52
218
56
50
106
200
120
114
116
118
124
138
222
112
M
36
38'
224

Fig. 13.

3,471,937
CLOTHES DRIER CONTROL SYSTEM

Francis S. Genbauffe, Irwin, Pa., assignor to Robertshaw Controls Company, Richmond, Va., a corporation of Delaware

Filed Nov. 12, 1958, Ser. No. 773,429
Int. Cl. F26b *21/10*
U.S. Cl. 34—45 16 Claims

This invention relates to clothes drier control systems and more particularly to those systems controlled in accordance with the degree of dryness of the clothes.

In general, clothes driers, particularly those of the domestic type, are provided with a revolving drum or tumbler, air heating means, a fan to blow the heated air through the drum, and a motor for driving the fan and drum.

Conventional systems for controlling the operation of such clothes driers are of two general types. First, there are those systems which control in accordance with the preselected period of time during which the clothes are subjected to the drying action of a flow of heated air. This type of system has an inherent disadvantage caused by the general inability of operators to preselect or determine the necessary period of time to dry the clothes. This results in excessive power being used when the clothes are overdried, or in insufficient drying of the clothes.

The second type of systems, similar to timed systems, maintain the temperature of the incoming air constant, and terminate the drying operation when the outlet temperature increases above a predetermined degree. The incoming air temperature must be held sufficiently low to prevent heat damage to the clothes near the end of the cycle when they are nearly dry. As a result, the entering air temperature is lower than is required during the major portion of the drying cycle when the clothes are moisture-laden and not subject to heat damage. This inflexible input temperature may lead to excessive drying times.

It is a general object of this invention to control the drying temperatures and terminate the drying cycle automatically in accordance with the degree of dryness of the material.

Another object of this invention is to decrease the drying period by increasing the incoming air temperature to a level above that which would cause damage if the clothes were dry, during periods when the clothes are heavily moisture-laden.

Another object of this invention is to maintain a relatively constant outlet air temperature until the inlet air temperature drops below a predetermined amount whereupon the drying cycle is terminated.

Another object of this invention is to further cool the clothes drier and the contents thereof after the heater has been turned off.

Briefly stated, in the preferred embodiment of this inveniton, thermostatic means are disposed within the drier which are operable in response to the temperature of the air passing through the outlet to control the heater, and are also operable in response to a predetermined drop in the temperature of the air passing through the inlet, downstream from the heater, to turn off the heater and terminate the drying cycle.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the drawings wherein:

FIG. 1 is a cross-section in somewhat schematic form of a conventional gas drier embodying this invention;

FIG. 2 is a graph illustrating one of the principles of operation of this invention;

FIG. 3 is a partial cross-section of one of the control valves of the gas drier shown in FIG. 1;

FIG. 4 is a partial cross-section of a control switch adapted for use in an electric clothes drier;

FIG. 5 is a partial cross-section of a thermostatic control employed in the drier shown in FIG. 1;

FIGS. 6, 7, 8, 9, 10, and 11 are views showing the positions assumed by elements of the switch of FIG. 5 during different phases of the operation of the switch;

FIG. 12 is a wiring diagram for a gas drier embodying this invention; and

FIG. 13 is a wiring diagram for an electric drier embodying this invention.

Referring now more particularly to the drawings, a clothes drier, indicated generally by reference numeral **20** in FIG. 1, is shown for the purpose of illustrating how the invention, as hereinafter described, may be applied. A casing **22** is provided having baffling means **24** disposed therein to form a flow passage through drier **20** which generally comprises an inlet **26** and an outlet **28**. A perforated rotary drum **30** is disposed within the passage between inlet **26** and outlet **28** and generally defines a drying chamber **32** within the walls thereof. A blower **34** is positioned to cause air to flow through the inlet **26**, drying chamber **32**, and outlet **28**. A motor **36** drives both drum **30** and blower **34**.

A gas burner **38** is disposed upstream from drying chamber **32** for heating the air prior to passage therethrough. Gas flows from a supply line **40**, through a normally closed solenoid valve **42**, and thermostatic valve means **44**. A temperature sensing bulb **46** is disposed downstream of drying chamber **32** and is operatively connected by a capillary tube **48** to thermostatic valve means **44** for controlling the flow of gas to burner **38**, in a manner hereinafter described. Thermostatic control means **50** is provided for terminating the drying cycle when the clothes are sufficiently dry and has a temperature sensing bulb **52** operatively connected thereto by a capillary tube **54**. An auxiliary bulb heater **56** is disposed adjacent temperature sensing bulb **52**.

