Nov. 4, 1958 W. L. KAUFFMAN II 2,858,618

AUTOMATIC CONTROL DEVICE FOR LAUNDRY DRIER

Filed March 11, 1955 4 Sheets-Sheet 1

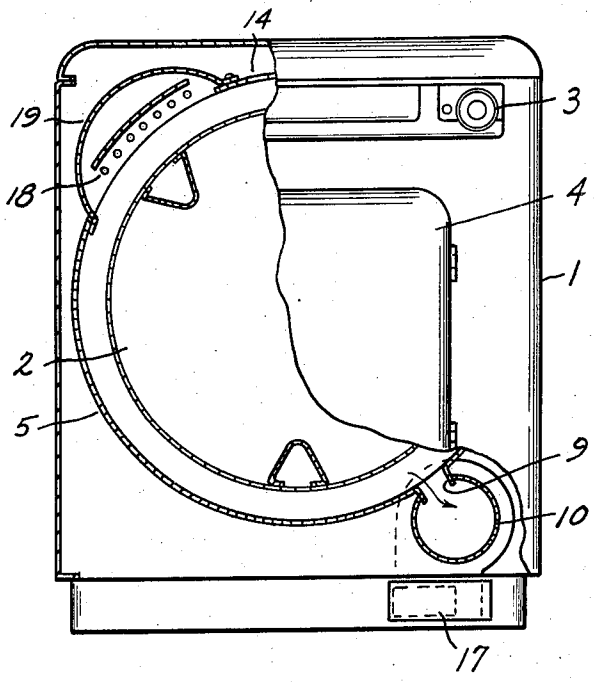


FIG. 1

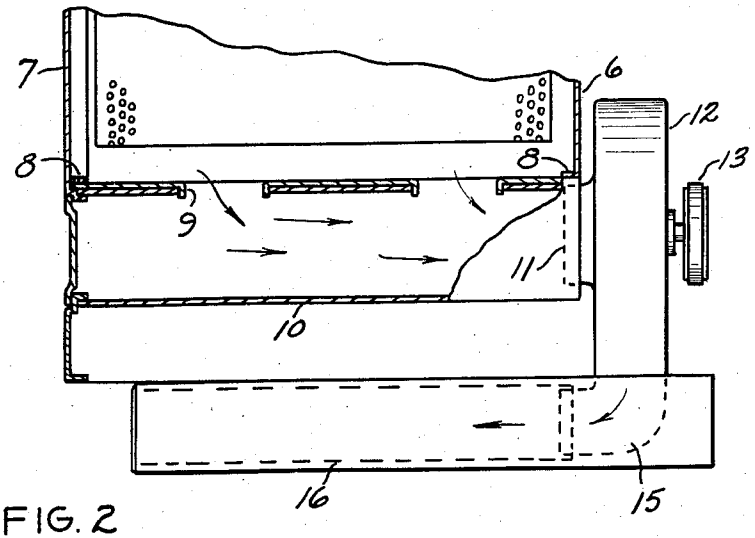


FIG. 2

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AUTOMATIC CONTROL DEVICE FOR LAUNDRY DRIER

