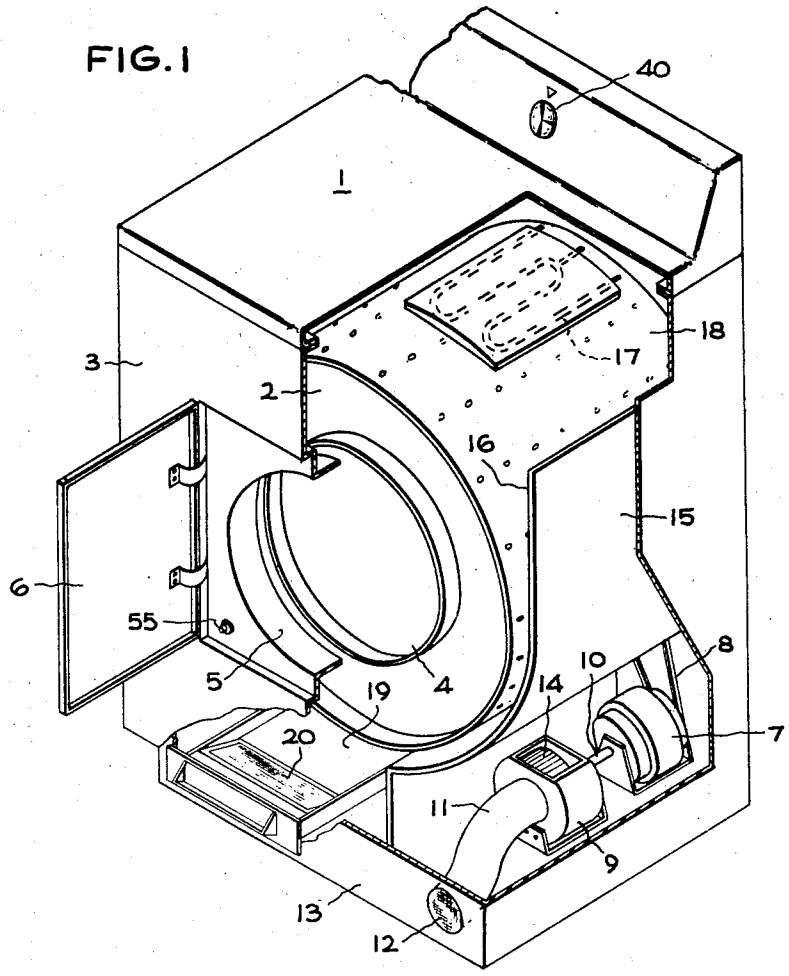
Sept. 16, 1958 R. L. DUNKELMAN 2,851,788

CLOTHES DRYER CONTROL

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FIG. 1



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CLOTHES DRYER CONTROL

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FIG. 2

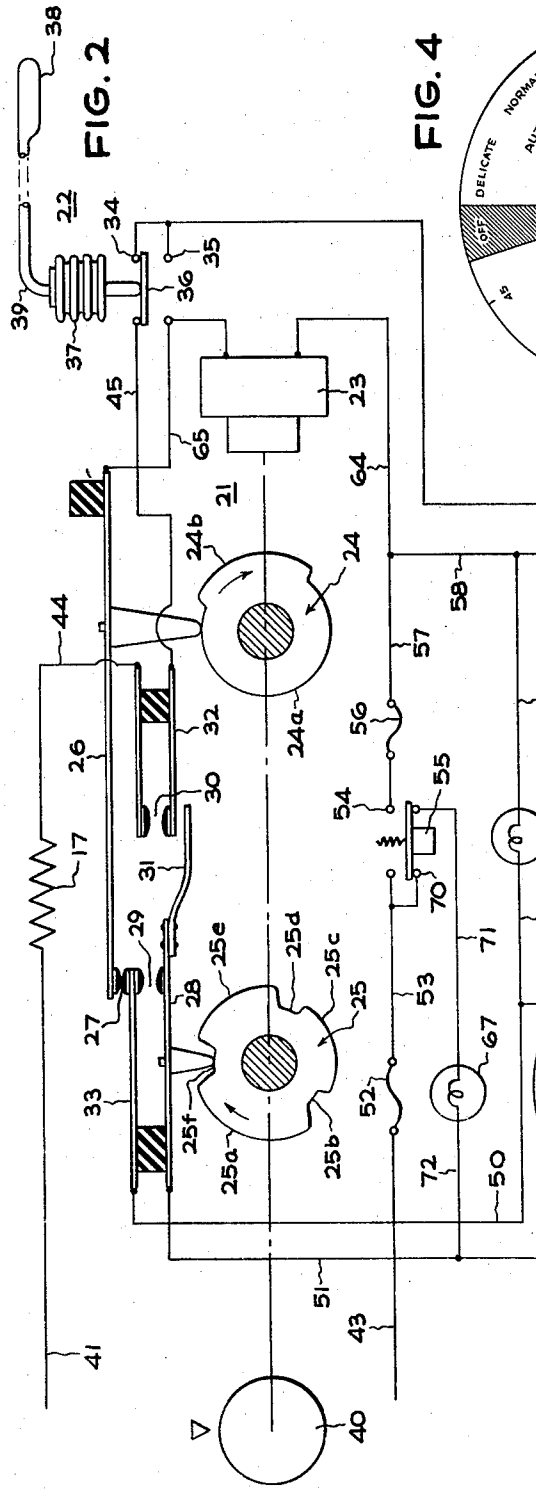


FIG. 4

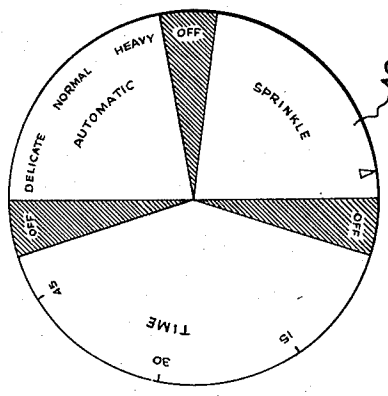
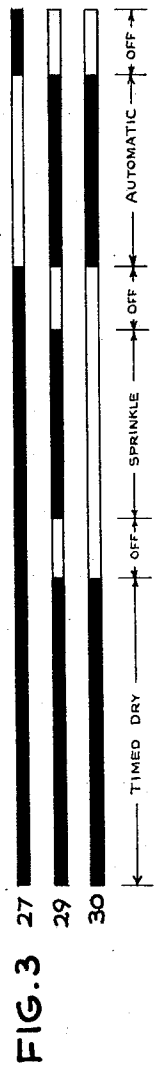


FIG. 3



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CLOTHES DRYER CONTROL

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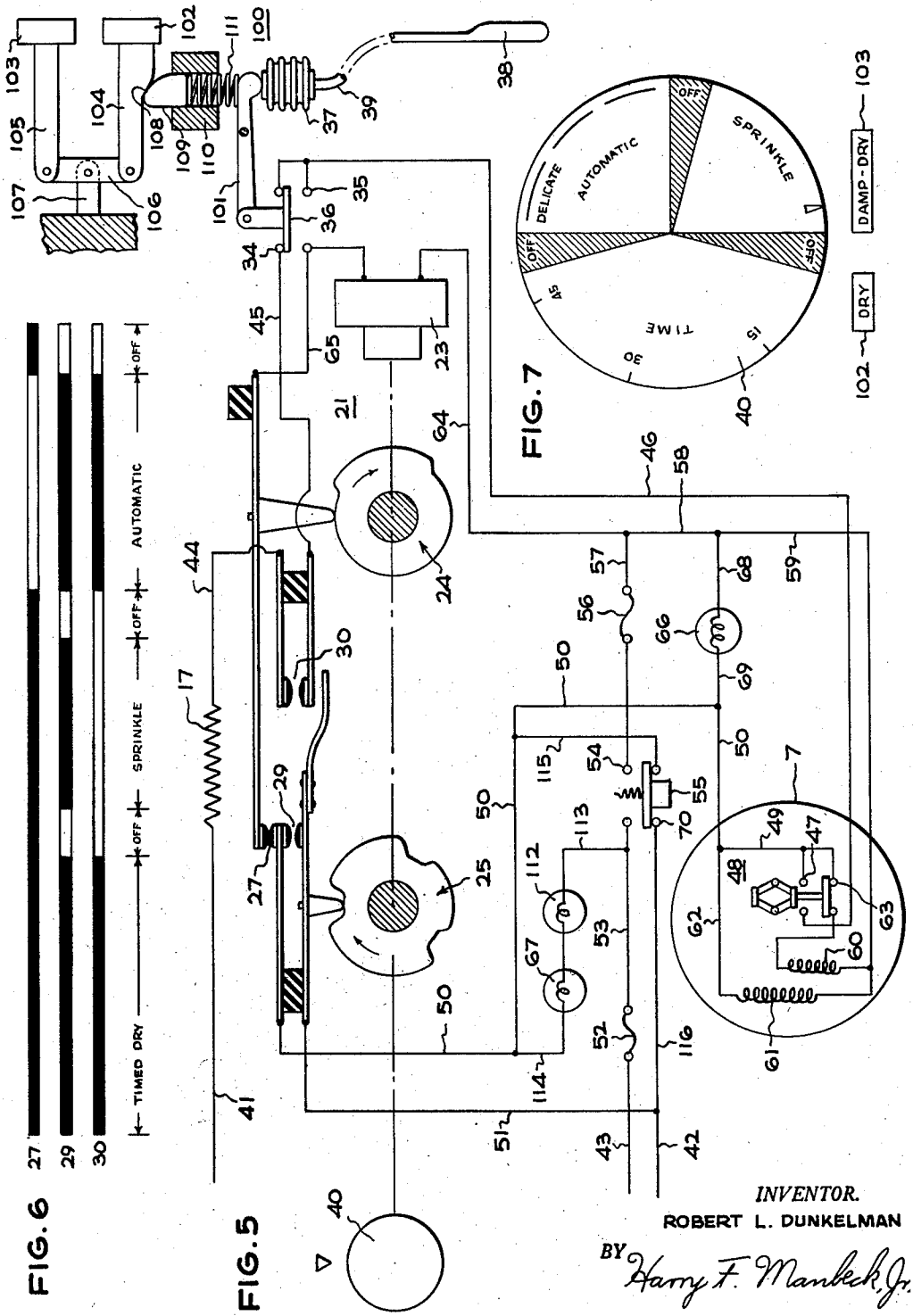