The graph in FIG. 2 is a temperature versus time plot wherein **T1** represents the air temperature prior to entering drying chamber **32** and **T2** represents the air temperature after passing through drying chamber **32**. At the beginning of the drying cycle, the air is heated until **T2** reaches the desired level. Concurrently, **T1** increases to a higher level. The temperature gradient between **T1** and **T2** remains relatively constant throughout the major portion of the drying cycle due to the relatively constant rate of evaporation of the moisture from the clothes. However, as the clothes become drier, the rate of evaporation decreases with a resultant increase in **T2**. The increase in **T2** is utilized to actuate valve **44** to reduce the flow of gas through burner **38**, thereby decreasing inlet temperature **T1** until the outlet temperature **T2** is restored (reduced) to the desired level. By properly choosing the parameters of the temperature responsive means in a conventional manner, **T1** is made higher, during periods when the clothes are more heavily moisture-laden, than a temperature which would damage the clothes if they were dry. Because of this higher temperature, the period of the drying cycle is decreased when compared to a system employing a lower **T1**.

As best shown in FIG. 3, thermostatic valve means **44** comprises a casing **58** formed of casing members **60** and **62**. Casing member **60** is substantially cup-shaped and is formed with a peripheral flange **64** secured to casing member **62** by a plurality of screws **66**. An annular gasket or washer **68** is disposed between casing member **60** and **62** to form a fluid-tight seal therebetween. Casing **58** is formed with an inlet **70**, an outlet **72**, and a passage **74** therebetween. An annular valve seat **76** is formed within passage **74** and cooperates with a disc valve member **78** to control the passage of gas from inlet 70 to outlet 72. Inlet 70 and outlet 72 are adapted to be connected to gas supply line 40.

A temperature sensing bulb 46 is connected to an expansible element 80 by a capillary tube 48 and generally forms thermally responsive means for actuating valve member 78. Element 80 is conventional and is formed with a flexible diaphragm on which an actuating stem 82 is mounted. The thermally responsive actuating means is filled with a conventional charge of temperature sensitive fluid which expands and contracts in response to changes in temperatures to cause actuating stem 82 to assume a relative position corresponding to the temperature of bulb 46. A threaded sleeve 84 is connected to element 80 and passes through casing 58. A nut 86 cooperates with the threaded sleeve 84 to position the element 80 within passage 74 and is used to calibrate the valve means. A cup-shaped plate 88, formed with an annular flange extending outwardly therefrom is secured to valve member 78 to form a chamber therebetween. An annular disc 90 is disposed within cup-shaped member 88 and is connected to actuating stem 82. A helical spring 92 biases disc 90 into engagement with cup-shaped member 88 whereby valve member 78 is carried by actuating stem 82. Disc 90 is slidably disposed within cup-shaped member 88 to prevent damage caused by excessive movement of actuating stem 82. Such excessive movement will cause disc 90 to compress spring 92 to move upwardly as shown in FIG. 3 to prevent any damage to valve member 78.

To maintain a minimum flame at burner 38, bypass means are provided through which gas may flow from inlet 70 to outlet 72 without passing between valve seat 76 and valve member 78. Such bypass means comprises a passage 94 which extends from outlet 72 into communication with a cylindrical chamber 96. A passage 98 etxends between chamber 96 and passage 74. A slidable valve member 100 is disposed within chamber 96 and has one end thereof formed with a conical section which cooperates with the walls of passage 98 to control the flow of gas through the bypass means. A helical spring 102 biases valve member 100 into engagement with adjusting means which comprise a screw 104 threadedly received in casing member 62. The amount of gas flowing through the bypass means can be adjusted by rotation of screw 104 which causes valve member 100 to move either in or out of chamber 96.

The position of valve member 78, as shown in FIG. 3, corresponds to that which occurs when the temperature sensing bulb 46 reaches the desired outlet air temperature and the flow of gas to heater 38 is cut off except for the amount flowing through the bypass means to maintain the minimum flame temperature. In operation, when the burner is initially turned on, valve member 78 is wide open. As the outlet temperature increases, expansion of fluid within the thermally responsive actuator causes actuating stem 82 to move valve member 78 toward valve seat 76 to restrict the gas flowing through the valve means and decrease the rate of heating. Subsequent cooling of the temperature sensing bulb 46 causes the actuating stem 82 to move downwardly, as shown in FIG. 3, to increase the gap between valve member 78 and valve seat 76 to allow more gas to flow through the valve means with the resultant increase in the outlet air temperature.

