

Dec. 3, 1957

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2,815,416

CONTROL APPARATUS FOR CLOTHES DRYERS

Filed Sept. 21, 1954

3 Sheets-Sheet 1

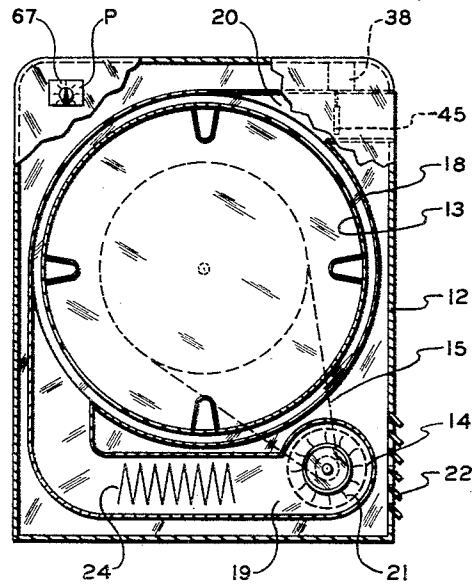


FIG. 1

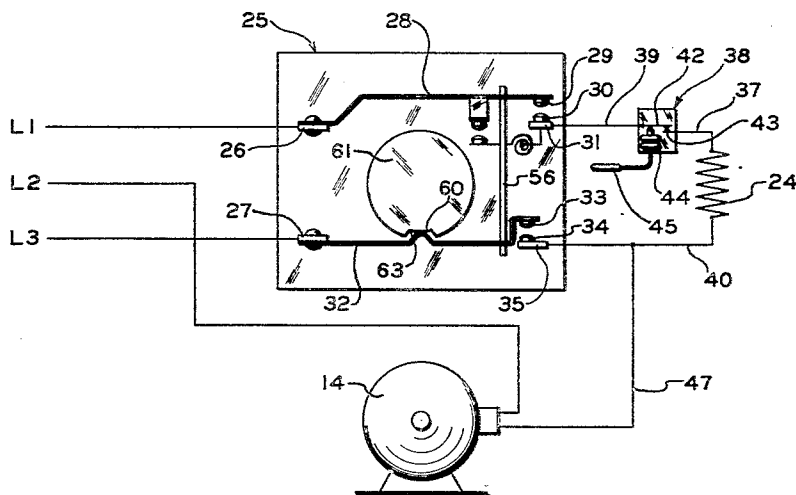


FIG. 2

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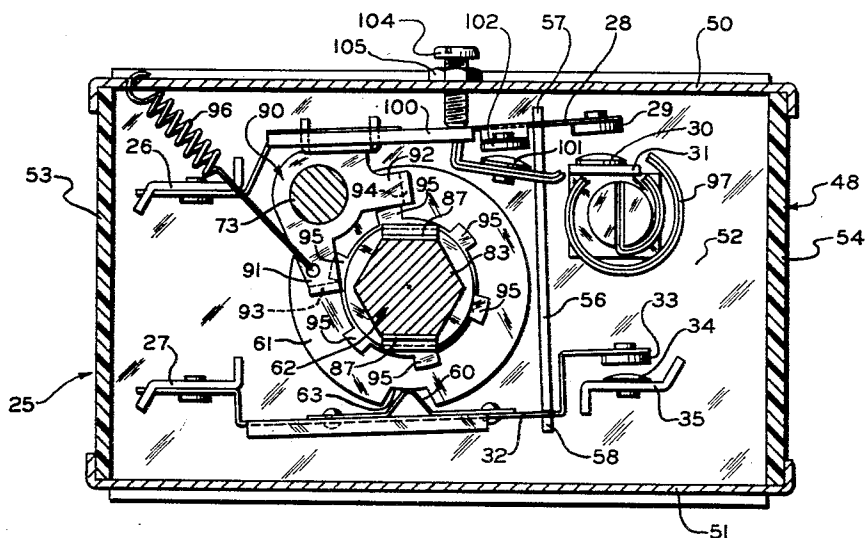