FIG. 7

FIG. 6

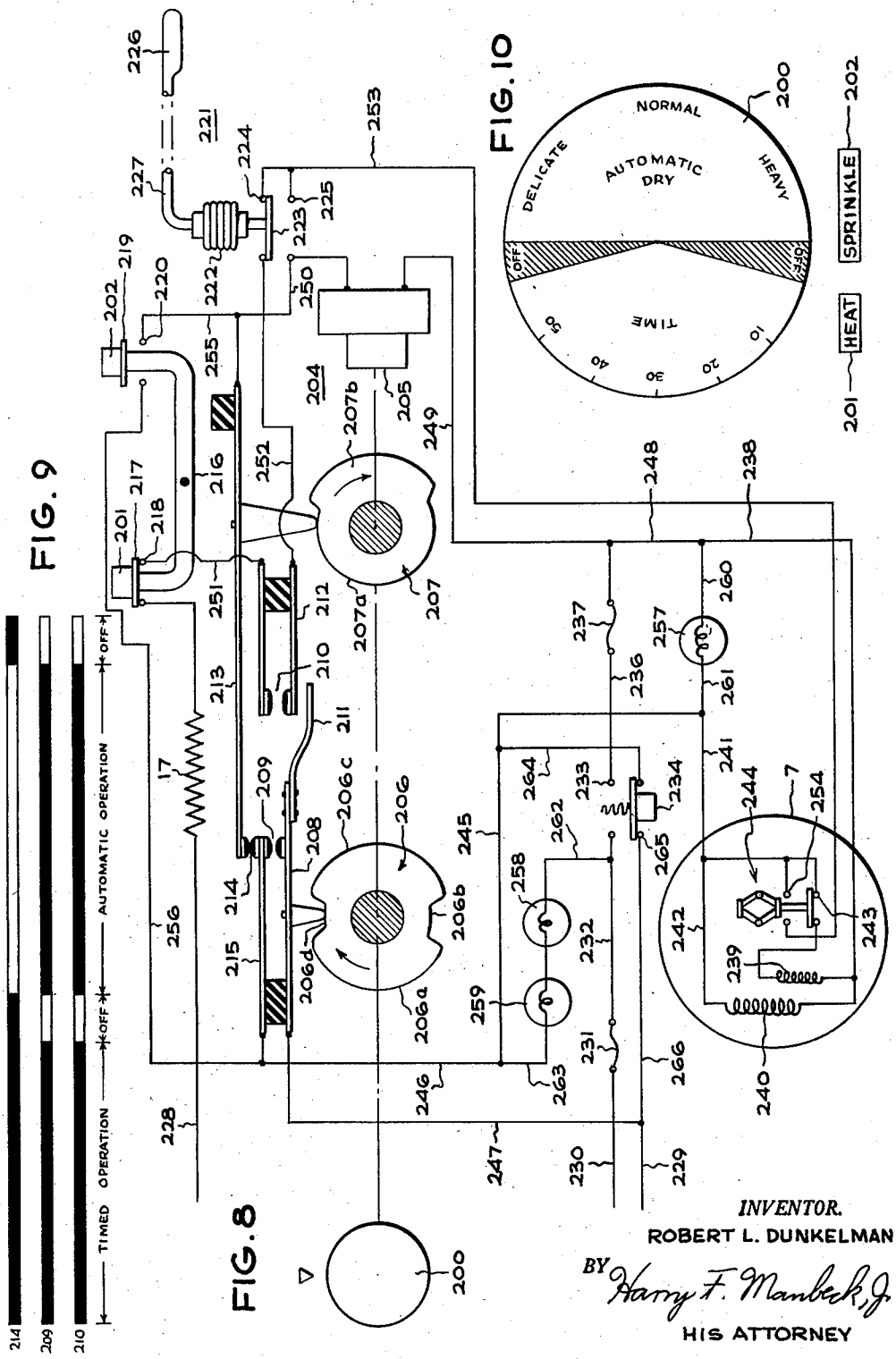
FIG. 5

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CLOTHES DRYER CONTROL

Filed Feb. 14, 1956 4 Sheets-Sheet 4



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United States Patent Office 2,851,788 Patented Sept. 16, 1958

2,851,788

CLOTHES DRYER CONTROL

Robert L. Dunkelman, Shreveport, La., assignor to General Electric Company, a corporation of New York

Application February 14, 1956, Serial No. 565,342

19 Claims. (Cl. 34—45)

My invention relates to domestic clothes drying machines and more particularly to the electrical control systems used in such machines.

For maximum utility a domestic clothes dryer should be capable of a number of clothes treating operations. It should, of course, be capable of fully drying a load of clothes to a condition suitable for immediate use. But also, it is desirable that the dryer be capable of damp drying clothes and of sprinkling already dried clothes. For the complete or fluff drying operation the dryer is preferably provided with a control which automatically varies the length of the drying operation in accordance with the load being dried, thereby to produce the correct drying effect. The automatic control gages the moisture content of the clothes, usually by sensing the temperature within the machine, and terminates the drying operation when the desired degree of dryness is reached. For the damp drying and sprinkling operations, however, an automatic control is not necessarily satisfactory since the operator may wish to vary the moisture content in the clothes considerably from one operation to the next. The operator may wish to dry the clothes much less in one damp dry operation than in the next, and may wish to sprinkle the clothes much more heavily in one sprinkling operation than in the next. Thus, for these operations it is desirable that the dryer control be arranged so that the operator can adjust and preset the length of the operation. In other words the control preferably should be such that the dryer can be set to operate for different periods of timed duration, both with heat for damp drying the clothes and without heat for sprinkling the clothes.

It is an object of my invention to provide a new and improved electrical system for clothes dryers, whereby a dryer may be selectively operated to produce a plurality of different clothes treating operations, with a suitable type of control being afforded in each operation.

Another object of my invention is to provide an improved control system whereby a dryer may be selectively operated to produce three different operations; a clothes drying operation of timed length, particularly for damp drying clothes; a clothes sprinkling operation of timed length; or a clothes drying operation particularly for fully drying clothes, whose length is automatically varied to produce the correct drying effect for fully drying the clothes load.

A further object of my invention is to provide a control system of this latter type wherein the control is adjusted by means of a single rotatable control knob.

Still a further object is to provide such a control system wherein the control is adjusted by means of a rotatable control knob and a pair of push buttons.

Another object of my invention is to provide an improved clothes dryer control system for producing the three different operations wherein the length of the automatic operation is modified according to the temperature within the dryer thereby to produce the correct drying effect.

Still another object of my invention is to provide an improved clothes dryer control including temperature responsive means for varying the length of the drying operation, which means may be selectively adjusted by the operator to provide for fully drying or damp drying clothes.

My invention also has as its object the provision of an improved control system for producing the above mentioned three operations, which includes an adjustable thermostat so that the third or automatic clothes drying operation may set to damp dry a homogeneous load of clothes of all one fabric rather than to dry them completely.

In carrying out my invention I provide a clothes dryer having suitable clothes tumbling means. A drive motor is provided for driving the clothes tumbling means, and a heater is arranged for heating the clothes being tumbled. By my invention the drive motor and the timer are controlled by means of a novel control system which includes a motor driven timer and a thermostat responsive to dryer temperature. This control system utilizes the timer and the thermostat to provide selectively three different operations of the dryer: a timed clothes drying operation, particularly for damp drying clothes; a timed tumbling operation without heat, particularly for sprinkling clothes; and an automatic or temperature modified clothes drying operation, particularly for fully drying clothes, wherein the timer begins to operate only after the dryer temperature rises to a predetermined high value. The length of the latter clothes drying operation is automatically varied by the temperature control of the timer so that it produces the correct drying effect for fully drying the clothes. According to one aspect of my invention the control is provided with a single control dial, and is so arranged that it may be adjusted between its various operations by the rotation of the dial without any additional adjusting means being required.

In my preferred embodiments the timer of the system operates a plurality of switch means and the thermostat is provided with heater contacts and timer contacts. The thermostat opens its heater contacts and closes its timer contacts when the dryer temperature rises to the aforesaid predetermined high value, and closes the heater contacts and opens the timer contacts when the dryer temperature falls to a predetermined lower temperature. The control system provides the different operations of the dryer through the manner in which it energizes the drive motor, the heater and the timer through the timer switches and the thermostat contacts. The system energizes the heater during both the timed drying operation and the automatic drying operation but not during the sprinkling operation. The heater contacts of the thermostat are included in the heater circuit so that the heater is de-energized whenever the dryer temperature reaches the aforesaid high value and is re-energized when it falls to the predetermined lower temperature. The system energizes the drive motor continuously in all three operations for driving the tumbling basket. The timer is also energized continuously in the timed drying operation and in the timed tumbling or sprinkling operation so as to provide operations of timed length. The timer, however, is energized through the timer contacts of the thermostat during the automatic clothes drying operation whereby it begins to run only after the dryer temperature rises to the aforesaid high value. This control of the timer whereby it runs only when the heater is turned off varies the length of operation to produce the desired drying effect. All of the connections in the different operations include the timer operated switch means for initiating

and terminating the operation. The adjustment of the control and thus the selection of the operation is made by the operator through the above mentioned single dial, or in different embodiments through other suitable manually operated means.

The features of my invention which are believed to be novel are pointed out with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a perspective view of a clothes dryer including my new and improved control system, the view being partially broken away and partially in section to illustrate details of construction;

Fig. 2 is a schematic diagram of a control system embodying my invention in one form thereof;

Fig. 3 is a chart showing the sequence of operation of the timer operated switches included in the system of Fig. 2;

Fig. 4 is a front view of the control dial included in the system of Fig. 2;

Fig. 5 is a schematic diagram of a control system embodying my invention in an alternate form;

Fig. 6 is a chart showing the sequence of operation of the timer operated switches included in the system of Fig. 5;

Fig. 7 is a front view of the manual controls for the system of Fig. 5;

Fig. 8 is a schematic showing of a control system embodying my invention in still another form thereof;

Fig. 9 is a chart showing the sequence of operation of the timer operated switches included in the system of Fig. 8; and

Fig. 10 is a front view of the manual controls for the system in Fig. 8.

Referring now to Fig. 1 I have shown therein a clothes dryer **1** which is illustrative of the various clothes dryers in which my new and improved control system may be used. The dryer **1** includes a rotatable drum or basket **2** which is mounted for rotation about a generally horizontal axis. The basket **2** is disposed within an outer enclosing cabinet structure **3**, and aligned openings **4** and **5** are provided respectively in the front walls of the basket and cabinet structure for the loading and unloading of clothes from the basket. The openings **4** and **5** are flanged as shown to prevent clothes from dropping down between the basket and the cabinet. A door **6** hingedly mounted on the cabinet closes the opening **5** during operation of the machine.

For rotating the basket **2** during operation of the dryer there is provided an electric motor **7** which is connected to the basket by a suitable belt drive **8**. The pulleys (not shown) mounting the belt are so arranged that the basket **2** is driven at a suitable speed for tumbling articles of clothing placed therein. The basket **2** preferably includes upstanding ribs on the inner surface thereof to aid in producing the tumbling action. Besides driving the basket **2**, the motor **7** also serves to drive air moving means for circulating a stream of air through the basket during the operation of the machine. The air moving means comprises a centrifugal blower **9** which is driven by motor **7** by means of a direct coupling **10**. The blower **9** draws in air from the surrounding room through a conduit **11** which leads from a screened air inlet opening **12** in the toeboard **13** of the cabinet.