In an electric drier, the elements are generally the same as those of the gas drier shown in FIG. 1 except that the burner 38 is replaced by an electrical heating element 38′ and the thermostatic valve means 44 is replaced by a thermostatic switch means 106. As shown in FIG. 4, thermostatic switch means 106 has a cubical housing 108 formed of insulation material which carries the thermally responsive means, similar to the means shown in FIG. 3. A temperature sensing bulb 46 is connected by capillary tube 48 to an expansible element 80 having a movable actuating stem 82. A sleeve 84 extends

through housing 108 and is cooperable with a nut 86 for positioning the end of actuating stem 82 within the interior of housing 108. The tip of actuating stem 82 is in this case covered by an insulating block 110 to electrically separate the temperature responsive means from the current carrying members within housing 108.

A plurality of terminals 112, 114, and 116 are mounted on and extend through one wall of housing 108. The inner end of terminal 112 carries a contact 118 which is disposed in a position opposed to a contact 120, both of which are cooperable with a contact 122 carried by a flexible switch member 124. Switch member 124 cooperates with contacts 118 and 120 to form a single-pole, double-throw switch. Switch member 124 is connected at the end opposite contact 122 to terminal 116. A fulcrum member 126 is also mounted on terminal 116 and has a V-shaped groove formed therein adapted to receive a portion of a lever 128. Lever 128 has the end opposite that which cooperates with fulcrum 126 biased in a counterclockwise direction, as shown in FIG. 4, by helical spring 130.

A projection 132 located intermediate the ends of member 128 abuts insulating block 110 and is movable in response to movement of actuating stem 82. A bimetallic element 134 is connected at one end to lever 128. A rollover spring 136 is disposed between the other end thereof and switch member 124. Bimetal 134 has the strip of metal with a higher coefficient of expansion disposed on the top side so that with increases in the temperature thereof, bimetal 134 curls in an inverted U-shaped manner, as viewed in FIG. 4. An auxiliary bimetal heater 138 is connected to terminal 114 and contact 120. A stop member 140 is disposed in the path of one end of bimetal 134 to limit the downward movement thereof to prevent a short circuit.

In operation, terminal 112 is serially connected to heater 38′ and one side of a power line, and terminal 116 is connected to the other side of the line. Terminal 114 is connected to a neutral conductor. At the start of the operation, temperature sensing bulb 46 is cool and bimetal 134 assumes the position shown in FIG. 4. As the temperature of the bulb 46 increases, movement of actuating stem 82 causes lever 128 to pivot in a clockwise direction about fulcrum 126 and thereby pivot bimetal 134 in the same direction. Actuating stem 82 is so positioned within housing 108 by calibrating nut 86 that when the temperature of bulb 46 approaches that of the desired outlet air temperature, the lines of force between bimetal 134 and switch member 124 cross whereupon roll-over spring 136 causes switch member 124 to snap between positions to disengage contact 122 from contact 118 and to engage contact 122 with contact 120. Consequently, bimetal heater 138 is energized. As the bimetal heats, the free end thereof will lower till it again reaches the snap point whereupon contact 122 moves into engagement with contact 118 to energize heater 38′.

This cycling action between bimetal 134 and switch member 124 continues as the temperature of bulb 46 increases until the switch member 124 and bimetal 134 have been pivoted in a clockwise direction about fulcrum 126 to a position such that prolonged heating of the bimetal 134 is ineffective to lower the end thereof sufficiently to snap switch member 124. This corresponds to the minimum or zero percent power point. It should be noted that when the drier 20 is initially placed in operation and the power requirements to heat the interior thereof are the greatest, the cycling switch means supplies the greatest amount of power to heater 38′. And when the power necessary to maintain the outlet air temperature at the desired level is less than during the heating up operation, the period of time which heater 38′ remains off is greater than when it is heating up.

As the condition of the clothes approaches dryness, the outlet air increases in temperature slightly, causing actuating stem 82 to move downwardly, compressing spring 130 and rotating lever **128** clockwise. This affects the continual "ON" and "OFF" cycling action between the bimetal **134** and the heater **138** such that the "OFF" portion of the cycle is increased, thereby decreasing the net power input to the drier heater **38'**, and thereby gradually decreasing the inlet air temperature as the outlet air temperature tends to increase. Thus, the action of the cycling switch **106** in the electric version performs the same function as valve **44** of the gas drier.