FIG. 3

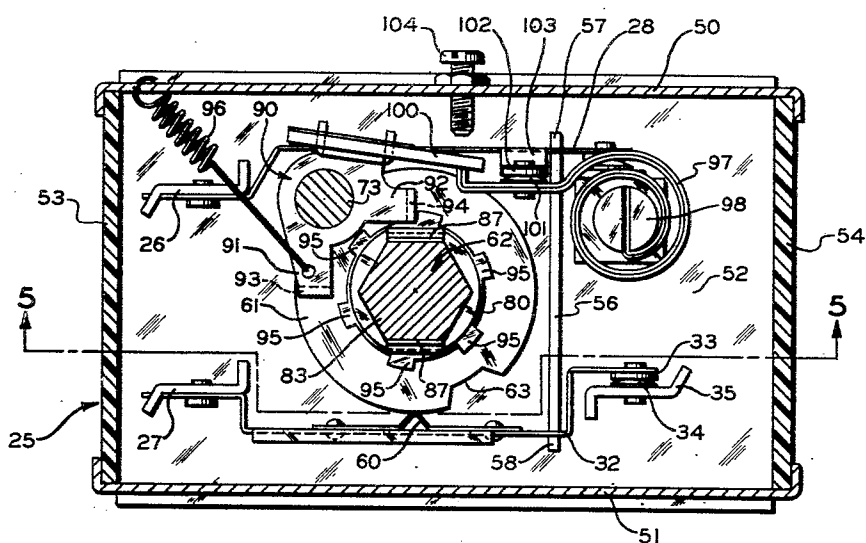


FIG. 4

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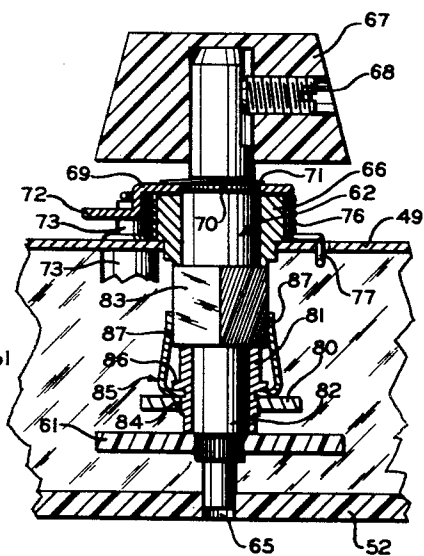
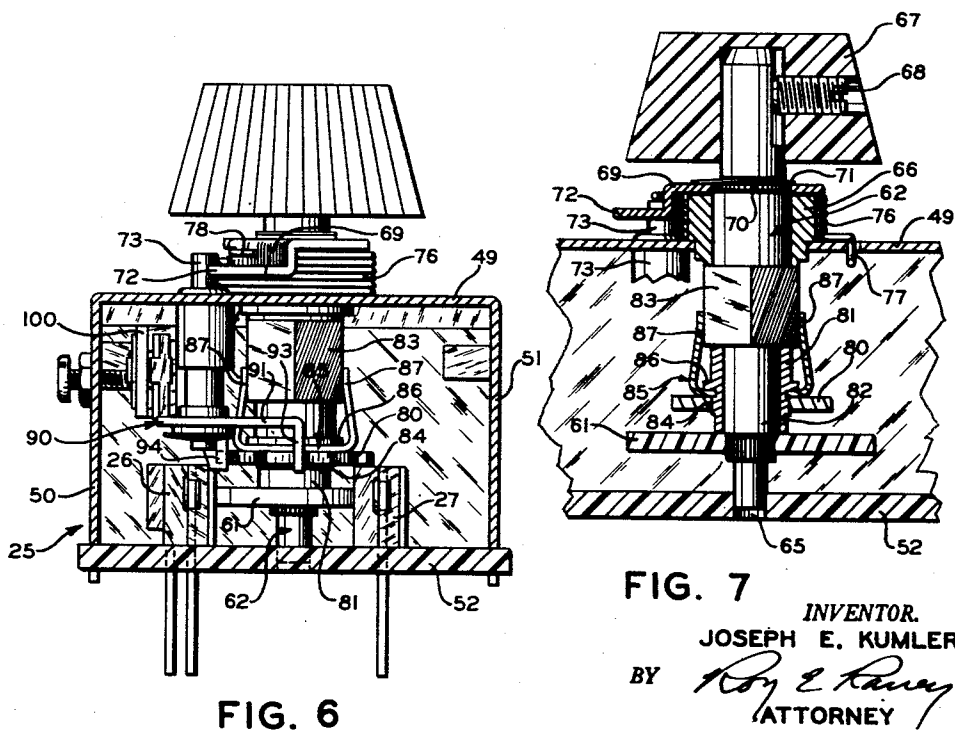
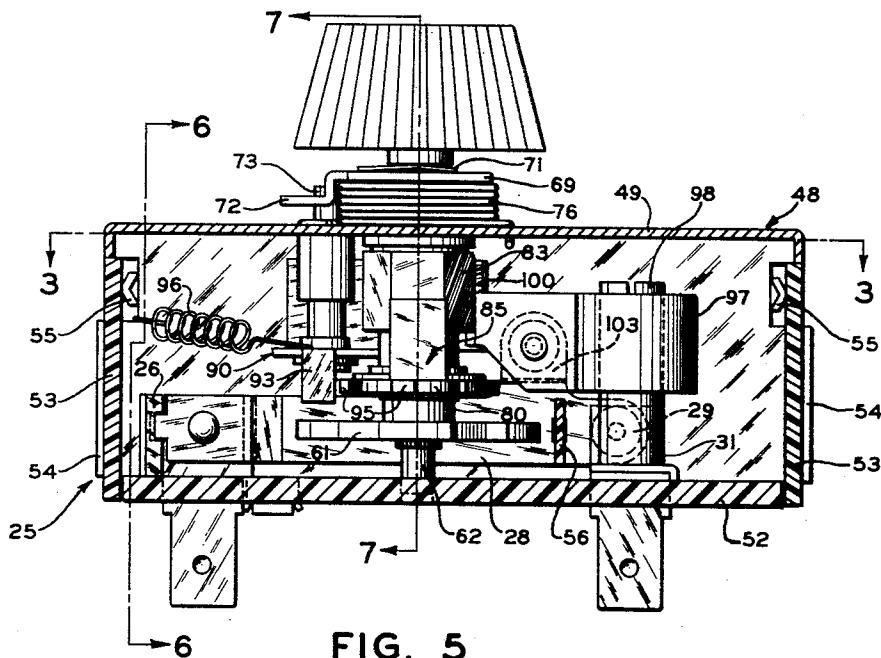


FIG. 7

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2,815,416

CONTROL APPARATUS FOR CLOTHES DRYERS

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Application September 21, 1954, Serial No. 457,444

2 Claims. (Cl. 200—138)

The present invention relates to apparatus for controlling the operation of clothes dryers, particularly clothes dryers of the so-called domestic type having a revolving clothes 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.

It has been proposed to control the air heating units in clothes dryers of the type mentioned by causing thermally responsive means to terminate the heating of the air in response to a rise in temperature of the air exhausted from the clothes drum, which rise occurs due to the reduction in moisture absorbed from the clothes. It has been found that for various reasons, this increase in temperature is not a true indication that the clothes are completely dry, and that additional drying is usually required. The present invention is concerned with improved means to provide preselected numbers of additional drying periods, within limits, whereby selection in the degree of dryness of the clothes may be had.

A broad object of the invention is the provision of control apparatus for clothes dryers of the type referred to, which apparatus includes a thermal device responsive to the exhaust air temperature to control the air heating means to cut off or reduce the heat supply in response to the rise of the exhaust air temperature to a predetermined degree and to re-establish the air heating upon reduction of the air temperature to a predetermined degree, and a counter device responsive to the cyclic operation of the thermal device to terminate the clothes drying operation in response to a preselected number of cycles of operation of the thermal device.