The air drawn in by the blower **9** is discharged through an opening **14** at the top thereof into a space **15** which is separated from the rotating basket by a baffle **16**. As shown, the baffle **16** extends upwardly from the base of the machine to a point in the general vicinity of an electrical heating element **17** mounted at the top of the machine, the baffle **16** being curved arcuately around the perforated side wall **18** of the basket for a portion of its length. The air discharged from the blower **9** flows upwardly through the space **15** and passes outwardly therefrom across the electrical heating element **17**. The air still under pressure from the blower then flows downwardly through the foraminated cylindrical wall **18** of the basket. The air moves through the basket and the articles of clothing being tumbled therein and next passes into a collecting chamber **19** lying beneath the basket **2** on the opposite side of the baffle **16** from the space **15**. From the chamber **19** the air is discharged out of the cabinet into the surrounding room through an appropriate lint trap structure **20** mounted in the toeboard **13**.

The clothes dryer **1** is intended for use both as a clothes drying means and as a clothes sprinkling means. When the machine is to be used as a clothes drying machine, the heater **17** is energized along with the drive motor **7**. Thus the air discharged from the space **15** absorbs heat from the heater **17** as it passes thereover. The heated air then extracts moisture from the clothes being tumbled in the drum as it passes therethrough. The heating element, however, is not energized when the dryer is being used as a clothes sprinkling means. Thus the air passing through the drum is not heated and it does not extract moisture from the clothes. Any suitable means may be used to sprinkle the clothes during the sprinkling operation, but it is preferred to use a container which may be mounted on the drum **2** so as to discharge water onto the clothes at a slow rate as the basket rotates. A suitable container for this purpose is shown and described in the copending application of Eugene G. Olthuis, S. N. 430,794 filed May 19, 1954, and assigned to the same assignee as the present invention.

Referring now to Fig. 2 I have shown therein a control system for the dryer **1**, this control system embodying my invention in one form thereof. The control system includes a sequence timer mechanism indicated generally at **21** and a thermostat **22** which is responsive to the temperature within the dryer. The sequence control or timer **21** includes a timer motor **23** and a pair of cams **24** and **25** which are driven by the timer motor. The cam **24** operates a switch arm **26** through a suitable cam follower so as to control a pair of contacts forming a switch **27**. The cam **25** operates a switch arm **28** through a cam follower so as to control a first pair of contacts forming a switch **29** and a second pair of contacts forming a switch **30**. The movable contact of switch **29** is mounted on switch arm **28**, and an extension **31** of switch arm **28** actuates a switch arm **32** so as to control switch **30**. It will be noted that the switches **27** and **29** share a common more or less stationary contact mounted on a switch arm **33**. As will be pointed out hereinafter all of the electrical components of the system including the timer motor **23**, the drive motor **7** and the heater **17** are energized through these timer operated switches.

The thermostat **22** serves two different functions, as pointed out hereinafter, and for that purpose it is provided with two sets of contacts **34** and **35**. These contacts are controlled by means of a contactor **36** which is operated by a temperature responsive bellows **37**. The bellows **37** specifically expands and contracts in response to the temperature within the interior of the dryer. A sensing bulb **38** for the bellows is positioned at a suitable place within the dryer and is connected to the bellows by a hydraulic line **39**. When operation of the dryer is initiated, the bellows **37** maintains the contacts **34** closed and the contacts **35** open until the temperature within the dryer rises to a predetermined high temperature. However, when the dryer termperature rises above that predetermined high temperature, the bellows operates the contactor **36** so as to open the contacts **34** and close the contacts **35**. The contactor then remains in this latter position until the dryer temperature falls to a predetermined lower temperature. At that lower temperature the bellows again returns the switch arm **36** to its first position to close the contacts **34** and open the contacts **35**. The thermostat thus cycles the contacts **34** and **35** inversely. Whenever

the contacts 34 are closed, the contacts 35 are opened and vice versa.

My control system utilizes the timer switches 27, 29 and 30 and the thermostat contacts 34 and 35 to provide three different clothes treating operations of the machine 1 at the selection of the operator. These three different operations are as follows: a clothes drying operation of timed duration, particularly for damp drying clothes; a clothes tumbling operation without heat also of timed duration, particularly for sprinkling clothes; and an automatic clothes drying operation, particularly for completely drying clothes, whose length is automatically varied to produce the correct drying effect for fully drying the clothes. The control is adjusted to the selected function by means of a rotatable control knob 40 which is mechanically connected to the timer 21. The mechanical connections between the dial 40 and the cams 24 and 25 and the timer motor 23 are such that the control 21 may be manually rotated to any desired setting.

The dial 40 includes three ranges: a "time" range, a "sprinkle" range, and an "automatic" range. When the dial is set in the "time" range, a clothes drying operation of timed length is provided. The length of the operation is determined by the position within the range at which the operator sets the dial. When the dial is set in the "sprinkle" range, a clothes sprinkling operation without heat is provided. This also is a timed operation whose length is determined by the setting of the dial with the range. When the dial is set in the "automatic" range, another clothes drying operation is provided. However, here the dryer does not operate for a predetermined length of time. Rather it is automatically controlled so as to operate until the clothes are dry and then shut off. In the "automatic" range the timer motor is not energized to turn the control cams toward the off position until a predetermined high temperature is reached within the machine indicating that the clothes have substantially dried. Since, however, even after this predetermined high temperature is reached some fabrics may need a longer period of drying than others, the "automatic" range is calibrated as shown into three segments according to the type of fabric: heavy, normal, and delicate. When articles are to be dried which shed moisture very quickly, the control is set in the delicate segment. Such items include lingerie, sheer fabrics and diapers. When cottons and linens forming the greater part of most domestic loads are to be dried, the dial is preferably set at normal. When very heavy articles which shed moisture very slowly are to be dried, the dial is preferably set at heavy. Such loads include bedspreads, shag rugs, slip covers, dungarees and overalls.

It will be noted that each of the ranges of the timer is separated from the others by an "off" segment. Thus, no matter into what range the control is placed, once the timer motor is energized it will drive the control toward an off position. As a result the operation of the dryer is eventually automatically terminated no matter which type of operation it is carrying out.

To explain the operation of my improved control system in each of its different clothes treating operations, let it be assumed first that the operator has set the dial 40 within the "time" range. This, of course, provides a clothes drying operation of predetermined length and is intended particularly for damp drying clothes. In this setting of the control the drive motor 7, the heater 17 and the timer motor 23 are all energized. Preferably and as shown they are energized from a three-wire source comprising supply conductors 41 and 42 and an electrical neutral line 43. The illustrated control system is particularly intended for use with a voltage of 220 volts between the supply conductors 41 and 42 and a voltage of 110 volts between each of the supply conductors and the neutral line 43. It will be understood however that my invention is not necessarily limited to control systems for use with a 220 volt, three-wire supply, but rather may be applied to control systems for use with an available domestic power supply, for example a 110 volt, two-wire supply.

When the dial 40 is moved into the "time" range all three of the timer operated switches 27, 29 and 30 are closed. A raised portion 25*a* of the cam 25 actuates the cam follower on the switch arm 28 so as to close the switch 29. Also, the switch 30 is closed since the raised portion 25*a* moves the arm 28 far enough to actuate switch arm 32 through extension 31. The switch 27 is closed too since with this setting of the dial 40 the lower or smaller diameter portion 24*a* of the cam 24 is under the cam follower of switch arm 26. With the switches 27, 29 and 30 all closed, the drive motor, the heater and the timer motor are all energized.

The heater 17 specifically is energized across the supply conductors 41 and 42. Commencing with the supply conductor 41 the heater circuit extends through the heater itself and a connection 44 to the closed contacts 30 of the timer. From the contacts 30 the circuit passes through a line 45 to the contacts 34 of the thermostat 22 and from the contacts 34 it passes through a line 46 to the normally open contacts 47 of a motor centrifugal switch 48. From the contacts 47 of the centrifugal switch the heater circuit extends through lines 49 and 50 to the closed timer switch 29 and thence through a conductor 51 to the supply conductor 42.

With this circuit the heater is placed under the control of the thermostat contacts 34 as soon as the centrifugal switch contacts 47 are closed. These contacts 47 are closed as soon as the drive motor 7 comes up to speed and remain closed so long as the motor continues to operate. Thus throughout this timed drying operation the heater is under control of the thermostat. The thermostat bellows 37 maintains the contacts 34 closed so long as the dryer temperature does not rise to a predetermined high temperature above that suitable for the drying of clothes. If the dryer should rise above that temperature, the thermostat then opens the contacts 34 until the machine cools down to a predetermined lower temperature. Thus the heater 17 is either continuously energized or continuously cycled during this timed drying operation. Of course, if the drive motor should stop rotating for any reason, the heater 17 is immediately de-energized by the action of the centrifugal switch 48. The heater circuit is opened at the end of the operation by the cam follower on switch arm 28 dropping into the recess 25*b* in cam 25. This opens both switches 29 and 30 and thereby de-energizes the heater.

The drive motor 7 is also energized continuously during the timed operation. It is energized across the neutral line 43 and the supply conductor 42. Commencing with the neutral line 43 the drive motor circuit passes through a fusible link 52 and a conductor 53 to the contacts 54 of a door switch 55. The door switch 55 is actuated by the door 6 of the dryer so that the contacts 54 are closed whenever the door is closed and open whenever the door is opened. The door is, of course, closed during the drying operations so that the contacts 54 are closed. From the contacts 54 the drive motor circuit extends through a fusible link 56 and lines 57, 58 and 59 to the start and run windings 60 and 61 of the drive motor. The opposite ends of the start and run windings are both connected to the line 49. The main winding 61 is connected directly thereto by a line 62. The start winding 60 is, however, connected thereto by a second pair of contacts 63 of the motor centrifugal switch 48. These contacts are normally closed when the motor is at rest but open up as soon as the motor comes up to speed. Thus, the start winding is in the motor circuit when the motor is first energized but is removed from the circuit as soon as the motor comes up to speed. From the line 49 the motor circuit is completed through the line 50, the switch 29 and the conductor 51 to the supply line 42.

With this circuit it will be seen that the motor remains

energized so long as the door switch contacts 54 and the timer switch 29 are closed. If the door should be opened up, the operation of the motor is interrupted, and this, of course, also turns off the heater due to the action of the contacts 47 of the centrifugal switch. The motor and the heater however both resume operation as soon as the door is re-closed. The switch 29 is, of course, opened at the end of the drying operation when the cam 25 drops into the depression 25*b* in the cam surface, and the opening of the switch 29 terminates the operation of the drive motor simultaneously with that of the heater.