Filed March 11, 1955 4 Sheets-Sheet 2

FIG. 3

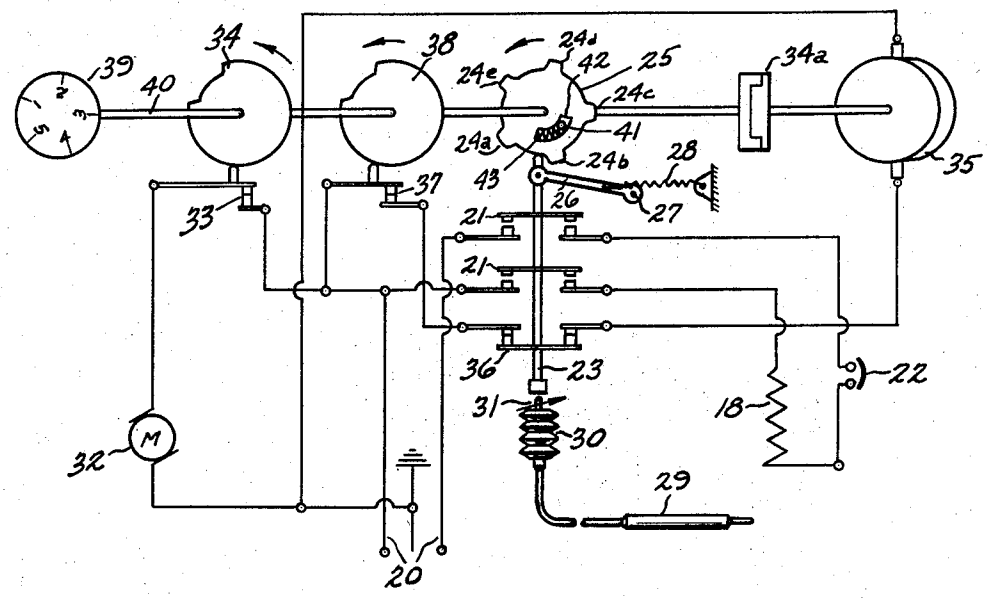
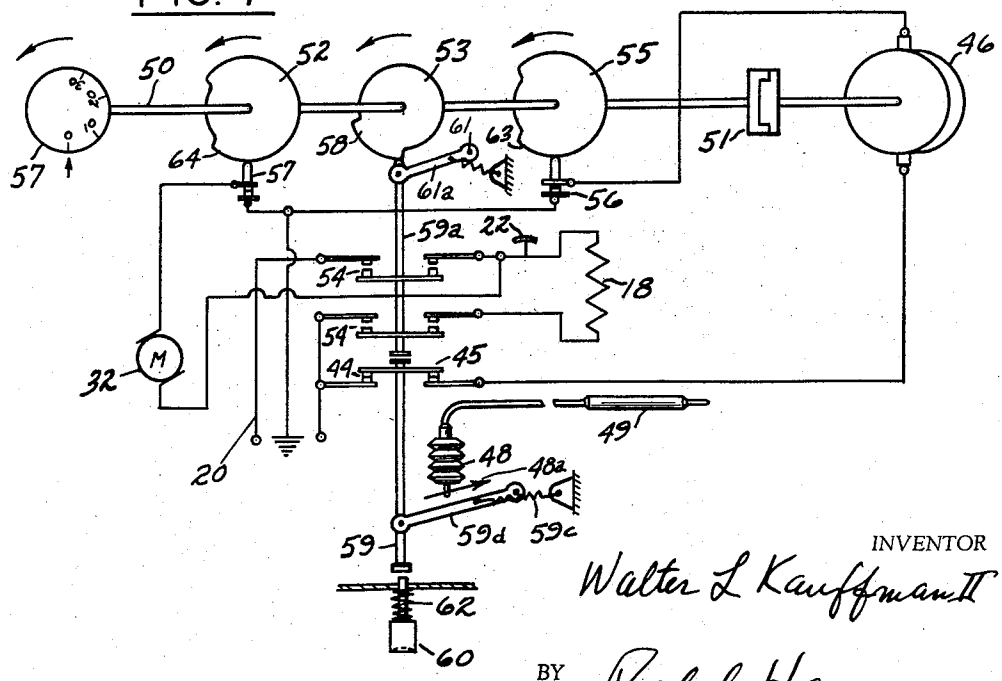


FIG. 4



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AUTOMATIC CONTROL DEVICE FOR LAUNDRY DRIER
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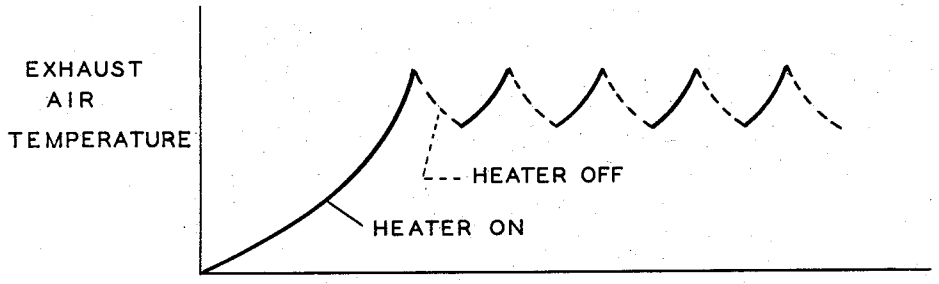