A more specific object of the invention is the provision of a counter of the type mentioned comprising a switch member in an electric control circuit for the air heater and arranged in circuit with the thermal device which controls the heater, a manually settable cam for operating the switch member to cause the air heater to be selectively rendered operative and inoperative, and means to move the cam through a given angle in response to a cyclic operation of the thermal device which controls the air heater, the cam moving means including a thermal responsive element movable from one position to another in response to heating and cooling thereof, an electric heating means for the thermal element, and switch means to control the heating element means for causing the latter to be energized when the air heater is operating and the thermal element is in one of its mentioned positions and de-energized when the thermal element moves to its other position.

Other objects and advantages of the invention will be apparent from the following description of a preferred form thereof, reference being had to the accompanying drawings wherein

Fig. 1 is a broken away view of a domestic type clothes dryer embodying the invention;

Fig. 2 is a schematic showing of the control system for the clothes dryer;

Fig. 3 is a sectional view of a control apparatus for

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the clothes dryer, the section being taken substantially along line 3—3 of Fig. 5;

Fig. 4 is a view similar to Fig. 3 but showing certain parts of the apparatus in different positions;

Fig. 5 is a sectional view of the control apparatus taken substantially along line 5—5 of Fig. 4;

Fig. 6 is a sectional view of the control apparatus taken substantially along line 6—6 of Fig. 5; and

Fig. 7 is a fragmentary sectional view of the control apparatus taken along line 7—7 of Fig. 5, certain parts of the apparatus being omitted for sake of clarity.

To illustrate the invention I have shown an electrically heated clothes dryer, although it is understood that the control apparatus could be used with a gas heated type clothes dryer in which the gas is controlled by an electrically operated valve, for example. Referring to Figs. 1 and 2, the clothes dryer is of conventional construction comprising a cabinet 12 having a clothes drum 13 rotatable on a horizontal axis and adapted to be rotated by an electric motor 14 through a drive including a belt 15. The cabinet 12 has a door in the front thereof through which the drum may be filled and emptied of clothes, the door being in registration with an end opening in the drum. Since this construction is well known in the art it is not shown in the drawing. As is usual, heated air is directed through the drum for drying the clothes as they are tumbled therein, and in the present instance the drum is enclosed in a shell 18 having an air intake duct 19 and a heated air discharge or exhaust duct 20. A centrifugal type fan 21 is driven by the motor 14 and is adapted to draw air into the duct 19 through an opening 22 in the cabinet 12 and to force the air through the drum 13 and out the exhaust duct 20. A suitable electrical heating coil 24 is located in the inlet duct 19 and is arranged to heat the air as it passes to the drum 13, as is well understood in the art.

Referring particularly to the electrical circuit for the air heater as shown in Fig. 2, current is supplied to the motor and heater of the dryer by a three wire system comprising power supply lines L1, L2, L3. The voltage drop between lines L1, L3 is 230 volts, while the drop between lines L1, L2 and L2, L3 respectively, is 115 volts. A cycle counter mechanism 25 is included in the heater circuit and has terminal posts 26, 27 to which lines L1, L3 are connected, respectively. The terminal post 26 has a switch member 28 attached thereto which carries a contact 29 adapted to engage a fixed contact 30 attached to a terminal bracket 31. The switch member 28 is comprised of a flat spring strip having one end attached to the terminal 26 and the other end biased downwardly, as viewed in Fig. 2, to cause contact 29 to engage contact 30.

The terminal 27 has a switch member 32 riveted thereto, which member comprises a flat spring strip having a contact 33 secured to the outer free end thereof and which contact is arranged to engage contact 34 attached to a fixed terminal bracket 35. The switch member 32 is inherently biased upwardly with sufficient force to overcome the downward bias of the switch member 28, the purpose of which will be apparent as the description proceeds.