Thermostatic means for terminating the drying operation in response to the inlet air temperature are provided, being indicated generally by reference numeral **50** in FIG. 5. A cubical housing **142**, formed of insulation material, is provided with a pair of upstanding projections **144** and **146**, and horizontal stop members **148, 150** and **152**. Temperature sensing bulb **52** is connected by a capillary tube **54** to an expansible element **154** having a movable actuating stem **156** extending therefrom. Element **154** has a rearwardly extending projection **158** by means of which the same is connected to a bracket **160**.

A pair of pivot groove members **163** (only one of which is shown) extend inwardly from the walls of housing **142** and pivotally receive an end portion of bracket **160**. Screw **162** is threadably received by bracket **160** and abuts housing projection **144**. A helical compression spring **161** extends between housing **142** and bracket **160** and biases the same in a counterclockwise direction about pivot **163**. However, movement in this direction is limited by screw **162** abutting member **144**. Spring **161** also serves as an overrun means for excessive temperature and screw **162** further serves as a calibrating means for thermostatic means **50**.

A support member **164** is connected to bracket **160** and extends outwardly therefrom. A lever **166** is disposed within the housing **142** with one end thereof in contact with actuating stem **156** and with the other end thereof pivotally resting on the surface of projection **146**. A helical tensile spring **168** interconnects support member **164** with lever **166** to bias lever **166** in a clockwise direction about the end thereof in contact with actuating stem **156**. Lever **166** is fixed to a flexible arm **170** adjacent one end thereof and the other end of arm **170** is connected to bracket **160**.

A latch member **172** extends upwardly from arm **170**. Similarly, a flexible arm **174** has one end thereof connected to bracket **160** and is formed with an upwardly extending latch member **176** adjacent to the other end thereof. Arm **174** moves between limits defined by the one end thereof contacting stop members **148** or **150**. A roll-over spring **178** interconnects arms **170** and **174** to provide a snap action in a manner hereinafter described.

A rod **180** slidably extends through housing **142** and is formed with a push button **182** at the other end thereof. Housing **142** and rod **180** are shaped to prevent rotation therebetween. Adjacent to the inner end, a cam surface **184** and a series of projections **186, 188** and **190** are formed. A helical spring **192** is disposed between housing **142** and the inner end of rod **180** and biases rod **180** in an outward direction when the rod is depressed in such a manner that latches **172** and **176** engage projections **186, 188**, and **190** in a manner hereinafter described. A pair of cam followers **194** and **196**, respectively operable to actuate switch means **198** and **200**, ride on the surface of cam **184** and are biased into engagement therewith by flexible contact arms **202** and **204**.

A terminal **206** is connected to switch means **198** and a terminal **208** is connected to switch means **200**. A terminal **210**, similar to terminal **208**, is connected to switch means **200** through contact member **204**. Arm **174** engages a pin **212** which is slidably disposed within stop member **150** and is biased into engagement with arm **174** by a flexible switch member **214**, which cooperates with a stationary switch member **216** through a set of contacts **218**. When latch member **176** engages the undersurface of rod **180**, as shown in FIG. 5, contacts **218** are closed. A bulb heater **56** is disposed adjacent temperature sensing bulb **52**.

The electrical connections within thermostatic means **50** are as follows: a first circuit serially comprises terminal **210**, contact member **204**, switch means **200**, and terminal **208**; a second circuit serially comprises terminal **210**, a portion of contact member **204**, contact member **202**, switch means **198**, and terminal **206'**; and a third circuit serially comprises terminal **210**, a portion of contact member **204**, switch member **214**, contacts **218**, switch member **216**, bulb heater **56**, and terminal **220**.

The wiring diagram for a gas operated drier is shown in FIG. 12 wherein the electrical connections are made to the terminating means **50**. A motor **36** drives the blower and the basket. A door switch **222** is provided to prevent the drier **20** from being turned on until the door is closed. A centrifugal switch **224** is provided to cut-off heater **38** when the rotation of the basket is below a predetermined level. A solenoid gas valve **42** having full open or closed position is connected in series with the valve means **44** and controls the on-off flow of gas. A high-limit thermostat **226** is set to shut off the flow of gas when the temperature of the air exceeds a predetermined value. The wiring diagram for an electric drier is shown in FIG. 13 and comprises a motor **36**, a centrifugal switch **224**, and a door switch **222** similar in operation to those of a gas drier.