Since the motor is in effect controlled by the timer operated switch 29, I prefer to designate the switch 29 as the motor switch of my control system. The heater circuit, of course, also passes through the switch 29 as well as through the switch 30. However, as pointed out hereinafter it is by means of switch 30 that the heater is deenergized during the sprinkle operation of the dryer. For this reason I prefer to designate the switch 30 as the heater switch of the control.

The timer motor is also energized continuously during the timed drying operation. Specifically, it is energized by a circuit connected across the neutral line 43 and the supply conductor 42. Commencing with the neutral line 43 the circuit for the timer extends through the fusible link 52, the line 53, the contacts 54 of the door switch, a fusible link 56 and lines 57 and 64 to the one side of the timer motor 23. The circuit is then completed from the other side of the timer motor through a line 65, the timer switches 27 and 29 and the line 51 to the supply conductor 42. With this circuit the timer motor is continually energized so long as the door switch contacts 54 and the timer switches 27 and 29 are closed. Thus throughout the drying operation it continually drives the cams in the clockwise direction indicated by the arrow. Of course, if the door is opened, the operation of the timer is interrupted along with that of the drive motor and the heater. The operation of the timer is terminated by the opening of switch 29.

The timed drying operation thus proceeds with the timer motor, the drive motor and the heater all energized until such time as the cam follower on switch arm 27 drops into the cam recess 25*b*. This allows the switches 29 and 30 to open as mentioned above. With switch 29 opened all three of the energizing circuits are opened simultaneously so that the dryer operation is completely terminated. The opening of the switch 30, of course, provides an additional break in the heater circuit. The length of time that the dryer operates before the circuits are all opened depends, of course, upon the initial setting of the dial within the "time" range. By changing the setting the operator can vary the amount of moisure remaining in the clothes at the end of the operation.

The sprinkling operation is like the timed drying operation in that the operator may set the machine to operate for a predetermined length of time. To initiate the clothes sprinkling operation, the operator first fills the above-mentioned sprinkling container with water and places it in the tumbling drum, and then turns the control dial 40 into the "sprinkle" range. This moves the cams 24 and 25 so as to operate the switches 27, 29 and 30 as indicated in the switch chart of Fig. 3. Specifically, in the "sprinkle" range the lower surface of 24*a* of cam 24 still engages the cam follower of switch arm 26 so that the switch 27 remains closed. However, the cam follower on switch arm 28 is engaged by an intermediate height portion 25*c* of the cam 25. This intermediate portion 25*c* raises the switch arm 28 far enough to close the switch 29. However, it does not raise it far enough to close the heater switch 30. Thus, during the "sprinkle" operation the timer switch 27 and the motor switch 29 are closed but the heater switch 30 remains open.

With the switches 27 and 29 closed the timer motor 23 and the drive motor 7 are energized through exactly the same circuits as they were during the timed drying operation. The drive motor thus operates to rotate the clothes basket 2 and the blower 9, and as a result of the rotation of the drum the water in the sprinkling container is sprinkled onto the clothes. Since the heater 17 is not energized due to the opening of switch 30, the air blown through the drum 2 does not evaporate this water. Rather having once fallen onto the clothes it remains therein and moistens them.

The timer motor 23 during this operation is continuously driving the cams 24 and 25 in the clockwise direction as indicated. The sprinkling operation continues until such time as the recess 25*d* in cam 25 moves under the cam follower on switch arm 28. When this happens the switch arm 28 moves downwardly so as to open the switch 29. The opening of switch 29 breaks both the drive motor circuit and the timer motor circuit, and this, of course, terminates the operation of the dryer. The length of time that the dryer operates before it is turned off, of course, depends upon the original setting made by the operator within the "sprinkle" range. The operator can cause the clothes to be sprinkled for a greater or lesser amount of time depending upon where she originally sets the dial 40 within the "sprinkle" range.

Of course, if the operator wishes to tumble the clothes without heat and without sprinkling them, she can do so by setting dial 40 in the "sprinkle" range and omitting to place the sprinkling container within drum 2.

The "automatic" drying operation is, however, different than both the timed drying operation and the sprinkle operation in that the machine does not run for a predetermined length of time as set by the operator. Rather the machine is automatically turned off when the clothes have reached the desired degree of dryness. To effect this result the timer motor 23 is not energized continuously during the drying operation. Rather it is energized only after the clothes have reached a temperature which indicates that they are almost dry.

To initiate the automatic drying operation, the operator turns the dial 40 into the "automatic" range. As indicated in the chart of Fig. 3 this closes switches 29 and 30 but opens the switch 27. Specifically, the raised portion 25*e* of the cam 25 moves under the follower mounted on switch arm 28 so as to close the switches 29 and 30. The raised portion 25*e* is of the same height as the raised portion 25*a* so that it is effective to close both switches. Simultaneously, a raised portion 24*b* of the cam 24 is moved under the cam follower mounted on switch arm 26. This moves the switch arm 26 upwardly so as to open the switch 27.

With the switches 29 and 30 closed, the drive motor and the heater are energized through exactly the same circuits as during the timed drying operation. The drive motor thus runs continuously so as to rotate both the clothes tumbling drum 2 and the blower 9. The heater 17 is also energized continuously until such time as the thermostat bellows 37 opens the heater contacts 34. However, due to the opening of switch 27 the timer motor 23 is not energized at the time the drying operation starts. In fact, the timer motor is not energized until such time as the thermostat opens the heater contacts 34. As the thermostat opens the contacts 34 it simultaneously closes the contacts 35, and as pointed out hereinafter the closing of contacts 35 completes a circuit for energizing the timer motor.

The thermostat 22 is so arranged that it opens the heater contacts 34 and closes the timer contacts 35 at a temperature which indicates that the clothes have been substantially dried. As the clothes are being dried within the drum 2, the temperature within the interior of the dryer rises slowly. For a period of the dryer operation the amount of heat supplied to the air and the clothes from the heating element 17 may even be approximately

equal to the amount actually utilized for moisture extraction, and during that period a temperature plateau will occur. This plateau or region of very slow rise is within the same general temperature range no matter what type of fabrics are being dried. The dryer operates at this plateau or with a very slow rise until such time as the clothes are substantially dry. Then when the clothes are substantially dry, the clothes temperature and the temperature within the dryer begin to rise more rapidly. The thermostat 22 is calibrated so that it opens the contacts 34 and closes contacts 35 at temperature slightly above where this rapid temperature rise begins. The thermostat thereby de-energizes the heater and energizes the timer motor only after the clothes are substantially dry.

The timer motor being energized then begins to rotate the cams 24 and 25 so as to terminate the machine operation. The timer does not shut the dryer down immediately though since some additional time is required to insure that the clothes are completely dried. There is, of course, some difference between various types of fabrics. For example, even though the thermostat indicates that they are substantially dry, heavy items such as bedspreads, shag rugs, bath towels, slip covers, overalls, etc. take somewhat longer to finish drying after the operating temperature of the thermostat is reached than do most cottons and linens. Similarly, cottons and linens take longer to dry completely after the thermostat operating temperature is reached than do items such as lingerie, sheer fabrics, diapers and items made of various synthetic fabrics. For this reason the automatic dry range includes some adjustment whereby the operator may set the machine to operate for a greater or lesser period after the thermostat de-energizes the heater and energizes the timer. By setting the dial 40 at delicate the timer will run the least amount of time. By setting it at normal it will run for an intermediate length of time and by setting it at heavy it will run for the greatest length of time. In this manner it is insured that no matter what type of fabrics are being dried, a correct drying effect will be provided. Of course, if the load being dried includes different types of fabrics the dial may be set at points intermediate the marked portions of the automatic range.

When the thermostat 22 closes the contacts 35, the timer motor 23 is energized across the neutral line 43 and the supply conductor 42. Commencing with neutral line 43 the timer circuit extends through fusible link 52, line 53, the contacts 54 of the door switch, fusible link 56, and lines 57 and 64 to the timer. From the other side of the timer the circuit extends through the thermostat contacts 35 and the line 46 to the contacts 47 of the motor centrifugal switch. The circuit is completed from the motor centrifugal switch through lines 49 and 50, timer operated switch 29 and line 51 to the supply conductor 42. Energized through this circuit the timer motor continues to run so long as the thermostat contacts 35 and the switch 29 are closed.

As soon as the thermostat opens contacts 34 and closes the contacts 35, the temperature in the interior of the dryer begins to fall off. If it drops to a certain predetermined lower temperature before the timer terminates the operation of the machine, the thermostat operates reversely so as to close the heater contacts 34 again and open the timer contacts 35. This, of course, energizes the heater again and de-energizes the timer. The heater then continues in operation with the timer off until such time as the predetermined higher temperature is reached again. At that time the thermostat reopens the contacts 34 and recloses the contacts 35. The timer again begins to run to move the cams toward machine shut-down position. The heater and the timer may thus be cycled inversely one or more times before the dryer operation is finally terminated. This action causes the clothes to be tumbled long enough and at the right temperature to insure their drying.

If the dial 40 is set in the delicate position of the "automatic" range, the timer normally shuts down the dryer before the temperature falls to the points where the thermostat opens contacts 35 and recloses contacts 34. Thus, there is no cycling of the heater and the timer when the dial is set at the delicate position. If, however, the dial 40 is set in the normal or heavy segments of the automatic range it is contemplated that the thermostat may cycle the timer and the heater one or more times before the dryer operation is terminated.

The dryer is shut off when the recess 25*f* of the cam moves under the cam follower on switch 28. When this occurs both the switches 29 and 30 are opened and their opening terminates the operation of the dryer. It de-energizes both the timer motor and the drive motor 7 and also opens the heater circuit so that the heater is not re-energized by the thermostat as the dryer cools down.

From the above it will be seen that I have provided an improved dryer control system which is effective to provide three different operations of the dryer. Specifically, it provides a timed drying operation which is particularly suitable for damp drying clothes; a timed tumbling operation without heat, particularly for sprinkling clothes; and an automatic clothes drying operation, particularly suitable for fully drying clothes, wherein the length of the drying operation is controlled by a thermostat responsive to the temperature within the dryer. In this embodiment the dryer is adjusted by means of a single control knob. The dryer may be adjusted into any one of its operations by the single control knob, and further it may be adjusted within the limits of that operation to produce the exact result desired. Specifically, it may be adjusted within the sprinkling and timed drying ranges to produce the exact time of operation desired, and in the automatic range it may be adjusted so as to compensate for the different types of fabrics from load to load.