FIG. 5

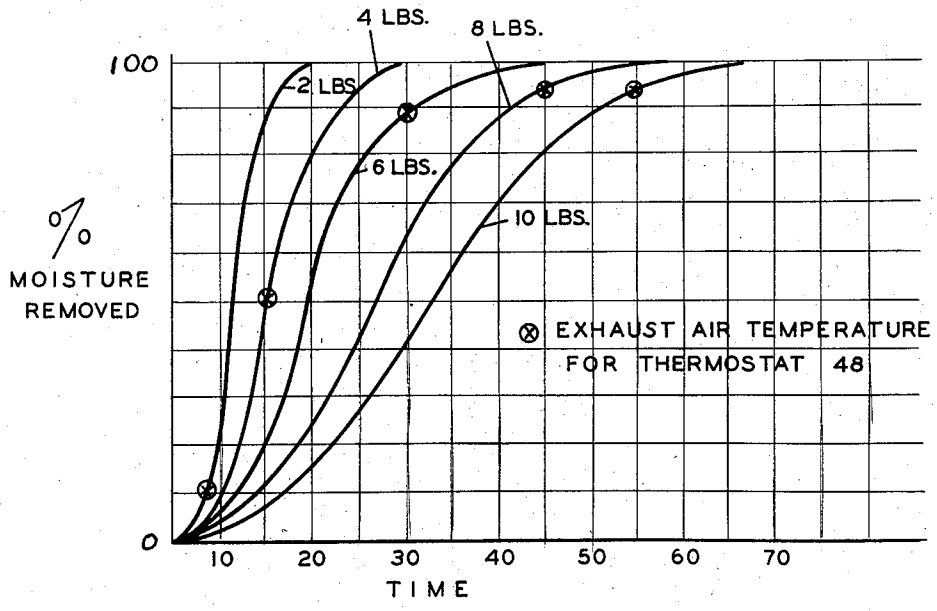


FIG. 6

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AUTOMATIC CONTROL DEVICE FOR LAUNDRY DRIER

Filed March 11, 1955 4 Sheets-Sheet 4

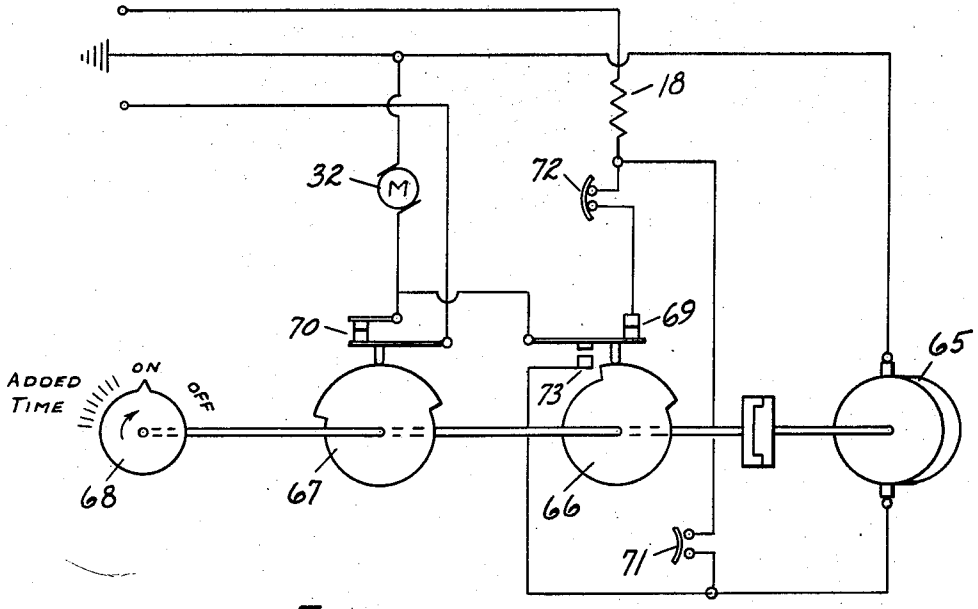


FIG. 7

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2,858,618

AUTOMATIC CONTROL DEVICE FOR LAUNDRY DRIER

Walter L. Kauffman II, Erie, Pa., assignor to Lovell Manufacturing Company, Erie, Pa., a corporation of Pennsylvania

Application March 11, 1955, Serial No. 493,730

4 Claims. (Cl. 34—45)

In clothes dryers, the size of load, type of fabric and degree of initial wetness cause wide variations in the drying time which are more noticeable when the clothes are to be fully dried and are much less or not at all noticeable when the clothes are to be damp dried for ironing. Because of these variations, either the timer or thermal control has not heretofore produced uniform results. With the timer control, the user invariably tends to select too long a drying time with the resultant overdrying and injury or excessive wear on the fabric due to the embrittlement which accompanies overdrying. With the thermal control where the dryer shuts off at a preselected exhaust air temperature there is a tendency for the dryer to shut down before complete drying of articles which are hard to dry such as shag rugs. This is particularly noticeable in small loads or in mixed loads of different fabrics. Because of these factors there is an element of judgment in the operation of an automatic dryer.

This invention is a combined thermal and timer control which is intended to minimize the skill or judgment necessary to select the desired degree of dryness which will thereafter be automatically obtained without objectionable overdrying. The first step is to adjust the thermal control responding to the exhaust air temperature for the kind of fabric being dried. Synthetics, which are never more than superficially wet, require a lower exhaust air temperature setting than shag rugs which are very hard to dry. The second step in the control involves the judgment of the operator to the size of load and involves added time required after the exhaust air temperature is up to the selected value. Depending upon these factors, the user selects additional drying time either as successive cycles controlled by exhaust air temperature or as straight timer controlled. Because the initial step of adjustment of the control has compensated for most of the variables, the selection of the added drying time requires much less skill than as though the user were required to estimate total drying time for each load. The selection of the added time necessary to bring the clothes from damp to full dry condition is made before the dryer starts and the entire drying cycle is thereafter automatically carried out.

In the accompanying drawing, Fig. 1 is a front elevation partly broken away of a clothes dryer; Fig. 2 is a fragmentary sectional side elevation; Fig. 3 is a control diagram; and Fig. 4 is another control diagram; Fig. 5 is a diagram illustrating the operation of the Fig. 3 control; Fig. 6 is a diagram illustrating the operation of the Fig. 4 control; and Fig. 7 is a control diagram of another modification.

Typically, the dryer has a cabinet **1** within which is located a horizontal clothes receiving drum **2**. The dryer control **3** may be located in an upper corner of the cabinet. A door **4** provides access to the open front end of the drum for loading and unloading clothes. The outer periphery of the drum is enclosed by a cylindrical casing **5** which extends between a back wall and a front wall **7** and is supported on these walls by inwardly extending

cylindrical flanges **8**. The casing **5** conveniently may be made in the form of the sheet which is wrapped around and suitably secured to the flanges **8**. In the lower part of the casing there are flanged openings **9** which register with and are crimped into corresponding openings in an inlet duct **10** which extends axially along the outside of the casing **5** and is connected to the inlet **11** of a suction fan **12** which is suitably driven by pulley **13**. In the operation of the dryer, air is drawn diagonally across the drum through an air intake slot **14** and through the perforated periphery of the drum into the fan inlet duct **10** through the openings **9** and is discharged by the fan through an outlet **15** into a lint trap **16** having a discharge **17** at the front of the dryer. Heat for evaporating the moisture is supplied by an electric heating element **18** suitably mounted within a reflector **19** adjacent the air intake slot **14**. The parts so far described are or may be of common construction and are subject to substantial variation in construction and appearance.