In both the electrical and gas drying systems, the operation of terminating means **50** is the same and can be best understood by reference to FIGS. 6 through 13. At the beginning of the driving cycle, the clothes are placed within drum **30** and the door to drier **20** is closed whereupon the door switch **222** closes. Push button **182** is depressed to the position shown in FIG. 6 wherein latch **176** engages projection **186** to prevent rod **180** from moving outwardly under the bias of spring **192**. In this position, contacts **198** and **200** are closed and current flows through motor **36** with the resultant motion of drum **30** and blower **34**.

As the drum rotates, centrifugal switch **224** closes. The control of heaters **38, 38'** is as previously described. Contacts **28** are closed and the bulb heater **56** is energized whereupon the temperature of bulb **52** increases and causes the fluid charge to expand.

This tends to force actuating stem **156** outwardly, urging lever **166** counterclockwise and flexible arm **170** upwardly. However, this motion is opposed by the appreciable downward force of roll-over spring **178** acting on arm **170**. As the fluid continues to heat and expand, the expansive element **154** builds up sufficient force to overcome the downward force of roll-over spring **178**. Consequently, lever **166** disengages stop **146** and begins a traverse to stop **152**. With this motion, the downward force of the roll-over spring **178** decreases rapidly because of the decreasingly effective angle of force of the roll-over spring **178**. However, the upward force exerted by the expansive element **154** does not decrease with the motion of lever **166** as rapidly because of the high lever ratio exhibited by lever **166** and the inherent resiliency of the expansive element **154**. Once lever **166** leaves stop **146**, the upward force continually overbalances the downward force and lever **166** moves rapidly without further temperature change to stop **152**. It should be noted that the high lever-ratio is used to preserve the contact pressure at a maximum until the instant of snap. This snap action causes latch **176** to be disengaged from projection **186**, and allows rod **180** to move outwardly until latch **172** engages projection **186**, as shown in FIG. 7. When latch **176** is disengaged the outer end of arm **174** depresses pin **212** to open contacts **218** and denergizes bulb heater **56**.

As the condition of the clothes approaches dryness, the inlet air temperature decreases causing bulb **52** to cool. At a predetermined level, this lower temperature causes the control to snap over in reverse to the manner previously described causing rod **180** to move to the position shown in FIG. 8, whereupon bulb heater **56** is energized. The temeprature of bulb **52** increases until the snap point is again reached, whereupon rod **180** moves outwardly to the position shown in FIG. 9. It should be noted that the movement of rod **180** through the positions shown in FIGS. 8 and 9 provides a time delay for drying the clothes more completely than when the clothes are in the condition which causes the movement from FIG. 7 to FIG. 8. It will be obvious that such a delay could be accomplished by eliminating one of the teeth **186** or **188** and by increasing the mass of bulb **52** to slow the rate of thermal change thereof. In such a case, the temperature of bulb **52** would not cool to the predetermined level as rapidly so that the difference provides the desired delay. The intermediate movements represented by FIGS. 8 and 9 would be eliminated.

When the bulb **52** subsequently cools to a predetermined level, latch members **172** and **176** snap over whereupon rod **180** moves outwardly to the position shown in FIG. 10. This outward movement causes cam follower **196** to drop along cam surface **184** and thereby open contacts **200** to prevent heater **38'** from being subsequently turned on. The heating operation is now finished, however, the motor **36** continues to operate the drum **30** and blower **34** and the bulb heater **56** is energized. The temperature of bulb **52** increases until actuating stem **156** causes latch members **172** and **176** to snap over. Rod **180** moves outwardly to the position shown in FIG. 11.

The subsequent cooling of bulb **52**, due to the lower inlet air temperature, causes latch members **172** and **176** to snap over. Rod **180** moves outwardly to the position shown in FIG. 5, and contacts **198** open to turn off the motor **36** and to stop the drying operation. The length of time after which heater **38** is turned off is dependent upon the temperature-time characteristics of bulb **52**. Should this be too rapid to allow sufficient cooling of the interior of drier **20**, a switch (not shown) may be connected into the circuit to provide the necessary time delay.

To provide for automatic stopping of the drier load in the damp dry state for ironing, the control **50** may be fitted with an operator control knob (not shown) attached to screw **162** to adjust the snap temperature to a higher point, thereby stopping the drier when a lesser drop in incoming air temperature has occurred, indicating that the load is suitably damp dry.