As shown in Fig. 2 my improved control system also includes a pilot light 66 for indicating when the machine is in operation and an illuminating lamp 67 for lighting the interior of the machine when the door 6 is open. The pilot light 66 is energized across neutral line 43 and conductor 42 by a circuit through the motor switch 29 so that it is lit whenever the machine is in operation. Commencing with the neutral line 43 the pilot light circuit extends through fusible link 52, line 53, contacts 54 of the door switch, fusible link 56, conductors 57 and 58, and a conductor 68 to the light 66 itself. From the light the circuit is completed through conductors 69 and 50, motor switch 29, and conductor 51 to the supply conductor 42. The illuminating light 67 is energized by means of a pair of back contacts 70 of the door switch 55 so that it is energized whenever the door is opened and deenergized whenever the door is closed. The illuminating light circuit is also connected across the neutral line 43 and supply conductor 42. Commencing with neutral line 43 the circuit extends through fusible link 52, conductor 53, the back contacts 70 of the door switch and a conductor 71 to the light 67. From the light the circuit is completed through a line 72 to the supply conductor 42. It will be seen with these circuits the pilot light 66 is energized whenever the machine is in operation and the illuminating light 67 is energized whenever the door is open.

Referring now to Figs. 5, 6 and 7 I have shown therein an alternate embodiment of my invention. This embodiment is similar in many respects to the embodiment of Figs. 2–4 and includes the same circuits for energizing the drive motor, the timer motor, and the heater of the dryer. Identical elements in the two embodiments have been indicated by the same reference numbers. However, in addition to providing the three different clothes treating operations of the first embodiment, this embodiment also provides for a temperature modified or automatically controlled damp drying operation. This additional operation is provided by means of an adjustable

thermostat **100** which takes the place of thermostat **22** of the first embodiment.

The thermostat **100** includes two pairs of contacts **34** and **35** and a contactor **36** which is effective to cycle these contacts inversely. In other words whenever the contactor **36** closes the contacts **34**, it opens the contacts **35** and vice versa. The contactor **36** is operated by a pivoted link **101** which is actuated by an expansible bellows element **37**. The bellows **37** is connected to a sensing bulb **38** in the interior of the dryer by a suitable hydraulic connection **39**, and it expands and contracts in response to the temperature within the dryer.

To provide the automatic damp dry operation in addition to the regular automatic drying operation, the thermostat **100** includes manually operated means whereby its response may be varied. These means comprise a pair of push buttons **102** and **103**. The push buttons **102** and **103** are connected respectively by rods **104** and **105** to a link **106** which is pivoted on a stationary member **107** mounted on the dryer cabinet **3**. With this arrangement whenever one push button is moved inwardly, the other is moved outwardly and vice versa.

In order to vary the response of the thermostat the operating rod **104** of push button **102** is provided with an inclined cam surface **108** on its lower edge. This cam surface engages a cam follower **109** which is slideably mounted in a suitable guide **110**. At its lower end the cam follower **109** bears on a coil spring **111** which in turn engages the pivoted arm **101** at its lower end. When the push button **102** is moved inwardly, the cam surface **108** moves the cam follower **109** downwardly compressing the spring **110** against pivoted link **101**. However, when the push button **103** is moved inwardly, the cam surface **108** is translated so that the cam follower may move upwardly and decrease the compression of the spring **111**. Thus when the push button **103** is operated, less force is required from the thermostat bellows **37** to open the contacts **34** than when the push button **102** is operated. Since the force produced by the bellows is proportional to the temperature within the dryer, a higher temperature is therefore required to open the contacts **34** and close the contacts **35** when the push button **102** is operated than when the push button **103** is operated.

As mentioned above the heater circuit of the embodiment of Figs. 6 and 7 is identical to that of the first described embodiment. In other words the contacts **34** of the thermostat are connected in the heater circuit in the identical manner as before. The adjustable thermostat **100** thereby provides a means whereby the heater **17** may be cycled in two different temperature ranges. When the push button **103** is operated the thermostat opens the contacts **34** and closes the contacts **35** at a lower temperature than when the push button **102** is operated. Also, the thermostat operates the contacts in the reverse direction at a lower temperature when the push button **102** is operated. The push button thereby provides for both a fully drying operation and a damp drying operation in the "automatic" setting of the dial **40**. When the push button **102** is pushed the thermostat operates to open the contacts **34** and close the contacts **35** at a temperature whereat the clothes are substantially dried. As a result an automatic operation effective to produce fully dried clothes is carried out. However, when the push button **103** is operated the thermostat opens the contacts **34** and closes the contacts **35** at a temperature below that at which the clothes are substantially dried. The timer motor is thereby energized to rotate the cams and terminate the operation of the machine while the clothes are still somewhat moist or damp dry.

The damp dry operation in the automatic or temperature modified range is particularly suited for loads of all one type of fabric. When a homogeneous load of all cottons and linens is to be damp dried, the operation may be advantageously carried out by moving the dial **40** into the "automatic" range, specifically to the "normal" setting, and then depressing the damp dry push button **103**. When a load of light fabrics such as lingerie, sheer fabrics, and diapers is to be damp dried, the dial is moved to the "delicate" setting of the "automatic" range and the damp dry push button **103** operated. When a load of heavy fabrics such as shag rugs, bath towels, slip covers, dungarees, etc. is to be damp dried the dial is moved to the "normal" setting of the automatic range and the damp dry push button **103** operated.

The moving of the dial to any point in the "automatic" range closes switches **29** and **30** to energize the heater and drive motor, but opens switch **27** so as to place the timer motor under the control of the thermostat. The sequence in which the switches **27, 29** and **30** are operated is, of course, shown in Fig. 6. During either automatic drying or automatic damp drying the heater **17** is energized through the same circuit including switches **29** and **30**, this circuit, as mentioned above, being identical to the heater circuit of Fig. 2. Specifically, the heater **17** is energized between the supply conductors **41** and **42**. Commencing with conductor **41** the circuit comprises the heater **17** itself, conductor **44**, timer operated switch **30**, conductor **45**, contacts **34** of the thermostat, line **46**, contacts **47** of the motor centrifugal switch, conductors **49** and **50**, timer operated switch **29** and conductor **51** to supply conductor **42**. With this circuit the heater is, of course, under the control of the thermostat so that the heater is de-energized as soon as the thermostat opens the contacts **34**. Whether a damp dry or a fully dry operation will result depends upon whether the thermostat is set to respond to a lower or higher temperature by means of the push buttons **102** and **103**.

Since switch **27** is open, the timer motor **23** is not energized when the dryer is first placed in operation. However, as soon as the thermostat opens contacts **34** and closes contacts **35**, the timer motor **23** is energized by the same circuit as in Fig. 2 so as to turn the cams **24** and **25** to an "off" position. The timer motor specifically is energized through contacts **35** between the neutral line **43** and the supply conductor **42**. Commencing with neutral line **43** the timer motor circuit comprises fusible link **52**, conductor **53**, contacts **54** of the door switch, fusible link **56**, conductors **57** and **64**, the timer itself, the back contacts **35** of the thermostat, conductor **46**, contacts **47** of the centrifugal switch, conductors **49** and **50**, timer operated switch **29** and conductor **51** to line **42**. With this circuit the timer motor is energized until such time as it rotates the cam **25** far enough to open the switch **29**. At that time it is de-energized simultaneously with the heater. The heater circuit is, of course, de-energized simultaneously through the opening of contacts **29** and **30**.

Depending upon the setting within the automatic range it is, of course, possible that the heater and the timer motor may be cycled inversely during either the automatic dry or the automatic damp dry operation. That is, it is possible the timer and the heater may be turned on and off oppositely with regard to each other by the thermostat one or more times before the operation is finally terminated.

The drive motor **7** is energized continuously during either the automatic damp dry or the automatic drying operation. This circuit as in Fig. 2 is energized between neutral line **43** and the supply conductor **42**. Commencing with neutral line **43** the circuit comprises the fusible link **52**, the conductor **53**, the contacts **54** of the door switch, the fusible link **56**, conductors **57, 58** and **59**, the winding **61** of the motor, the conductors **62** and **50**, the timer operated switch **29** and conductor **51** to the supply conductor **42**. The starting winding **60** is connected in the circuit when the dryer first commences operation but is removed by the contacts **63** of the centrifugal switch as soon as the motor comes up to speed. Energized by means of this circuit the motor **7**, of course, rotates until such time as the timer operated cam **25** opens switch **29**. At that time the motor

is de-energized simultaneously with the other elements of the dryer.

Besides the automatic range for drying or damp drying, the control system of Figs. 5–7 also provides for a timed drying operation and a timed sprinkling operation. The control is adjusted to perform either of these operations by means of the rotatable dial **40**. As shown in Fig. 6, the switches **27**, **29** and **30** are all closed by the dial for the timed drying operation, and the switches **27** and **29** only are closed for the sprinkling operation. The length of the operation is, of course, determined by the setting of the dial within the selected range "time" or "sprinkle."

When the control dial **40** is turned into either the "time" or the "sprinkle" range, a motor circuit is completed identical to that employed during the automatic dry and damp dry operations. In other words the motor during these operations is under the control of the timer operated switch **29**. During timed dry the heater circuit is also the same as that used during the automatic operations. This circuit, of course, includes both the timer operated switches **29** and **30** and the thermostat contacts **34**. It is contemplated that during the timed dry the push button **102** will normally be operated so that the thermostat operates in its upper range. In other words the operator will ordinarily control the degree of drying obtained during timed dry by setting the time the machine is to operate and allowing the machine to heat to its safe maximum temperature if it should be in operation long enough to do so. Of course, if the damp dry push button **103** should be operated during this timed drying operation, the only result will be that the heater is turned off by the thermostat at a lower temperature than with the dry push button **102** depressed. During the sprinkling operation the heater **17** is de-energized. This is accomplished as in the first embodiment by cam **25** which maintains the heater switch **30** open throughout that operation. If it is desired to tumble clothes without heat and without sprinkling them, the dial is moved into the "sprinkle" range but the sprinkling container is not placed within the drum **2**.

The timer motor **23** runs continuously during both the timed drying operation and the sprinkle operation. The circuit through which the timer motor is energized is the same as that employed in the first embodiment. The timer motor specifically is energized between the neutral line **43** and the supply conductor **42** through switches **27** and **29**. Commencing with neutral line **43** the circuit for the timer motor during both the timed dry and the sprinkle operations extends through fusible link **52**, conductor **53**, contacts **54** of the door switch, fusible link **56** and conductors **57** and **64** to the timer motor. The circuit is completed from the timer motor through conductor **65**, switches **27** and **29** and conductor **51** to the supply conductor **42**. Energized in this manner the timer motor runs continuously until such time as the switch **29** is opened to terminate the operation.