During the early part of the drying cycle, the moisture in the clothes is evaporated at a rapid rate and the latent heat of vaporization limits the rise in temperature of the air exhausted by the blower **12** to a value of the order of 140° to 150° F. When the air reaches this temperature, the bulk of the moisture has been evaporated but there remains enough moisture in the clothes so that the clothes are merely damp dried suitable for ironing. The time required for the clothes to reach the damp dry condition naturally depends upon the size of the load and the degree of initial wetness. Except for light loads, the exhaust air temperature has been found to be a very reliable indication of when the clothes are damp dry. As the clothes are progressively dried beyond the damp dry condition, less of the heat goes into vaporizing the moisture and more of the heat goes into raising the temperature of the clothes and air. In this further drying operation, the size of the load and the type of fabric become increasingly important and introduce substantial variations in the relationship between the exhaust air temperature and the degree of dryness. For example, an an exhaust air temperature of 180° which might correspond to full dry for broadcloth shirts will not correspond to full dry for shag rugs. In other words, the exhaust air temperature is a less reliable indicator of the full dry condition. The exhaust air temperature, however, does automatically indicate when normal sized loads of clothes are damp dry and does automatically take care of indicating when the great bulk of the moisture in the clothes has been evaporated. For light loads, the heat bypasses the clothes so the rise in exhaust air temperature is higher than could be expected from the moisture remaining in the clothes.

In order to take care of variations which are not accurately reflected in the exhaust air temperature, it is proposed to utilize a control in which the initial part of the drying cycle corresponding to that required to bring the clothes to a damp dry condition is controlled by the exhaust air temperature and the final part of the drying cycle necessary to bring the clothes to a full dry condition is preselected by the judgment of the operator in accordance with the size of load and type of fabric. Because of the damp dry condition the clothes have an essentially constant amount of moisture, it is not necessary that the operator also estimate the initial wetness. This results in a control which can be adjusted with a minimum of skill so as to fully dry without overdrying any load.

In the control diagram shown in Fig. 3, the heating element **18** is connected across a grounded neutral 230 volt power supply **20** through contacts **21** and a safety thermostat **22** which cuts off the heating element under abnormal conditions such as when the belt driving the

blower breaks or when the normal air circulation is interfered with. The contacts 21 are mounted on a rod 23 which is depressed to the contact closing position by any one of the cam projections 24*a–e* on a cam 25 acting through a lever 26 pivoted at 27 and associated with an over-center spring 28. The depression of the lever 26 by the projections 24*a–e* moves the lever past the center line of the spring 28 after which the contacts 21 are closed under the pressure developed by the spring 28. The contacts 21 are opened under the control of a thermostatic bulb 29 connected to a bellows 30 having an adjustable abutment 31 which engages the lower end of the rod 23. The thermostatic bulb 29 is arranged in heat transfer relation to the exhaust air discharged by the blower 12 so that the bulb 29 has essentially the same temperature as the exhaust air. As the temperature of the bulb 29 rises, the bellows 30 expands and moves the rod 23 upward until it moves above the center line of the spring 28 after which the contacts 21 are opened with a snap action. The illustration of the snap action opening and closing of the contacts 21 is diagrammatic and commercially available snap action switches have substantially different appearances. The contacts 21 merely control the heating element 18. The contacts 21 have no control over the motor 32 for driving the drum 2 and blower 12. The motor 32 is connected across one side of the power supply 20 through a switch 33 controlled by a cam 34 arranged so that the motor 32 is energized whenever the contacts 21 are closed to energize the heating element 18 and the motor 32 continues to be energized after the contacts 21 cut off the power to the heating element.

The cams 25 and 34 which control the heating element 18 and the dryer motor 32 are driven through a slip clutch 34*a* by a timer motor 35 in series with contacts 36 which are open whenever the contacts 21 are closed and are closed whenever the heater 18 is de-energized by opening of the contacts 21. The timer motor 35 is also in series with a switch 37 controlled by a cam 38 and closed so long as the contacts 33 controlling the motor 32 are closed. This means that the timer motor 35 is always in condition for operation whenever the dryer is operating even though the timer motor 35 never runs except when the heating element 18 is de-energized. The slip clutch 34*a* permits the cams 25, 34 and 38 to be manually set by means of a control knob 39 fixed to the timer shaft 40. The cams 34 and 38 are rigidly fixed to the timer shaft 40. The cam 25 is loose on the timer shaft 40 and is connected thereto by a lost motion connection diagrammatically illustrated as a lug 41 projecting through a slot 42 in the cam 25 and spring 43. The lost motion connection between the timer shaft 40 and the cam 25 permits projections 24*a–e* on the cam 25, which close the contacts 21, to move out of the way after the contacts have been closed so as not to block the opening of the contacts under the action of the thermostatic bellows 30. The lost motion connection is well understood and is only diagrammatically illustrated.

In the use of the Fig. 3 dryer control, the operator starts the operation by turning the control knob 39 in a clockwise direction to the desired position and by setting the adjustment 31 of the thermostat 29. For normal loads, the temperature adjustment should be lower for synthetic fibers and higher for fibers difficult to dry such as shag rugs. For light loads, the temperature adjustment should be higher. The first position of the control knob will be damp dry in which the first of the projections 24*a* on the cam 25 closes the heater contacts 21. There are four additional projections 24*b*, 24*c*, 24*d*, and 24*e* on the cam 25 which are successively brought into play as the control knob 30 is turned in a clockwise direction. These additional projections, as will be hereinafter explained, add successive cycles of heat input to the dryer and are selected in accordance with the judgment of the operator as to the weight and type of clothes to be fully dried. Before the first projection 24*a* has closed the contacts 21 on the heater 18, the cams 34 and 38 have respectively closed the contacts 33 in series with the dryer motor 32 and the contacts 37 in series with the timer motor 35. The closing of the contacts 33 in series with the dryer motor 32 starts the rotation of the drum to tumble the clothes and the drive to the blower 12 to circulate air through the drum and discharge it out through the lint trap 15. Let us assume that the operator has a normal sized load of clothes of a fabric which is easy to dry. If this load is to be fully dried, the operator will turn the control knob 39 to a position in which the projection 24*b* on the cam 25 is slightly to the right of the upper end of the rod 23. As the projection 24*a* moves past the upper end of the rod 23, the contacts 21 are closed so that the cam projection 24*b* does not close the contacts 21. The initial drying operation with this setting of the control knob 39 will be to damp dry the clothes. This will be determined by the rise in temperature of the thermostatic bulb 29 to a temperature in the range of from 140° F. to 150° F. This temperature range will vary somewhat with the dryer heat input and dryer construction but will be a definite figure for any particular dryer design. By adjustment of the abutment 31, the setting of the exhaust air temperature can be adjusted to any selected value. When the exhaust air temperature reaches the selected value, the expansion of the bellows 30 moves the rod 21 upward and opens the heater contacts 21 and simultaneously closes the timer contacts 36, as shown in Fig. 3. This starts the rotation of the timer shaft 40 moving the cams 25, 34, and 38 in a counterclockwise direction. The rotation of the timer shaft 40 continues until the projection 24*a* engages the lever 26 and closes the heater contacts 21 and at the same time opens the timer motor contacts 36. The length of time required to reclose the contacts 21 by the projection 24*a* is determined by the speed of the timer motor shaft 40 and by the spacing between the projections 24*a* and 24*b*. This time will ordinarily be of the order of 5 minutes and during this time the circulation of air through the drum in the absence of the heat from the heating element 18 will result in a cooling down of the clothes and dryer. Accordingly, when the heater contacts 21 are reclosed by the cam projection 24*a*, the temperature has dropped so that a substantial period of time will be required to raise the exhaust air temperature back to the selected 140–150° F. value. The amount of heat imparted during this additional drying cycle will be sufficient to fully dry a normal load of easy to dry clothes. When the exhaust air temperature reaches the selected value at the end of this second drying cycle the contacts 21 are again opened and the contacts 36 in series with the timer motor 35 are again closed starting the rotation of the timer shaft 40 which continues until the circuit to the timer motor is interrupted by the opening of the contacts 37. This adds a further cool down period during which the exhaust air temperature drops because the air continues to circulate through the drum without any heat input. At the end of the final cool down period the contacts 33 in series with the drum motor 32 are opened shutting down the dryer.

If the operator had had a load of clothes which are very difficult to dry such as shag rugs, instead of turning the knob 39 so as to bring the cam projection 24*b* slightly to the right of the upper end of the rod 23, the operator would have turned the knob to the full limit in a clockwise direction bringing the projection 24*e* slightly to the right of the rod 23. This would have resulted in five successive cycles during each of which the exhaust air temperature was brought up to the selected 140°–150° F. value followed by a cool down period during which the blower continues to operate to circulate air through the drum with the heating element 18 cut off. These five successive cycles will result in the full drying of the most difficult load.

Because the clothes temperature as reflected by the exhaust air temperature is limited, the danger of overdrying the fibers with the resultant excessive wear due to brittleness is minimized even if the operator should turn the control knob **39** to the maximum drying position there would still not be dangerous overdrying of the clothes. From one aspect, the operator selects the number of drying cycles which correspond to the degree of dryness desired and will vary with the size of the load and the type of fabric being dried. The initial drying cycle merely brings the clothes to a damp dry condition and the added four cycles possible take care of the difficulty of drying different sized loads of different fabrics.

In the Fig. 4 control, the exhaust air temperature is used to determine when the clothes are damp dry and a timer is adjusted by the operator to add the additional drying time to bring the clothes to full dry. Because the damp dry clothes have an essentially uniform concentration of moisture less skill is required to estimate the added time required to fully dry the clothes. Surprisingly, the Fig. 4 control obtains almost perfect compensation for the weight of the clothes being dried.

The damp dry control is shown utilizing a non-recycling thermostat which closes contacts **44, 45** in the circuit of timer motor **46**. The contacts **45** are mounted on a rod **59** and are held in either open or closed position by an over-center device **59*c*, 59*d***. When the exhaust air temperature rises to the value corresponding to damp dry (140°–150° F. for a normal sized load), a bellows **48** associated wtih a thermostatic bulb **49** expands and moves the contacts **45** against the contacts **44** thereby closing the circuit to the timer motor. The timer motor **46** drives a shaft **50** through a slip clutch **51**. Fixed to the timer shaft **50** is a cam **52** controlling the motor **32** which drives the drum **2** and the blower **12**, a cam **53** which controls contacts **54** in circuit with the dryer heating element **18**, and a cam **55** which controls contacts **56** in the circuit of the timer motor **46**. The timer shaft **50** can be manually set by a control knob **57** which is turned in a clockwise direction to select the desired added drying time before the drying operation is started. The added drying time selected will depend upon the type of fabric, a factor which the operator is most familiar with. Ordinarily, the timer can be set to add anywhere as from 1 to 30 minutes additional drying time after the clothes have reached a damp dry condition as reflected by the temperature of the air exhausted through the lint trap **15**.

To set the dryer in operation, the operator first sets the control knob by turning it in a clockwise direction thereby determining the additional drying time after the clothes are damp dried. The setting of the additional drying time closes contacts **57** in the circuit of the dryer motor **32** and starts the rotation of the drum and the operation of the blower **12**. The setting of the timer shaft **50** also closes the contacts **56** in the circuit of the timer motor **46** and moves the projection **58** on the cam **53** clear of the upper end of a rod **59*a*** carrying the heater contacts **54**. The second step necessary to start the drying operation is to push a start button **60** at the lower end of a rod **59** carrying the timer contacts **45**. The rods **59** and **59*a*** are in axial alignment so that when the rod **59** is pushed upward, the rod **59*a*** moves upward and moves the contacts **54** to the closed position energizing the heating element **18**. The upward movement of the rod **59** opens the contacts **44, 45** in the circuit of the timer motor. There is an over-center spring **61** associated with a lever **61*a*** connected to the rod **59*a*** carrying the heater contacts **54** which acts to hold the contacts **54** in either the opened or closed position. The push button **60** is not mechanically connected to the rod **59** or to the contacts **44** but is biased away from these parts by spring **62** so that after the push button **60** is depressed to close the contacts **54** and **44, 45**, it is retracted by the spring **62** out of the way so as not to interfere with the subsequent opening of these contacts. A similar over-center spring **59*c*** is associated with a lever **59*d*** connected to the rod **59**. Because the pushing of the start button **60** opens the contacts **44, 45** in the circuit of the timer motor **46**, the initial stage of the operation of the dryer is solely under the control of the exhaust air thermostat **48, 49** having a temperature adjustment diagrammatically indicated at **48*a***. When the exhaust air temperature reaches the value corresponding to damp dry as selected by the adjustment **48*a***, the expansion of the bellows **48** depresses the rod **59** and closes the contacts **44, 45** and thereby starts the rotation of the timer motor **46** to add the additional drying time selected by the operator. If the minimum added time is selected, the timer motor **46** almost immediately turns the cam **53** to a position in which the raised portion **58** depresses the rod **59*a*** and opens the contacts **54** in the circuit of the heating element **18**, as shown in Fig. 4. At this point, a raised portion **63** on the timer motor cam **55** is still holding the contacts **56** in the timer motor circuit closed and a raised portion **64** on the dryer motor cam **52** is still holding the contacts **57** closed. Accordingly, the drum continues to rotate and the blower continues to circulate air through the dryer for a cool down period during which the temperature of the clothes and dryer is brought down to a lower value at which the clothes are more comfortably handled. This cool down period will ordinarily be from 4 to 5 minutes duration. At the end of this cool down period, the clothes will be damp dried. If a substantial amount of added drying time is selected so as to bring the clothes to the fully dried position the operation above described will be preceded by a timer controlled cycle during which the heating element **18** is energized. This added time control drying cycle may last as long as 30 minutes in the case of fabrics which are difficult to dry such as shag rugs. At the end of the added drying time, the raised portion **58** on the cam **53** opens the contacts **54** in the circuit of the heating element **18** and the cool down period described above follows the opening of the circuit to the heating element.

In both types of control the exhaust air temperature is used to select the damp dry condition of the clothes and a timer is adjusted by the operator to determine the additional drying necessary to bring the clothes up to the full dry condition. In each control, a non-recycling thermostat is used to set the timer in operation. The term non-recycling thermostat is used to describe thermostatic contacts which operate once and then have to be reset before operating again. In the Fig. 3 control, the timer resets the thermostat to operate for a selected number of additional drying cycles in each of which the exhaust air temperature is brought up to the value corresponding to damp dry and is followed by a cool down period during which air is circulated through the dryer with the heating element off. In the Fig. 4 control, the timer merely determines the additional drying time during which heat shall be supplied to the dryer so as to bring the clothes to the fully dried position. Both controls have a cool down period which is more necessary in the case of the Fig. 3 control but is desirable in both controls. In the Fig. 3 control if there were no cool down period the additional drying cycles would be of such short duration as to be of no practical value. In the Fig. 4 control where the cool down period appears solely at the end of the cycle it has only the function of reducing the clothes temperature so that the clothes can be more comfortably handled.

In Fig. 5 is a diagram of the exhaust air temperature for the Fig. 3 control, the full lines indicating the periods when the heat is on and the dotted lines indicating the periods when the heat is off.

In Fig. 6 is a diagram of the percentage of moisture removal for the Fig. 4 control having a fixed setting of the

exhaust air temperature thermostat 48, 49 and a fixed setting for the added time for the timer 46. The dryer is designed for a normal load of 8 pounds of clothes and in the range of 6–10 pounds of clothes a fixed exhaust air temperature setting turns on the timer a fixed time before the clothes are fully dried. Surprisingly, for light loads, e. g. 2–4 lbs., the control produces fully dried clothes by the same setting used for the 6–10 lb. loads. This is surprising because the percentage of moisture removed at the fixed exhaust air temperature at which the timer 46 is turned on varies from 12½% for the 2 lb. load to 90% for the normal or 8 lb. load and 92½% for the 10 lb. load. Yet despite the wide variation, all of the loads were fully dried without overdrying and without touching the dryer control setting. The setting for normal loads (8 lb.) worked equally well on light loads (2–4 lbs.) and on heavier than normal loads (10 lbs.). This produced substantially perfect compensation for the size of the load and provided complete protection from fiber embrittlement accompanying overdrying. The calibration of the Fig. 4 control is very simple. The exhaust air temperature is set for 90% moisture removal at normal load and the added time is set to bring the normal load to full dry. These two settings will then produce fully dry clothes for any size of load without overdrying.

In Fig. 7 is shown another control diagram in which the operator selects the added time for drying as in Fig. 4. In this control, the timer motor 65 is connected across one side of the 230 volt line and drives a cam 66 controlling the current to the dryer heater 18, a cam 67 controlling the current to the drum and fan motor 32 and a manual dial 68 by which the timer can be reset. The heater 18 is connected across the 230 volt line through a switch 69 controlled by the cam 66. The drum motor 32 is connected across one side of the 230 volt line to a switch 70 controlled by the cam 67.

The dryer is started by turning the dial 68 counterclockwise to the "on" position or as much past the "on" position as the operator desires added drying time controlled by the position of the cam 67. This closes the switch 69 in series with the heater 18 and the switch 70 in series with the motor 32. The timer 65 does not start at this time but remains stationary.

As soon as the exhaust air temperature comes up to the value determined by the adjustable normally open thermostat 71, a circuit is closed to the timer motor 65 which also extends through a normally closed thermostat 72 and the switch 70 in series with the drum motor 32.

After the timer motor 65 starts because the thermostat 71 has closed, the timer runs until it has used up the elapsed time set in by the cam 67. If only a small amount of added time was set in by the cam 67, the timer motor 65 may run continually until all of this time is used up. If a larger amount of added time is set in by the cam 67, the exhaust air temperature may rise sufficiently to open the normally closed thermostat 72 thereby interrupting the circuit to the timer motor 65 and to the heater 18 and permitting the drum motor 32 to keep running with the heater shut off. When the normally closed thermostat 72 recloses due to a drop in the exhaust air temperature, the timer motor starts again.

When the added time set in by the cam 67 is used up, the heater switch 69 opens and an auxiliary contact 73 is closed which keeps the timer 65 running. The timer runs for the cool-down period controlled by the cam 67 at the end of which the switch 70 in series with the drum motor opens shutting off the dryer 70 and likewise the timer 65.

In the Fig. 7 control, the thermostat 72 should not be open except when the thermostat 71 is closed. This would normally take place because the thermostat 72 is in essence an over-temperature thermostat which would always have a higher operating point than the thermostat 71.

As in the Fig. 4 control, the thermostat 71 can determine the damp dry condition for normal clothes and the timer 65 can determine the full dry condition. This eliminates the need for estimating load sizes and leaves only the need for a setting which depends on the type of fabric. The adjustability of the exhaust air thermostat 71 and of the timer 65 permits automatic drying without overdrying.

In clothes dryers there are two factors which affect the rate of drying, the rate at which heat is transmitted to the clothes and the rate at which the clothes absorb the heat. The rate at which the heat is transmitted to the clothes is a function of dryer design and except for the initial warm-up period when heat is dissipated in warming up the metal parts is essentially constant for any dryer. The rate at which clothes absorb the heat is a function of the kind of fabric. Thick fabrics such as shag rugs give up moisture relatively slowly while synthetic fabrics which are only superficially wet give up moisture quite readily. As the moisture is evaporated the heat of evaporation lowers the exhaust air temperature. For any particular kind of fabric the exhaust air temperature is primarily an indication of the total amount of moisture remaining in the clothes. For example, in a dryer where an exhaust temperature of 150° F. indicated that a two pound load of cotton towels had one and three-fourths pounds of water remaining to be evaporated, the same exhaust air temperature would indicate the presence of one and three-fourths pounds of water in loads of 4, 6, 8 and 10 pounds. Knowing the rate at which the dryer transmitted heat to the clothes the same amount of time would be required to evaporate the one and three-fourths pounds of water for each of the loads. The initial wetness of the clothes would not be important because only when the residual water reached one and three-fourths pounds would the exhaust air temperature rise to 150° F.

Accordingly, by selecting an exhaust air temperature corresponding to a fixed amount of residual moisture (which might, for example, range from 140° F. for synthetics to 160° F. for shag rugs) a control which adds a fixed amount of drying time after reaching this temperature will fully dry any size load with any degree of initial wetness. The only variable would be in the type of fabric which would determine whether the fabric was easy or hard to dry. The control which uses exhaust air temperature corresponding to damp dry followed by a fixed time of drying accordingly eliminates all of the variables except the type of fabric and offers the possibility of an automatic dryer control which eliminates most of the variables affecting the drying time.

By having the thermostat 72 set for a few degrees higher temperature than the thermostat 71, the drying can be carried out at temperatures low enough to prevent injury or overdrying of any fabrics, even the synthetics. For example, the normally open thermostat 71 might be set to close at 150° F. and to open at 130° F., while the normally closed thermostat 72 might be set to open at 165° F. and to close at 135° F., all temperatures being exhaust air temperatures. With these values, the thermostat 71 starts the timer then adds the selected amount of drying time but because of the thermostat 72, the timer stops when the exhaust air temperature reaches 165° F. and starts again when the exhaust air temperature drops to 135° F., thereby preventing drying at such high temperatures as to injure delicate fabrics. With this control, the timer does not measure elapsed time but measures additional drying time at temperatures below 165° F.

What is claimed as new is:

1. In a clothes dryer of the type having a rotatable clothes receiving drum, a heater associated with the drum, a circuit for the heater including contacts, a blower for exhausting air from the drum, and a motor drive for the blower and drum, the combination of a control movable to an "on" position for starting the operation of the dryer by energizing the heater through the said contacts and starting the motor drive for the drum and blower, a timer initially de-energized in the "on" posi-

tion of the control, said timer having a control for stopping the operation of the dryer by de-energizing the heater by opening said contacts and stopping the motor drive, a circuit for the timer branching from the heater circuit, an operator actuated selecting means for selecting the time interval after which the timer operated control stops the operation of the dryer, and normally open thermostat means in said timer circuit but not in said heater circuit closed in response to the exhaust air temperature for starting the operation of the timer without interrupting the heater when the exhaust air temperature reaches the value corresponding to the damp dry clothes for normal sized loads.

2. In a clothes dryer of the type having a rotatable clothes receiving drum, a heater associated with the drum, a blower for exhausting air from the drum, and a motor drive for the blower and drum, the combination of a control movable to an "on" position for starting the operation of the dryer by energizing the heater and starting the motor drive for the drum and blower, a timer initially de-energized in the "on" position of the control, said timer having a control for stopping the operation of the dryer by de-energizing the heater and stopping the motor drive, an operator actuated selecting means for selecting the time interval after which the timer operated control stops the operation of the dryer, a normally open thermostat means responsive to the exhaust air temperature for closing a circuit to the timer when the exhaust air temperature reaches the value corresponding to the damp dry clothes for normal sized loads, a normally closed thermostat in the timer circuit and in the circuit to the heater for interrupting both the timer and heater, but not the motor, upon excessive exhaust air temperature.

3. In a clothes dryer of the type having a rotatable clothes receiving drum, a heater associated with the drum, a heater circuit including a switch controlling the heater, a blower for exhausting air from the drum, and a motor drive for the blower and drum, a motor circuit including another switch controlling the motor, the combination of a control movable to an "on" position for starting the operation of the dryer by closing the heater switch and closing the motor switch, a timer initially de-energized in the "on" position of the control, said timer having a control for stopping the operation of the dryer by opening the heater and motor switches, an operator actuated selecting means for selecting the time interval after which the timer operated control stops the operation of the dryer, and a circuit to the time extending through the motor switch, and thermostat means in said timer circuit but not in said heater circuit having normally open contacts closed in response to the exhaust air temperature for starting the operation of the timer without interrupting the heater when the exhaust air temperature reaches the value corresponding to damp dry clothes for normal sized loads.

4. In a clothes dryer of the type having a rotatable clothes receiving drum, a heater associated with the drum, a switch controlling the heater, a blower for exhausting air from the drum, and a motor drive for the blower and drum, another switch controlling the motor, the combination of a control movable to an "on" position for starting the operation of the dryer by closing the heater switch and closing the motor switch, a timer initially de-energized in the "on" position of the control, said timer having a control for stopping the operation of the dryer by opening the heater and motor switches, an operator-actuated selecting means for selecting the time interval after which the timer operated control stops the operation of the dryer, a circuit to the timer extending in series through the motor switch, a normally closed thermostat connected in series with the heater and a normally open thermostat, said normally open thermostat closing at an exhaust air temperature corresponding to damp dry clothes for normal sized loads and said normally closed thermostat being closed at an exhaust air temperature corresponding to damp dry clothes for normal sized loads and opening at a higher exhaust air temperature whereby the timer measures drying time at temperatures between the temperature corresponding to damp dry clothes for normal sized loads and said higher exhaust air temperature.

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