It will be obvious that the controls described can readily be applied to any temperature gradient within a drying system, which temperature gradient is caused by a decrease in temperature of the air passing over the moisture-laden clothes. Such controls, although described with reference to a conventional clothes drier, can also be applied to a condenser type clothes drier. In such a system, the constant control temperature would preferably be at or near the condenser wall and the gradient sensed near a heat transfer wall commonly used in such driers.

It will be understood that many changes in the details of construction and arrangement of parts may be made without departing from the scope of the invention as defined in the appended claims.

I claim:

1. A drier comprising means defining a drying chamber for receiving articles to be dried, said chamber having an air inlet and an air outlet, means for inducing a flow of air through said chamber from said inlet to said outlet, heating means for heating air for flowing through said inlet, regulating means on said heating means for varying the heat output of said heating means, first temperature responsive means for controlling said regulating means to vary the output of said heating means to maintain the temperature of air adjacent said outlet at a substantially constant temperature, and second temperature responsive means operable in response to a reduction in the heat output of said heating means to a pre-selected minimum output for discontinuing operation of said heating means.

2. A drier comprising means defining a drying chamber for receiving articles to be dried, said chamber having an air inlet and an air outlet, means for inducing a continuous flow of air through said chamber from said inlet to said outlet, regulatable heating means located to heat air flowing through said inlet, regulating means for varying the heat output of said heating means to thereby increases or decrease the temperature of air adjacent said inlet, first temperature responsive means located in the path of air flowing through said outlet, means coupling said first temperature responsive means to said regulating means to control said regulating means to maintain the temperature of air adjacent said outlet at a substantially constant temperature, second temperature responsive means located in the path of air flowing through said inlet for discontinuing operation of said heating means when the temperature of air adjacent said inlet is reduced to a predetermined temperature.

3. A drier comprising a variable output heater, first heater control means selectively actuable to start or to stop operation of said heater, second heater control means for adjustably varying the heat output of said heater during operation of said heater, means defining a drying chamber for receiving damp articles to be dried, air flow inducing means for inducing a flow of air heated by operation of said heater through said drying chamber to evaporate moisture from articles located in said chamber, means for actuating said first heater control means to start operation of said heater, first temperature responsive means operable upon starting of said heater for operating said second heater control means to operate said heater at its maximum heat output until the temperature of air leaving said drying chamber reaches a selected temperature and to subsequently adjustably reduce the output of said heater in response to the drying of articles in said chamber to maintain the temperature of air leaving said chamber at said selected temperature, and second temperature responsive means operable upon a reduction in the heat output of said heater by operation of said first temperature responsive means to a selected minimum heat output ot actuate said first heater control means to stop operation of said heater.

4. A drier comprising a variable output heater, first heater control means selectively actuable to start or to stop operation of said heater, second heater control means for adjustably varying the heat output of said heater during operation of said heater, means defining a drying chamber for receiving damp articles to be dried, air flow inducing means for inducing a flow of air heated by operation of said heater through said drying chamber to evaporate moisture from articles located in said chamber, means for actuating said first heater control means to start operation of said heater, first temperature responsive means operable upon starting of said heater for operating said second heater control means to operate said heater at its maximum heat output until the temperature of air leaving said drying chamber reaches a selected temperature and to subsequently adjustably reduce the output of said heater in response to the drying of articles in said chamber to maintain the temperature of air leaving said chamber at said selected temperature, and second temperature responsive means operable upon a reduction in the heat output of said heater by operation of said first temperature responsive means to a selected minimum heat output to actuate said first heater control means to stop operation of said heater, said second temperature responsive means comprising a temperature responsive element located to respond to the temperature of air entering said drying chamber, means operable by said temperature responsive element to stop operation of said heater when the temperature sensed by said temperature responsive element is less than a selected minimum temperature, and auxiliary heating means operable by said means for starting operation of said heater to apply heat to said temperature responsive element to prevent actuation of said first heater control means to stop operation of said heater during the initial stages of operation of said heater.

5. A drier as defined in claim **4** further comprising means operable by said temperature responsive element for discontinuing operation of said auxiliary heater when the temperature as sensed by said temperature responsive element increases to a temperature above said selected minimum temperature.

6. A drier as defined in claim **4** further comprising means operable by said temperature responsive element for operating said air flow inducing means when the temperature as sensed by said temperature responsive element exceeds said selected minimum temperature, and switch means operable upon stopping operation of said variable output heater by said first heater control means for energizing said auxiliary heater to cause said temperature responsive element to operate said air flow inducing means for an additional cool down period after the stopping of said variable output heater.