The embodiment of Figs. 5–7 includes a pilot light **66** for indicating when the machine is in operation. This pilot light is energized between the neutral line **43** and the conductor **42** by the same circuit as in the embodiment of Fig. 2. The embodiment of Figs. 5–7 also includes a lamp **67** for illuminating the interior of the dryer and an ozone lamp **112** for purifying the air within the dryer. The illuminating lamp **67** and the ozone lamp **112** are connected so that they are energized whenever the dryer is in operation and also whenever the door **6** is open. When the dryer is in operation, the ozone lamp and the illuminating lamp are energized by a circuit connected across the neutral line **43** and the supply conductor **42**. Commencing with the neutral line this circuit comprises fusible link **52**, conductor **53**, conductor **113**, the ozone lamp and the illuminating lamp connected in series, conductors **114** and **50**, switch **29** and conductor **51** to the supply conductor **42**. When the door **6** is opened, the illuminating light **67** and the ozone lamp **112** are energized by an alternate circuit also connected between the neutral line **43** and the supply conductor **42**. Commencing with the neutral line this alternate circuit comprises the fusible link **52**, conductors **53** and **113**, the lamps themselves, conductors **114** and **50**, and a conductor **115** which is connected to the back contacts **70** of the door switch. The circuit is completed from the back contacts **70** of the door switch by means of a conductor **116** which is connected to the supply line **42**. With these circuits, it will be seen that the ozone lamp **112** and the illuminating lamp **67** are energized whenever the dryer is in operation and also whenever the door **6** is open.

Summing up with regard to the embodiment of Figs. 5–7, it will be seen that this control system provides the same three different operations as the first described embodiment. It provides a timed drying operation, particularly suitable for damp drying clothes; a timed tumbling operation, particularly for sprinkling clothes; and an automatic drying operation which is automatically controlled to produce the proper drying effect for fully drying clothes. In addition this embodiment also provides an automatically controlled damp drying operation, which is particularly effective for damp drying homogeneous loads of clothes all of the same fabric. The control is adjusted between the timed drying, the timed tumbling or sprinkling, and the automatic drying operations by means of a single rotatable control knob. Within the automatic range it is adjusted between drying and damp drying by means of a pair of push buttons.

Referring now to Figs. 8, 9 and 10 I have shown therein a third embodiment of my invention. The control system of these figures is similar to both of the above described control systems in that it provides for three different operations of a dryer, namely: a timed clothes drying operation, particularly for damp drying clothes; a timed tumbling operation, particularly for sprinkling clothes; and a clothes drying operation, particularly for fully drying clothes, wherein the drying operation is automatically controlled so as to provide the proper drying effect. This control system is adjusted by means of a rotatable control knob **200** and a pair of push buttons **201** and **202**. The rotatable dial **200** includes two separate ranges which are separated by "off" positions of the control. One range, "the automatic dry" range, provides for an automatically controlled drying operation. When the dial is set in that range and the heater push button **201** is operated, a drying operation is produced which is controlled by a thermostat so as to provide the proper drying effect for fully drying a load of clothes. The other range, the "time" range, provides for a timed operation of the dryer. This range is used to produce both a sprinkling operation and a clothes drying operation particularly suited for damp drying clothes. When the dial **200** is set in the "time" range and the push button **202** is operated, a sprinkling operation without heat is produced. Conversely, when the dial is in the "time" range and the heat push button **201** is depressed, a timed clothes drying operation with heat is produced.

The dial **200** controls the initial setting of a sequence control or timer generally indicated at **204**. The timer **204** includes a timer motor **205** and a pair of cams **206** and **207** which are driven by the timer motor. The cam **206** operates a switch arm **208** through a suitable cam follower so as to control a first pair of contacts forming a switch **209** and a second pair of contacts forming a switch **210**. One of the contacts of the switch **209** is mounted on the switch arm **208** so that it moves with the arm, and an extension **211** of the arm actuates a switch arm **212** so as to control the contacts **210**. The cam **207** operates another switch arm **213** through a suitable cam follower on the arm so as to control a pair of contacts forming a switch **214**. It will be noted that

the switches 209 and 214 share a common contact mounted on a switch arm 215. As is pointed out hereinafter all the electrical components of the control system including the timer motor 205, the drive motor 7 and the heater 17 are energized through these timer operated switches.

The push buttons 201 and 202 are connected together by means of a pivoted link 216 so that when one is depressed, the other is moved outwardly. The push button 201 operates a contactor 217 so as to open and close a pair of contacts forming a switch 218. The push button 202 likewise operates a contactor 219 so as to open and close a pair of contacts forming a switch 220. Due to the mechanical connection between the two push buttons it will be seen that whenever the switch 218 is closed the switch 220 is open and vice versa. The switch 218 comprises a means whereby the heater 17 is removed from the circuit during sprinkle, and the switch 220 comprises a means whereby the timer is positively locked in for sprinkle. The action of these switches will be more fully explained hereinafter.

For controlling the heater 17 during both the timed dry operation and the automatic dry operation, and also for controlling the timer during the automatic dry operation, the control system of Figs. 8–10 includes a suitable thermostat 221. The thermostat comprises an expansible bellows element 222 which operates a contactor 223. The contactor 223 is movable between two sets of contacts 224 and 225 so as to cycle them inversely. When the contacts 224 are opened the contacts 225 are closed, and when the contacts 225 are closed the contacts 224 are opened. The bellows 222 operates the contacts in response to the temperature within the interior of the dryer. A suitable sensing bulb 226 for the bellows is positioned within the dryer, and the sensing bulb is connected to the bellows by a suitable hydraulic line such as the line 227.

The bellows 222 actuated by the bulb expands in response to a rise in temperature within the machine and contracts in reponse to a fall in temperature within the machine. When the dryer is placed in operation, the bellows maintains the contacts 224 closed and the contacts 225 open until the temperature rises to a predetermined high value. However, when the dryer temperature rises above the predetermined high temperature, the bellows actuates the contactor 223 so as to open the contacts 224 and close the contacts 225. The contactor then remains in this latter position until the dryer temperature falls to a predetermined lower temperature. At that lower temperature the bellows again returns the contactor 223 to its first position to close the contacts 224 and opens the contacts 225. The thermostat thus cycles the contacts 224 and 225 inversely.

The control system of Fig. 9 utilizes the timer operated switches 209, 210 and 214, the push botton operated switches 218 and 220 and the thermostat contacts 224 and 225 to provide three different clothes treating operations at the selection of the operator. As mentioned above these three operations are: a clothes drying operation of timed duration, particularly effective for damp drying clothes; a timed tumbling operation without heat and also of timed duration, particularly for sprinkling clothes; and an automatic clothes drying operation, particularly suitable for fully drying clothes, whose length is automatically varied to produce the correct drying effect. The control is adjusted to the selected function by adjusting the control dial 200 and operating the push buttons 201 and 202. The mechanical connections between the dial 200 and the cams 206 and 207 and the timer motor 205 are such that the control may be manually rotated to any desired setting.

To initiate the timed drying operation, the control knob 200 is moved into the "time" range and the heat push button 201 is depressed. The setting of the dial 200 within the time range determines the duration of the operation and the operating of the push button 201 causes the heater to be energized during the operation.

When the controls are moved into these positions, the drive motor 7, the heater 17 and the timer motor 205 are all energized. In the illustrated embodiment these elements are energized from a three-wire source comprising a pair of supply conductors 228 and 229 and a neutral line 230. The system is particularly intended for use with a source having a voltage of 220 volts between the supply conductors 228 and 229 and a voltage of 110 volts between each of the supply conductors and the neutral line 230.

When the dial 200 is moved into the time range, a raised portion 206*a* of the cam 206 actuates the switch arm 208 so as to close the switch 209. The raised portion 206*a* is high enough so that the switch 210 is also closed, the arm 208 being moved far enough to actuate switch through extension 211. The switch 214 is closed too since the cam follower associated with cam 207 is on the lower or smaller diameter portion 207*a* of cam 207.

With these switches closed, as shown in the chart of Fig. 9, the drive motor and the timer motor are both energized. The drive motor 7 specifically is energized across the supply conductor 229 and the neutral line 230. Commencing with the neutral line 230 the circuit for the drive motor extends through a fusible link 231 and a conductor 232 to the contacts 233 of a door switch 234. The door switch 234 is actuated by the door 6 of the dryer so that the contacts 233 are closed whenever the door is closed and open whenever the door is open. The door is, of course, closed during the drying operation so that the contacts 233 are closed. From the contacts 233 the drive motor circuit continues through a conductor 236, a fusible link 237 and conductors 248 and 238 to the start and run windings 239 and 240 of the drive motor. The windings 239 and 240 are both connected to a conductor 241, the main winding 242 being connected directly thereto by a conductor 242 and the start winding being connected thereto through the contacts 243 of a motor centrifugal switch 244. The contacts 243 are closed when the motor is at rest and open up as soon as the motor comes up to speed. Thus the start winding 239 is connected in the motor circuit when the motor is first energized but is removed from the motor as soon as it comes up to speed. From the line 241 the motor circuit extends through conductors 245 and 246 to the timer operated switch 209, and it is completed from the switch 209 through a conductor 247 which is connected directly to the supply conductor 229. With this circuit it will be seen that the drive motor remains energized so long as the door switch contacts 233 and the timer switch 209 are closed. If the door should be opened the operation of the motor is, of course, interrupted. The switch 209, however, remains closed throughout the operation and is opened up only when the operation is completed. This occurs when the cam on switch arm 208 drops into a depression 206*b* in the cam 206.

The timer motor 205 is also energized during the timed dry operation between the neutral line 230 and the conductor 229. Commencing with the neutral line 230 the circuit for energizing the timer extends through fusible link 231 and conductor 232 to the contacts 233 of the door switch. From there it proceeds to the timer through the conductor 236, the fusible link 237, and the conductor 249. From the timer the circuit is completed through a conductor 250, the switch arm 213, the switches 214 and 209 and the conductor 247 to the supply line 229. Energized through the circuit the timer motor 205 runs continuously so long as the door switch contacts 233 and the switches 214 and 209 remain closed. The switches 214 and 209 are held closed throughout the operation as shown in Fig. 9. However, if the door should be opened, the operation of the timer is interrupted simul-

taneously with that of the motor. At the close of the operation the timer is turned off simultaneously with the motor when the cam follower of switch arm **208** drops into the depression **206***b* in cam **206**. The resultant opening of switch **209** breaks the timer circuit as well as the drive motor circuit. As mentioned above, the length of time that the drive motor and the timer run before this occurs depends upon the setting of the dial **200** within the "time" range.

Since the heater push button **201** is depressed the heater **17** is energized simultaneously with the drive motor and the timer. The depressing of the heater push button closes the switch **218** and the heater is energized through this switch in series with the timer switches **209** and **210** across the supply conductor **228** and **229**. Commencing with the conductor **228** the heater circuit passes through the heater itself and then through the switch **218** and a conductor **251** to the switch **210**. From switch **210** the heater circuit continues through a conductor **252** to the thermostat contacts **224**. The circuit then passes through a conductor **253** to the contacts **254** of the motor centrifugal switch **244**. The contacts **254** are normally open but are closed as soon as the drive motor comes up to speed. From the contacts **254** the heater circuit continues through conductors **241**, **245** and **246** to the switch **209**. The circuit is completed from switch **209** through conductor **247** to the supply conductor **229**. With this circuit the heater remains energized so long as the timer switches **209** and **210**, the push button switch **218** and the thermostat contacts **224** all remain closed. The thermostat contacts **224** remain closed unless the dryer temperature reaches the predetermined high limit. At that time the thermostat opens these contacts. The thermostat then cycles the contacts between this high temperature and some predetermined lower value. However, if the predetermined high value is not reached during operation the contacts **224** remain closed continuously. The contacts **209** and **210** remain closed until the cam follower on switch arm **208** drops into recess **206***b* on cam **206**. At that time the switches **209** and **210** are opened thereby breaking the heater circuit at the same time as the drive motor circuit and the timer circuit are broken. This action, of course, terminates the dryer operation.