It will be seen that both lines L1, L3 to the heater 24 are controlled by the contacts 29, 30 and 33, 34 respectively, one side of the heater being connected with terminal 31 through wire 37, control device 38 and wire 39. The other side of the heater is connected with terminal 35 by wire 40.

The control device 38 may be of any suitable, well-known construction and for the sake of clarity is merely shown schematically in Fig. 2. In the form shown, the device 38 comprises a movable switch contact 42 adapted to close on a fixed contact 43 and is moved to and from

contact 43 by the contraction and expansion of a thermally responsive device which comprises a bellows 44 having a tube and bulb 45 attached thereto, the bellows, tube and bulb being filled with a suitable thermally responsive liquid. The bulb 45 is located in the exhaust duct 29, and when the temperature of the exhaust air reaches approximately 165° F., for example, the bellows 44 expands to move switch contact 42 from contact 43 to break the heater circuit. When the bulb 45 is cooled to approximately 130° F., the bellows contracts to cause switch contact 42 to again engage contact 43 and reclose the heater circuit therethrough. For the sake of simplicity switch contact 42 is shown to be moved directly by the bellows 44; however, according to well known practice, the switching means could include a snap mechanism to snap move the contact between open and closed positions.

The temperature at which the contacts 43, 44 are opened is established when the control device is manufactured and is selected so that it will normally be reached only after the clothes have reached a semi-dry condition. The control device may be mounted inside the cabinet 12 by suitable brackets, not shown.

The circuit for the motor 14 includes line L2, wire 47 to wire 40, contacts 34, 33, switch member 32 to L3.

It will be seen that when the contacts 29, 30 and 33, 34 are closed, which is accomplished by manually operable means described hereinafter, the motor 14 is energized and the heater 24 will then be controlled by the device 38 so that when the exhaust air temperature rises to 165° F., in the form shown, the heater circuit will be broken at contacts 42, 43, and when the temperature of the exhaust air falls to 130° F. the heater circuit will be re-energized. This cycle of operation of the control device 38 will repeat until contacts 29, 30 and 33, 34 are reopened at which time the heater 24 will be de-energized irrespective of the closing of contacts 42, 43 and the motor 14 will likewise be de-energized. The contacts 29, 30 and 33, 34 are reopened automatically after a pre-selected number of cycles of operation of the control device 38 by means described presently.

Referring now more specifically to the construction and operation of the control apparatus 25, the apparatus comprises a suitable housing 48 formed by a channel shape member which provides a front wall 49 and top and bottom walls 50, 51. The back wall is comprised of a plate 52 formed of insulating material, such as Bakelite which is suitably attached to the rear edge portions and of the top and bottom walls. The ends of the housing are closed by plates 53, frictionally held between flanges 54 and tongues 55 formed on the side walls. The housing 48 is preferably attached by any suitable means to the inside of the front wall of the cabinet 12 so that the manual control knob 67 thereof may project exteriorly of the cabinet in a position convenient to the operator.

The back plate 52 has slots therein through which the terminal members 26, 27, 31 and 35 extend and the terminal members are suitably secured to the plate as by swaging the edges of the outwardly projecting prongs against the plate at the bases thereof to secure at the terminal members proper to the inside surface of the plate. This construction is a well known expedient and is not shown. As mentioned previously, the switch member 28 is attached to the terminal 26 and switch member 32 is attached to terminal 27, and as may be clearly seen in Figs. 3, 4, these members extend substantially parallel and are inter-connected by a rigid link 56. The link is formed of insulating material and has end neck portions 57, 58 which project through slots in the switch members 28, 32 so that the shoulders formed thereby engage the inner sides of the switch members and as switch member 28 moves upwardly member 32 is moved upwardly, as viewed in Fig. 3. By this arrangement, switch member 28 may move upwardly independently of switch member

32, the purpose of which will be apparent as the description proceeds.