7. A clothes drier or the like comprising means defining a drying chamber for receiving damp articles to be dried, said chamber having an air inlet and an outlet, means for inducing a flow of air through said chamber from said inlet to said outlet, a variable output heater located adjacent said inlet for heating air at said inlet to an adjustably selected inlet temperature, first heater control means responsive to the temperature of air adjacent said outlet for varying the output of said heating means to maintain the temperature of air flowing through said outlet at a substantially constant temperature by varying the air inlet temperature in accordance with the temperature lost by air during its passage through said drying chamber, and second heater control means responsive to the temperature of air adjacent said inlet for discontinuing operation of said heater when the temperature of air adjacent said inlet has been reduced to a selected minimum temperature by said first heater control means.

8. A clothes drier or the like comprising means defining a drying chamber for receiving damp articles to be dried, said chamber having an air inlet and an outlet, means for inducing a flow of air through said chamber from said inlet to said outlet, a variable output heater located adjacent said inlet for heating air at said inlet to an adjustably selected inlet temperature, first heater control means responsive to the temperature of air adjacent said outlet for varying the output of said heating means to maintain the temperature of air flowing through said outlet at a substantially constant temperature by varying the air inlet temperature in accordance with the temperature lost by air during its passage through said drying chamber, and second heater control means responsive to the temperature of air adjacent said inlet for discontinuing operation of said heater when the temperature of air adjacent said inlet has been reduced to a selected minimum temperature by said first heater control means. said second heater control means comprising a temperature responsive element movable in proportional response to the temperature of air adjacent said inlet, switch means movable to a first position when the temperature of air at said inlet is below a selected temperature and movable to a second position when the temperature of air adjacent said inlet is above selected temperature, an auxiliary heated located adjacent said temperature responsive element operable to maintain the temperature sensed by said element above said selected temperature when said auxiliary heater is operated, and means operable upon the starting of operation of said variable output heater for energizing said auxiliary heater.

9. A clothes drier or the like comprising a gas burner, gas supply means operatively connected to supply gas under pressure to said burner, shutoff valve means connected in said supply means for controlling communication between said supply means and said burner, modulating valve means connected in said supply means for adjustably varying the rate of flow of gas to said burner to thereby vary the heat output of said burner, means defining a drying chamber for receiving damp articles to be dried, air flow inducing means for inducing a flow of air heated by operation of said burner through said drying chamber to evaporate moisture from articles located in said chamber, means for opening said shutoff valve to place said supply means in communication with said burner and for igniting said burner, temperature responsive means operable upon ignition of said burner for operating said modulating valve means to supply gas to said burner at a maximum rate until the temperature of air leaving said drying chamber reaches a selected temperature and to subsequently operate said modulating valve means to adjustably reduce the rate of flow of gas to said gas burner in response to the drying of articles in said chamber to maintain the temperature of air leaving said chamber at said selected temperature, and means operable upon a reduction in the heat output of said burner by adjustment of said modulating valve means to a selected minimum heat output to shift said shutoff valve means to a closed position to discontinue the supply of gas to said burner.

10. A clothes drier or the like comprising a gas burner, gas supply means operatively connected to supply gas under pressure to said burner, shutoff valve means connected in said supply means for controlling communication between said supply means and said burner, modulating valve means connected in said supply means for adjustably varying the rate of flow of gas to said burner to thereby vary the heat output of said burner, means defining a drying chamber for receiving damp articles to be dried, air flow inducing means for inducing a flow of air heated by operation of said burner through said drying chamber to evaporate moisture from articles located in said chamber, means for opening said shutoff valve to place said supply means in communication with said burner and for igniting said burner, temperature responsive means operable upon ignition of said burner for operating said modulating valve means to supply gas to said burner at a maximum rate until the temperature of air leaving said drying chamber reaches a selected temperature and to subsequently operate said modulating valve means to adjustably reduce the rate of flow of gas to said gas burner in response to the drying of articles in said chamber to maintain the temperature of air leaving said chamber at said selected temperature, and means operable upon a reduction in the heat output of said burner by adjustment of said modulating valve means to a selected minimum heat output to shift said shutoff valve means to a closed position to discontinue the supply of gas to said burner, said means operable upon a reduction in the heat output of said burner comprising a temperature responsive element located to sense the temperature of air adjacent said burner, means operable by said temperature responsive element to close said shutoff valve when the temperature of air adjacent said temperature responsive element is less than a selected minimum temperature, an auxiliary heating means operable by said means for starting operation of said burner to apply heat to said temperature responsive element to prevent closing of said shutoff valve means during the initial stages of operation of said burner.

11. A clothes drier or the like as defined in claim **10** further comprising means operable by said temperature responsive element for operating said air flow inducing means when the temperature as sensed by said temperature element exceeds a selected minimum temperature, and switch means operable upon stopping of operation of said burner by said shutoff valve means for energizing said auxiliary heater to cause said temperature responsive element to operate said air flow inducing means for an additional cool down period after the stopping of operation of said burner.

12. In a clothes dryer control system, a dryer chamber, a burner having a heat output for furnishing heated air through an inlet passageway to said chamber, an exhaust duct for exhausting air from said chamber, a gas valve means, means connecting said valve means in a gas supply conduit to control the supply of gas from a source to said burner, a first temperature responsive means, means for mounting said responsive means in said exhaust duct to be responsive to the air temperature of the air exhausting from said dryer chamber, means connecting said temperature responsive means to said gas valve so that said burner heat output is maintained at a level needed to maintain a predetermined exhaust air temperature, second temperature responsive means, means for mounting said second responsive means in said inlet passageway to be responsive to the temperature of the heated air furnished to said chamber, further means for terminating the flow of gas to said burner and means connecting said second temperature responsive means to said further means to terminate the operation of the burner when the temperature of the air furnished to the dryer chamber reaches a selected low value indicating that the clothes are dry.

13. In a clothes dryer control system, a dryer chamber having an air exhaust passage, a heat supply for heating air that is delivered to said chamber, first means for modulating controlling said heat supply to change the temperature of the air delivered to the dryer chamber, temperature responsive means, means for mounting said responsive means in said exhaust passage to be responsive to the temperature of the air leaving said dryer chamber through said exhaust passage, means connecting said temperature responsive means to said first means for maintaining the temperature of air as high as possible without increasing the exhaust air temperature above a predetermined value, second means for stopping the heat supply, second temperature responsive means responsive to the air temperature of the air delivered to said dryer chamber, and means connecting second temperature responsive means to said second means whereby said heat supply is terminated when the temperature of the delivered air temperature decreases to a predetermined value.

14. In a drying control system, a drying chamber, means for supplying heat to heat the inlet air delivered to said chamber, an exhaust passage for said drying chamber for discharging air and moisture removed from the material in said chamber being dried, exhaust air temperature responsive means, means connecting said temperature responsive means to control said means for supplying heat to maintain the exhaust air temperature below a predetermined value, and second means responsive to a condition indicative of the temperature of said heated air supplied to said chamber, further means for shutting off said means for supplying heat, and means connecting said second means to said further means to terminate said heat supply when said condition reaches a value indicative of a predetermined low inlet air temperature.

15. In a drying apparatus, a chamber for holding material which is to be dried, heating means for supplying heat to said chamber to accomplish both sensible and latent heating, said chamber having an exhaust opening for exhausting air from said chamber, first means for varying the heat output of said heating means from a high output to a low output, second means responsive to a condition indicative of the temperature of the air leaving said chamber by said exhaust opening, means connecting said second means to said first means to maintain the exhaust air temperature at a predetermined temperature whereby as the moisture is removed from the material and less latent heat is needed to evaporate moisture in the material and more of said heat output is used for sensible heat, said first means is adapted to reduce the heat output of said heating means, second means for terminating the operation of said heating means, second responsive means responsive to a parameter indicative of a predetermined low level of output of said heating means, and means connecting said second responsive means to said second means to terminate the operation of said heating means when said low level of heat output is reached.

16. In material treating apparatus, a chamber for holding material to be treated, a heat source for supplying heat to said chamber, said chamber having an exhausted passage, means adapted to vary the heat supplied to said chamber by said heat source, first temperature responsive means, means for mounting said responsive means in said exhaust passage to be responsive to the temperature of the gases exhausting from said exhaust passage, means connecting said temperature responsive means to said first means to control the level of heat supplied to said chamber to maintain said exhausting gases at a selected temperature value, second means for terminating the operation of said heat source, third means responsive to said level of said heat supplied to said chamber by said source, and means connecting said third means to control said second means to determine the termination of the operation of the heat source when said level reaches a predetermined low value.

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FREDERICK L. MATTESON, JR., Primary Examiner