If it is desired to sprinkle clothes rather than to damp dry them, the "time" section of the dial **200** is still used. In other words the dial is again adjusted to the position within the "time" range of the dial which will give the desired length of the operation. This connects the drive motor and the timer in the same circuits as before so that they are energized together and for the same period of time. However, in order to produce the sprinkling operation rather than the heating operation, the sprinkle push button **202** is depressed. This closes the switch **220** and simultaneously opens the switch **218**. With the switch **218** open the heater circuit can not be completed, and thus the dryer operates with the heater de-energized. The clothes are thereby tumbled without heat. Of course, it will be understood that to sprinkle the clothes, the operator will place a suitable sprinkling container within the rotating drum before the dryer is placed in operation. The contents of the container will then moisten the clothes as they are sprinkled thereon, and since the heater is de-energized, the air blown through the machine is ineffective to evaporate this moisture from the clothes. If the sprinkling container is omitted, the clothes are tumbled both without heat and also without sprinkling. The sprinkling operation, like the timed drying operation, is terminated when the cam **206** opens switch **209** to de-energize the drive motor and the timer motor. Thus the only difference between the timed drying operation and the timed sprinkling operation is that the heater is de-energized by means of the push button **202**.

It will be noted though that the closing of the switch **220** during the sprinkling operation completes an alternate path between the return conductor **250** of the timer and the common contact of the switches **209** and **214**. In other words the closing of switch **220** completes a parallel path around the switch **241**. This parallel path comprises the conductor **255**, the switch **220** itself, the conductor **256** and the switch arm **215**. The completion of this parallel path, however, does not cause the timer to operate any differently than during the timed drying operation. When the switch **209** is opened, the timer motor circuit is still broken despite the parallel path through switch **220**. The only purpose of the parallel path through switch **220** is to energize the timer if the operator should mistakenly push the sprinkle push button **202** when the dial **220** is set in the "automatic dry" range. The reason such a connection is needed is explained hereinafter.

To adjust the timer for its final operation, that is the automatic drying operation, the dial is adjusted to a point within the "automatic dry" range and the heat push button **201** is depressed. This results in the heater and the drive motor being energized through exactly the same circuits as during the timed drying operation. A raised surface **206***c* on the cam **206** operates the switch arm **208** so as to close both the switches **209** and **210** and the operation of the push button **201**, of course, closes the switch **218**. With these switches closed the same circuits are completed for energizing the drive motor and the heater as during the timed drying operation. The timer motor **205** is, however not energized through the same circuit as before. A raised portion **207***b* of the cam **207** opens the switch **214** when the dial is set in the "automatic dry" range so that the timer circuit of the time operation is not completed. The timer motor **205** rather is energized through a circuit, as described below, including the back contacts **225** of the thermostat. The back contacts **225** are not closed by the thermostat until such time as the temperature in the interior of the dryer reaches a predetermined high point which indicates that the clothes are substantially dried. Thus the timer motor **205** does not operate during the major portion of the automatic drying cycle; rather it comes into operation only when the clothes are substantially dry. As pointed out above with regard to Fig. 2 the clothes tend to dry with a very slow temperature rise or in fact a temperature plateau may be created within the matchine as long as an appreciable amount of moisture remains in the clothes. But when the moisture is substantially removed from the clothes the temperature begins to rise very rapidly. The temperature at which this rapid temperature rise occurs is within the same range for most types of fabrics, and the thermostat **221** is calibrated so that it opens the contacts **224** and closes the contacts **225** when this temperature is reached.

When the thermostat closes the contacts **225**, the timer motor is energized by a circuit connected across the neutral line **230** and the supply neutral line to **30**. Starting at conductor **229** the energizing circuit for the timer extends through fusible link **231**, conductor **232**, contacts **233** of the door switch, conductor **236**, fusible link **237** and conductor **249** to the timer motor itself. From the timer the circuit continues through contacts **225** of the thermostat and conductor **253** to the contacts **254** of the motor centrifugal switch. From the centrifugal switch the circuit passes through conductors **241**, **245** and **246** to switch **209** and thence is completed through conductor **247** to the timer **229**. Energized through this circuit the timer motor drives cams **206** and **207** toward the machine "off" position so long as the thermostat contacts **225** remain closed. Assuming the contacts **225** do not open, the dryer operation is then terminated when the recess **206***d* in cam **206** allows timer switch **209** to open. The opening of switch **209** opens the timer motor circuit and also simultaneously opens the heater and drive motor circuits. Thus all the operating elements of the dryer are turned off at the same time to shut down the dryer.

But as pointed out with respect to Fig. 2, different types of fabrics may take slightly different amounts of time to dry completely after the high temperature is reached which indicates that they are substantially dry. The automatic dry portion of the dial **200** therefore allows some variation in the length of time the timer **205** runs before it shuts the machine off. For delicate fabrics the timer motor may be set to run for a minimum amount of time. For fabrics such as cottons and linens it can be set to run for a longer time, and for heavy fabrics such as rugs, dungarees, overalls, etc., it may be set to run for even a longer time. In the latter settings of the dial, that is the normal and heavy settings of the dial, it is possible that the timer may be cycled off and on one or more times before it finally turns the machine off. This happens if the dryer temperature drops to the predetermined low value at which the thermostat again closes the contacts **224** and opens the contacts **225**. This, of course, energizes the heater so as to bring the dryer temperature up again. Thus the timer motor and the heater may cycle inversely one or more times before the dryer operation is finally terminated.

From the above it will be seen that the control system of Figs. 8–10 provides the same three different clothes treating operations as the two earlier described embodiments. The clothes treating operations are, of course, a timed clothes drying operation, particularly suitable for damp drying clothes; a timed tumbling operation without heat, particularly for springling clothes; and an automatically controlled clothes drying operation particularly suited for fully drying clothes. The control may be adjusted to any one of these operations simply by turning a single dial and actuating a push button. As pointed out above, it is contemplated that the sprinkle operation will take place when the dial **200** is set in the "time" range. However, it will be understood that the operator might mistakenly set the dial in the "automatic dry" range and then depress the push button **202** so as to obtain sprinkling. It is primarily for this reason that the switch **220** is included in the circuit. When the dial **200** is set in the "auto dry" range, the switch **214** is open and this opens the timer circuit which is provided during the normal timed sprinkling operation. Further, since the heater is not energized with the sprinkle push button **202** depressed, the thermostat will never close the contacts **225** so as to close the automatic dry timer circuit. Thus, without the switch **220** the timer would run forever. The switch **220**, however, provides a circuit for energizing the timer even if the operator mistakenly sets the dial **200** in the automatic dry range for sprinkling. As pointed out above, the closing of switch **220** completes an alternate path in parallel with the switch **214** between the one side of the timer to the switch **209**. The timer is then energized through this path with the rest of the circuit the same as during the regular timed sprinkling operation, and thus rotates the cams so as to eventually terminate the dryer operation.

Referring to the cam of Fig. 9 it will be noted that the timer switches **209** and **210** are always opened and closed together. The motor circuit, of course, passes through the switch **209** and the heater circuit passes through both switches **209** and **210**. Since the switch **209** is in both the motor circuit and the heater circuit, the switch **210** could be omitted from the control and the dryer would still operate as described above. The switch **209** would control the heater circuit without the action of switch **210**. However, it is preferred to include the switch **210** so as to provide a second break in the heater circuit.

Besides the elements described above the control system of Fig. 9 includes a pilot light **257**, an ozone lamp **258** and an illuminating light **259**. The pilot light is energized whenever the machine is in operation so as to indicate that fact to the operator. The pilot light specifically is energized between the neutral line **230** and the supply conductor **229**. Commencing with the neutral line **230** the pilot light circuit comprises the fusible link **231**, conductor **232**, contacts **233** of the door switch, conductor **236**, fusible link **237** and conductors **248** and **260** to the pilot light. From the light the circuit is completed through conductors **261**, **245** and **246**, switch **209** and conductor **247** to the supply line **229**.

The ozone lamp **258** and the illuminating light **259** are energized whenever the dryer is in operation and are also energized whenever the dryer door is open. In both cases they are energized in series between the neutral line **230** and the supply conductor **229**. During the operation of the machine their energizing circuit extends from conductor **230** through fusible link **231** and conductors **232** and **262** to the ozone lamp. The circuit then extends through the ozone lamp and the illuminating lamp in series and is completed through conductors **263** and **246**, switch **209** and conductor **247** to the supply line **229**. When the door is open the ozone lamp and the illuminating light are energized through an alternate circuit. Commencing with neutral line **230** this circuit extends through fusible link **231** and conductors **232** and **262** to the lamps. From the lamps the circuit extends through conductors **263**, **245** and **264** to a set of back contacts **265** on the door switch. These back contacts **265** are closed whenever the door is open and opened whenever the door is open. From the contacts **265** the circuit is completed through a conductor **266** which is connected to the supply line **229**. The ozone lamp refreshes the air within the dryer and the illumination light, of course, illuminates the interior of the dryer.

While in accordance with the patent statutes I have described what at present are considered to be the preferred embodiments of my invention, it will be understood by those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall in the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; a control means including a motor driven timer for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein said timer operates only after the dryer temperature rises to a predetermined high temperature; said control means further including switch means operated by said timer; a thermostat having heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts when said dryer temperature rises to said high temperature and closing said heater contacts and opening said timer contacts when said dryer temperature falls to a predetermined lower temperature; and circuit means including the timer operated switch means and the thermostat contacts for energizing said drive motor, said heater, and said timer, said circuit means having a first circuit for energizing said drive motor continuously in all three of said operations of said dryer, a second circuit for energizing said heater through said heater contacts of said thermostat during both said timed clothes drying operation and said temperature modified clothes drying operation, a third circuit for energizing said timer motor continuously during said timed clothes drying operation and said timed tumbling operation, and a fourth circuit for energizing said timer motor through said timer contacts of said thermostat during said temperature modified clothes drying operation, all of said circuits including said timer operated switch means; said timer having at least two separate presettable ranges and operating said timer switch means to close a different combination of said circuits in each of said ranges; and manually operable means for adjusting said

control means including adjusting said timer to close said circuits selectively to effect the desired operation of said dryer.