The switch member 32 has a rise 60 formed thereon which engages the periphery of a cam 61 attached to a shaft 62 rotatably journaled in the front and rear walls 49, 52 respectively. In the form shown, the cam 61 is composed of a suitable dielectric material, and has a dip or recess 63 formed therein so that when the cam is rotated to a position in which the dip is in registration with the rise 60 on the switch member 32, the latter springs upwardly thereby separating contacts 33, 34 and overcomes the bias of the switch member 28 to move the same upwardly, through the link 56, to open contacts 29, 30. In all other positions of the cam 61 the switch member 32 is urged downwardly to close contact 33 on contact 34 as is shown in Fig. 4.

The inner end of the shaft 62 is journaled in an opening 65 in the plate 52 and the portion thereof which extends through the front wall 49 is journaled in a bushing 66 which is staked in an opening in the front wall. The outer end of the shaft 62 is flattened and the adjusting knob 67 is attached thereto by a set screw 68 threaded against the flat portion of the shaft. Preferably, the knob has a pointer thereon which cooperates with indicia on a dial plate P attached to the outside of the dryer and having an "off" position and five operative indicia, each spaced approximately 60° from one another.

Rotation of the shaft 62 in opposite directions is limited by a stop plate 69 which has a serrated opening the teeth of which lockingly engage splines 70 on the shaft and which is held in place on the shaft by a spring clip 71 frictionally secured in a groove in the shaft, as may be clearly seen in Fig. 7. The stop plate 69 has a finger 72 formed thereon which is arranged to strike a post 73 projecting from the front wall 49.

The shaft 62 is urged in a counterclockwise direction, as viewed in Figs. 3 and 4, by a torsion spring 76 surrounding the bushing 66 and having one end 77 projecting into an opening in the front wall 49 and the other end 78 lodged in a slot formed in one edge of the stop plate 69, as may be seen in Fig. 6.

Counterclockwise rotation of the shaft 62 and cam 61 is controlled automatically by means comprising an escapement wheel 80 which is attached to a sleeve 81 rotatably supported on a cylindrical section 82 of the shaft and positioned between one end of a hexagonal formation 83, formed on the shaft, and the cam 61. The escapement wheel 80 has a serrated central opening the teeth of which lock with splines 84 formed on the sleeve 81 so that the escapement wheel and sleeve rotate as a unit.

It is desirable that the cam 61 be manually settable at positions spaced at sixty degrees, which positioning is made by rotation relative to the escapement wheel. For this purpose a spring clip 85 is locked to the sleeve 81 in the same manner as is the wheel 80 and is positioned against a collar formation 86 on the sleeve at the outer end of the splines 84. The spring 85 includes two outwardly projecting fingers 87 which are disposed opposite one another and yieldingly engage opposite surfaces of the hexagonal portion 83 of the shaft 62, the fingers having flat surfaces which tend to bottom on oppositely disposed flat surfaces of the hexagonal portion and thereby yieldingly position the escapement wheel 80 into predetermined angular alignment with the shaft 62. Thus, the shaft 62 can be rotated relative to the escapement wheel and at each 60° of rotation the spring fingers 87 exert a maximum effort tending to lock the shaft with the wheel.

Rotation of the escapement wheel 80 is controlled by a pawl 90 which is pivoted on the post 73 and has two arms 91, 92 having rearwardly projecting fingers 93, 94, respectively which are adapted to alternately extend into the paths of teeth 95, formed on the wheel 80, when the pawl is oscillated about its pivot. There are six teeth 95

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on the wheel 80 spaced sixty degrees apart, and the angular positions of the arms 91, 92 are such that when finger 93 is withdrawn from the path of a tooth, finger 94 engages the periphery of the wheel and forms a stop for the tooth approaching the latter by counterclockwise movement of the escapement wheel, and when the pawl is rotated counterclockwise to withdraw the finger 94 from its stop position, finger 93 is moved against the wheel and forms a stop for the tooth preceding the tooth just released by the finger 94, hence, the escapement wheel moves through approximately sixty degrees each time the pawl is moved in opposite directions about its pivot and the rotation of the cam 61 and shaft 62 by the torsion spring 76 is controlled.

A torsion spring 96 is attached at one end to the arm 91 of the pawl and the opposite end is connected to the wall 50 so that the pawl is normally biased clockwise to the position shown in Fig. 4.

The pawl 90 is adapted to be moved counterclockwise from the position shown in Fig. 4 to the position shown in Fig. 3 by a thermal motor comprising a bimetal strip 97 in the form of a spiral having its inner end attached in a slot in the end of a post 98 attached to the terminal bracket 31. An arm 100 is rigidly attached to the pawl 90 and is adapted to be engaged by the outer end portion of the strip 97 so that the strip may tilt the pawl counterclockwise, as described hereinafter. The arm 100 is preferably formed of insulating material to isolate electric current in the bimetal 97, which is in a circuit including the terminal 31 by way of the post 98. The bimetal 97 carries a contact 101 thereon which is arranged to engage a contact 102 carried on a laterally projecting arm 103 on the switch member 28. When the bimetal 97 is relatively cool its outer end is biased in an upward position, as viewed in Figs. 2, 3, 4, and moves the arm 100 against the end of a screw 104 threaded through a nut 105 attached to the side wall 50 of the housing, which screw provides an adjustable stop to limit rotation of the pawl 80 in a counterclockwise direction. When the bimetal 97 is relatively hot it moves downwardly and permits the spring 96 to withdraw finger 93 from engagement with a tooth 95 of the escapement wheel and to move finger 94 to a tooth stopping position, as described previously.

The contacts 101, 102 connect the bimetal 97 in the circuit for the heater coil 24 and the composition of the bimetal is such that the current passing therethrough quickly heats the same and causes it to deflect downwardly as described. Alternatively, a suitable resistance element could be connected in the circuit by contacts 101, 102 and which would be arranged to heat the bimetal. The post 98 is preferably rotatably adjustable so that the tension of the outer end of the bimetal against arm 100 can be regulated to provide proper operation of the pawl.

The operation of the apparatus is as follows: When the various parts of the apparatus are as shown in Figs. 2 and 3, the knob 67 is in the "off" position and contacts 29, 30 and 33, 34 are open. When a drying operation is desired to be initiated the user rotates the knob 67 in a direction to move the cam 61 clockwise as viewed in Figs. 3 and 4. The escapement wheel 80 is prevented from rotating with the shaft 62 by finger 93 blocking movement of a tooth 95. The spring fingers 87 yield to the camming action of the hexagonal portion 83 of the shaft 62 as the shaft is rotated by the knob. The knob 82 may be moved to any one of five positions, and as seen in Fig. 4, as an example, the knob has been rotated to the fifth position. In this position of the cam 61, switch member 32 is depressed to close contacts 33, 34 and switch member 28 is free to close contact 29 on contact 30. Initially contacts 29, 30 are not closed since contacts 101, 102 are engaged, due to the elevated position of the outer end of the bimetal 97, which prevents contact arm 28 from moving to its contact closing position. Nevertheless, a heating circuit is established through the heater coil 24 since the circuit therefor includes the bimetal 97 which is quick-

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ly heated by the passage of current therethrough which causes the outer end thereof to be moved downwardly, permitting contacts 29, 30 to close. The heating of the bimetal is limited since the circuit therethrough is broken by the separation of contact 102 from contact 101 which occurs when the bimetal deflects beyond the point at which contact arm 28 rests on contact 30, and the bimetal will immediately begin to cool and reclose the contacts 101, 102 to re-establish a circuit therethrough the bimetal. The tendency of the bimetal 97 to cool decreases the contact pressure at contacts 29, 30 thereby increasing the resistance of the circuit therethrough and causing sufficient current to be shunted through the bimetal to maintain the bimetal in the lowered position, as is shown in Fig. 4. Thus, the position of the bimetal 97 is automatically regulated to that in which the finger 94 of the pawl 90 is maintained in engagement with the periphery of the escapement wheel 80. As indicated previously, when the bimetal 97 is heated and moves downwardly, finger 93 is withdrawn from engagement with a tooth 95 of the escapement wheel which permits the torsion spring 76 to rotate the shaft 62 and cam 61 through 30° as described.

When the bulb 45 of the control device 38 reaches 165° F. due to the approaching dryness of the clothes in the drum 13, the bellows 44 opens switch contacts 42, 43 and terminates operation of the heater 24. The opening of the heater circuit discontinues heating of the bimetal 97, which cools rapidly relative to the decrease in exhaust air temperature, and moves to the raised position in which the pawl 90 is tilted counterclockwise about its pivot causing the finger 94 to be withdrawn from engagement with the tooth 95 of the escapement wheel engaged thereby so that the wheel and shaft 62 are permitted to rotate 30° at which point a tooth 95 engages finger 93, as is shown in Fig. 3. In this condition, contacts 102, 103 will be engaged since the switch member 28 is normally biased downwardly and the link 56 is in its lowered position. Thus, when the heater circuit is again completed through contacts 42, 43 of the control device 38, due to the reduction in exhaust air temperature to 130° F., the bimetal 97 will again be reheated by the current flowing to the heater 24 and actuate the pawl as described previously.

It will be seen that the pawl 90 will be actuated to permit rotation of the cam 61, about 60° for each cycle of operation of the heater 24, which cycle comprises energization and de-energization of the heater, until the recess 63 of the cam is again moved into registration with the cam follower 60 on the switch member 32, at which time the switch member 32 moves to separate contacts 33, 34 as well as contacts 29, 30 and terminate operation of the clothes dryer. It will be seen that the degree of dryness of the clothes can be regulated according to the position at which knob 67 is set.

The knob 67 can be manually rotated to the "off" position any time it is desired to terminate a drying cycle since the clutch fingers 87 permit rotation of the cam and its shaft relative to the escapement wheel. Thus, complete control of the dryer is provided.

While but one form of the invention has been shown it is to be understood that other forms, modifications and adaptations could be employed all falling within the scope of the claims which follow.

I claim:

1. Control apparatus for a clothes dryer or the like comprising, a movable switch member adapted to be connected in an electrical circuit, a contact engageable by said member to complete an electric circuit, means to move said switch member relative to said contact comprising a rotatable cam, means to rotate said cam comprising an escapement wheel, a yieldable clutch structure between said cam and wheel and comprising a plurality of like surfaces spaced at predetermined angles and a spring member urged in a direction to engage said surfaces individually, said surfaces and spring member having relatively rota-

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tional movement, a spring to bias said cam in one direction, manual means to rotate said cam in the opposite direction, a pawl cooperating with said escapement wheel and arranged to permit predetermined rotation of said wheel during an oscillation of said pawl, a bimetallic element movable to first and second positions in response to heating and cooling thereof, means to connect said element in said circuit comprising a switch including said movable switch member and a contact on said element, said element being heated by current flow therethrough and being in parallel circuit relation with said movable switch member and first mentioned contact.

2. Control apparatus for a clothes dryer or the like comprising, a movable switch member, a contact engageable by said member to complete an electric circuit, means to move said switch member relative to said contact comprising a rotatable cam, a spring connected with the cam for urging said cam in one direction of rotation, manual means to rotate the cam in the opposite direction, an escapement wheel axially aligned with said cam, means to drivingly connect said wheel with said cam comprising means forming a plurality of angular spaced surfaces

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in planes spaced equally from and extending parallel to the axis of rotation of said cam and wheel and spring means yieldingly engageable with a plurality of said angularly spaced surfaces, one of the last two mentioned means being connected with said cam for rotation therewith and the other of said last two mentioned means being connected with said wheel for rotation therewith, said spring means and surfaces having relative rotation about a common axis and said spring means successively engaging different of said surfaces during relative rotation about said axis to yieldingly position said escapement wheel and cam, and means to periodically release said escapement wheel.

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