2. The combination of claim 1 wherein said timer switch means comprises a plurality of switches including a heater switch, a timer switch, and a drive motor switch, and said manually operable means comprises a control member for said timer.

3. The combination of claim 1 wherein the timer switch means includes a drive motor switch and a timer switch; and said manually operable means comprises a control member for said timer and a manually operated heater switch.

4. The combination of claim 1 including means for adjusting the response of said thermostat to vary said predetermined high temperature and said predetermined lower temperature at which said thermostat operates said contacts, thereby to provide a temperature modified damp drying operation as well as temperature modified clothes drying operation.

5. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and control means including a motor driven timer for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein said timer operates only after the dryer temperature rises to a predetermined high temperature; said control means further including a motor switch, a heater switch and a timer switch operated by said timer; a thermostat having heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts when said dryer temperature rises to said predetermined high temperature and closing said heater contacts and opening said timer contacts when said dryer temperature falls to a predetermined lower temperature; a motor circuit including said motor switch of said timer for energizing said motor in all three of said operations of said dryer; a heater circuit including said heater switch of said timer and said heater contacts of said thermostat for energizing said heater during both said timed clothes drying operation and said temperature modified clothes drying operation; a first timer circuit including said timer switch of said timer for energizing said timer continuously during both said timed clothes drying operation and said timed tumbling operation; a second timer circuit including said timer contacts of said thermostat and one of said switches of said timer for energizing said timer during said temperature modified clothes drying operation; said timer having at least two separate presettable ranges and operating said timer switches to close a different combination of said circuits in each of said ranges; and manually operable means for adjusting said control means including adjusting said timer to selectively energize said circuits, thereby to select the desired one of said operations of said dryer.

6. The combination of claim 5 wherein said second timer circuit includes said motor switch of said timer so that said motor switch de-energizes said timer and said drive motor simultaneously at the conclusion of said temperature modified clothes drying operation.

7. The combination of claim 5 wherein said manually operable means comprises a rotatable control member for adjusting the setting of said timer, and said timer includes three ranges into which it can be adjusted by said control member, said timer having cam means closing all three timer operated switches in one of said ranges for producing said timed clothes drying operation, for closing said motor and timer switches only in a second of said ranges for producing said timed tumbling operation, and for closing said motor and heater switches only in the third of said ranges for producing said temperature modified clothes drying operation.

8. The combination of claim 5 wherein said manually operable means comprises a rotatable control member for adjusting the setting of said timer; and a manually operated heater switch in said heater circuit; said timer including two ranges into which it can be set, and said timer having cam means closing all three of said timer operated switches in one of said ranges for producing said timed clothes drying operation and closing said motor and heater switches only in the second of said ranges for producing said temperature modified clothes drying operation, said manually operated heater switch being opened when said timer is in said one range to produce said timed sprinkling operation.

9. The combination of claim 8 including a second manually operated switch for energizing said timer if said heater switch should be opened when said timer is in second range, and means interlocking said switches for opening either of said switches when the other is closed.

10. The combination of claim 5 including manually actuated means for adjusting the response of said thermostat for varying said predetermined high temperature and said predetermined lower temperature at which it operates said heater and timer contacts, thereby to produce a temperature modified damp drying operation as well as said temperature modified clothes drying operation.

11. In a clothes dryer, clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; control means including a motor driven timer for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein said timer operates only after the dryer temperature rises to a predetermined high temperature; said control means further including first and second switches operated by said timer; a thermostat having heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts when said dryer temperature reaches said predetermined high temperature and closing said heater contacts and opening said timer contacts when said dryer temperature falls to a predetermined lower temperature; a motor circuit including said first switch of said timer for energizing said motor in all three of said operations of said dryer; a heater circuit including said first switch of said timer and said heater contacts of said thermostat for energizing said heater during both said timed clothes drying operations and said temperature modified clothes drying operation; a first timer circuit including said second switch of said timer for energizing said timer continuously during both said timed clothes drying operation and said timed tumbling operation; a second timer circuit including said timer contact of said thermostat and one of said timer operated switches for energizing said timer during said temperature modified clothes drying operation; said timer having a plurality of separate operating ranges and operating the timer switches differently in each of said ranges; a separate heater switch connected in said heater circuit; and manually operable means for adjusting said timer and said heater switch to selectively energize said circuits, thereby to select the desired one of said operations of said dryer.

12. The combination of claim 11 wherein said manually operable means includes a rotatable control member for adjusting said timer, and said timer includes two ranges, said timer closing said first and second timer operated switches in one of said ranges for said timed clothes drying operation and closing said first timer switch only in said second range for said temperature modified clothes drying operation, said timed sprinkling operation being effected by opening said heater switch when said timer is set in first range.

13. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and control means

including a motor driven timer and a thermostat for controlling said motor and said heater to produce selectively a timed tumbling operation of said dryer, a temperature modified clothes drying operation of said dryer, and a temperature modified damp drying operation of said dryer; said timer including a plurality of switch means; said thermostat being responsive to the dryer temperature and including heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts at a high temperature of said dryer and closing said heater contacts and opening said timer contacts at a lower temperature of said dryer, a motor circuit including said switch means of said timer for energizing said motor in all three operations of said dryer; a heater circuit including said switch means of said timer and said heater contacts of said thermostat for energizing said heater during both said temperature modified clothes drying operation and said temperature modified damp drying operation; a first timer circuit including said switch means of said timer for energizing said timer continuously during said timed tumbling operation; a second timer circuit including said timer contacts of said thermostat and said switch means of said timer for energizing said timer during said temperature modified clothes drying operation and said temperature modified damp drying operations; said timer having at least two presettable ranges, one of said ranges being effective to connect said circuits for said timed tumbling operation and the other of said ranges being effective to connect said circuits for said temperature modified drying operations; manually operable means for selectively adjusting said timer into the desired one of said ranges to operate said switch means to connect said circuits for said timed tumbling operation or for one of said temperature modified drying operations; and means for adjusting the response of said thermostat to vary said high temperature and said lower temperature at which said thermostat operates said contacts, thereby to adjust said control between said temperature modified clothes drying operation and said temperature modified damp drying operation.

14. The combination of claim 13 including a rotatable control knob for adjusting said timer, and a plurality of push buttons for adjusting the response of said thermostat thereby to select between said temperature modified clothes drying operation and said temperature modified damp drying operation when said timer control knob is moved into said second range.

15. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and control means for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein the operation of the dryer is automatically terminated when the clothes have dried, said control means including a thermostat responsive to dryer temperature, a motor driven timer, a plurality of switches operated by said timer and controlling said drive motor, said heater and said timer, said timer having a plurality of different presettable ranges and operating a different combination of said switches in each of said ranges for producing a different operation of said dryer, one of said switch combinations providing an operation wherein said timer is driven independently of said thermostat, another of said switch combinations providing an operation wherein driving of said timer is controlled by said thermostat during at least a major part of the operation, and a single rotatable dial for adjusting said control means including adjusting said timer to select the desired one of said operations.

16. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and a control system for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein said timer operates only after the dryer temperature rises to a predetermined high level, said control system including a thermostat, a motor driven timer, a plurality of switches operated by said timer and controlling said drive motor, said heater, and said timer, said timer having three separate presettable ranges and operating a different combination of said switches in each of said ranges for producing the three different operations of said dryer, two of said switch combinations providing an operation wherein said timer is driven independently of said thermostat, the third of said switch combinations providing an operation wherein driving of said timer is controlled by said thermostat during at least a major part of the operation, and a single rotatable dial for adjusting said timer thereby to adjust said control system to produce the desired one of said operations.

17. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and a control system including a motor driven timer for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation of said dryer wherein said timer operates only after the dryer temperature rises to a predetermined high temperature; said control system further including switch means operated by said timer; a thermostat having heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts when said dryer temperature rises to said high temperature and closing said heater contacts and opening said timer contacts when said dryer temperature falls to a predetermined lower temperature, circuit means for energizing said drive motor, said heater and said timer and a single rotatable dial for adjusting said timer through said timer switch means, with said heater contacts of said thermostat being connected to control said heater, and including a pair of circuits for energizing said timer, one of said circuits including said timer contacts of said thermostat and being closed for said temperature modified clothes drying operation, the other of said circuits providing for energizing said timer independently of said thermostat and being closed for both of said timed operations; said timer having three different presettable operating ranges and operating said timer switch means in said temperature modified clothes operation to provide the first of said circuits and operating said timer switch means in each of said timed operations to provide said second circuit; thereby to adjust said control system to produce the desired one of said operations.

18. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and control means for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation wherein the operation of the dryer is automatically terminated when the clothes have dried, said control means including a thermostat responsive to dryer temperature, a motor driven timer, a plurality of switches operated by said timer and controlling said drive motor, said heater and said timer, said timer having a plurality of different presettable ranges and operating a different combination of said switches in each of said ranges for producing a different operation of said dryer, one of said switch combinations providing said temperature modified clothes drying operation wherein driving of said timer is controlled by said thermostat during at least a major part of the operation, the other switch combinations providing an operation wherein said timer is driven independently of said thermostat for each of said timed operations, and

manually operable means including a rotatable control dial connected to said timer for adjusting said control means to select the desired one of said operations.

19. In a clothes dryer; clothes tumbling means; a drive motor for driving said clothes tumbling means; a heater for heating the clothes being tumbled; and a control system including a motor driven timer for controlling said motor and said heater to produce selectively a timed clothes drying operation of said dryer, a timed tumbling operation of said dryer without heat, and a temperature modified clothes drying operation of said dryer wherein said timer operates only after the dryer temperature rises to a predetermined high temperature; said control system further including switch means operated by said timer, a thermostat having heater contacts and timer contacts, said thermostat opening said heater contacts and closing said timer contacts when said dryer temperature rises to said high temperature and closing said heater contacts and opening said timer contacts when said dryer temperature falls to a predetermined lower temperature, circuit means for energizing said drive motor, said heater, and said timer through said timer switch means, with the heater contacts of said thermostat being connected

to control said heater, and including a pair of circuits for energizing said timer, one of said circuits including said timer contacts of said thermostat and being closed for said temperature modified clothes drying operation, the other of said circuits being provided by said timer switch means exclusive of said thermostat and providing for operation of said timer independently of said thermostat during each of said timed operations, said timer having a plurality of different presettable ranges and operating said timer switch means to produce said other circuit during said timed operations and to produce said one circuit during said temperature modified clothes drying operation, and manually operated adjustment means including a rotatable dial connected to said timer for adjusting said control system to select the desired one of said operations.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,851,788 September 16, 1958

Robert L. Dunkelman

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 24, line 38, strike out "and a single rotatable dial for adjusting"; line 39, strike out "said timer", first occurrence; line 52, after "circuit;" insert -- and a single rotatable dial for adjusting said timer --.

Signed and sealed this 9th day of December 1958.

(SEAL)

Attest:
KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents