Oct. 30, 1962 J. LIEBERMANN 3,060,591

DRYER CONTROL APPARATUS

Filed Sept. 8, 1959 2 Sheets-Sheet 1

Fig. 1.

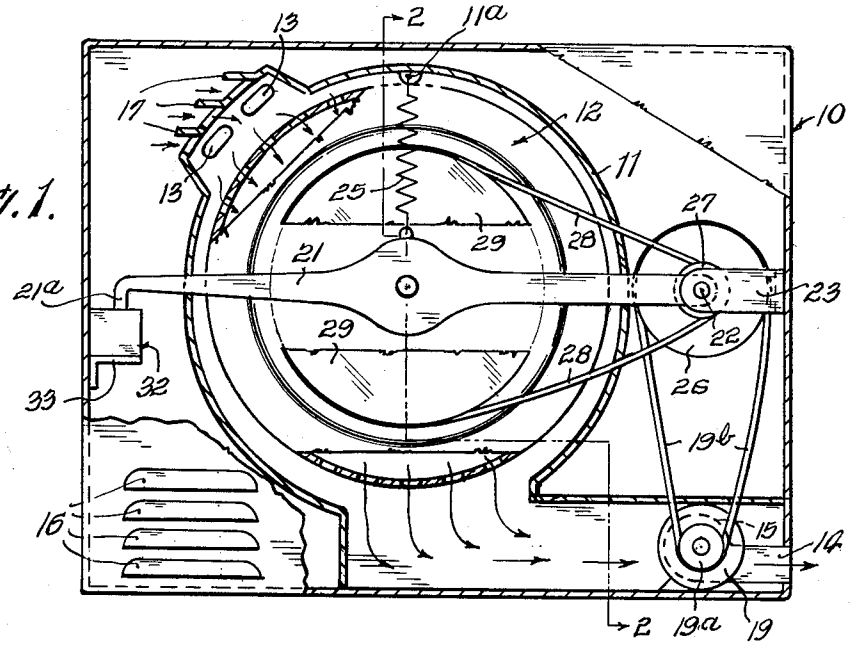
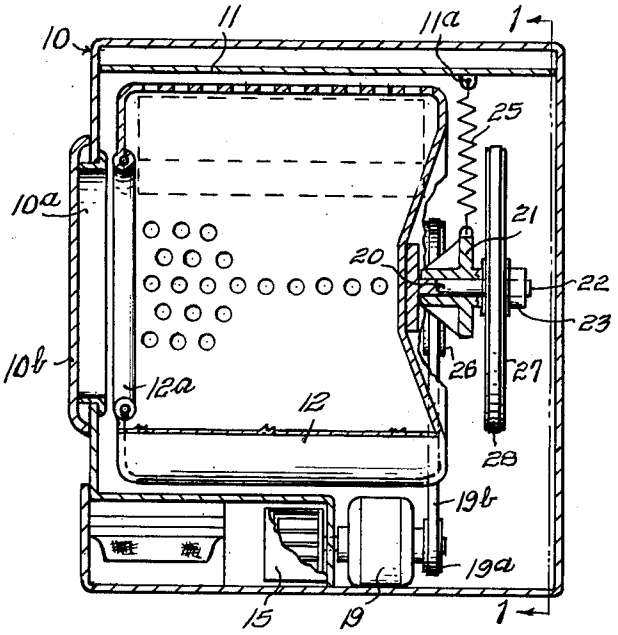


Fig. 2.



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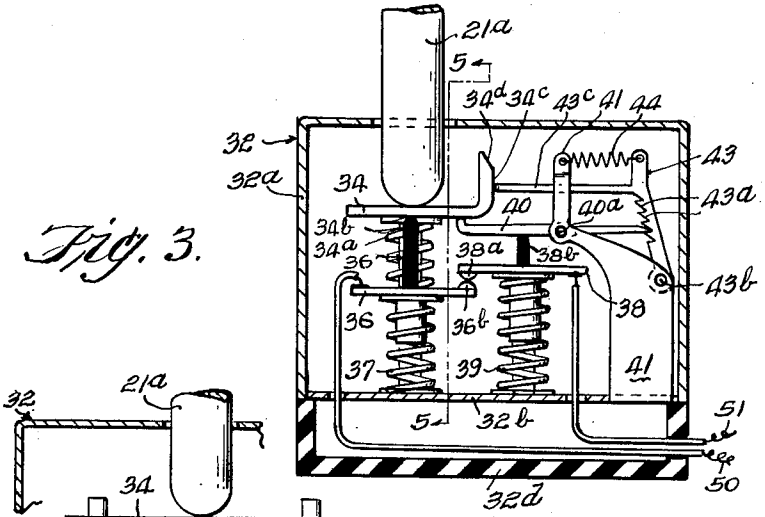


Fig. 3.

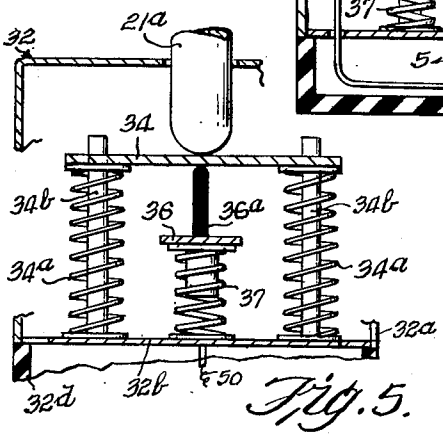


Fig. 5.

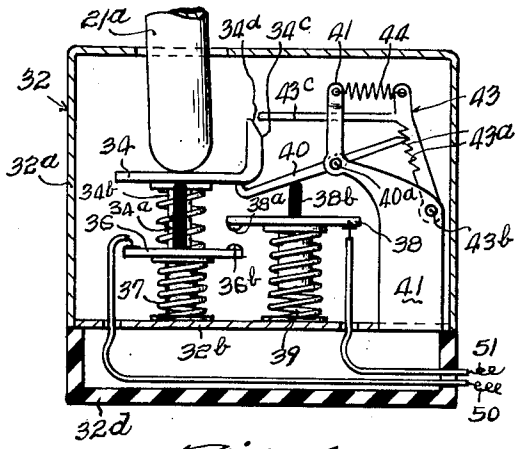


Fig. 4.

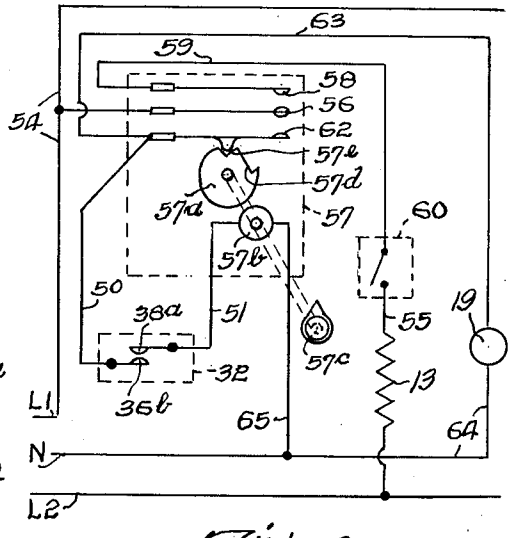


Fig. 6.

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DRYER CONTROL APPARATUS

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8 Claims. (Cl. 34—55)

The present invention relates to an improved dryer control apparatus particularly suitable for use in controlling the operation of clothes drying machines, although it could be embodied in control apparatus in machines for drying other materials.

The principal object of the present invention is the provision of an improved control apparatus for drying machines, such as domestic type clothes dryers, in which the drying cycle is terminated in response to a predetermined percentage reduction in weight of the material being dried, whereby material can be accurately dried to a predetermined degree less than "bone" dry.

In carrying out the invention, a drying machine is provided having a material containing element, such as a rotatable basket in which clothes are tumbled during the drying cycle, and which is arranged to be deflected from a normal position by the weight of material placed therein and to return toward the normal position as the material loses weight due to evaporation of the moisture. The drying machine is arranged to pass desiccating air over the material and the drying operation is automatically terminated by a control apparatus comprising a first control member movable in opposite directions in a path according to the amount of deflection and return of the material containing element from its normal position and which cooperates with a second control member to terminate the drying cycle, the second control member being moved by the deflection of the material containing element but through a different distance per unit of deflection of the element than the distance moved by the first control member, the second control member being restrained from following the return movement of the material containing element so that as the material loses weight by drying, the first control member moves to a given control position relative to the second control member to effect termination of the drying cycle.

In the preferred form of the invention, the two control members comprise switch contact members, one of which is movable directly by a weight responsive means proportional to the deflecting and return movements of the material holding element while the other contact is moved by the weight responsive means through a reduction lever so that its movement is at a ratio of less than unity according to the movement of the first control member, and the second contact member is retained at the extremity of its movement responsive to the deflection of the material containing element by a holding mechanism which is operated to release the second control member when the dried material is removed from the element.

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

FIG. 1 is a rear view of a domestic type clothes drying machine embodying the improved control apparatus, parts of the machine being broken away and shown in section substantially along line 1—1 of FIG. 2;

FIG. 2 is a view taken substantially along line 2—2 of FIG. 1;

FIG. 3 is a sectional view of the control apparatus;

FIG. 4 is a view similar to FIG. 3 but showing certain parts in different positions;

FIG. 5 is a view taken substantially along line 5—5 of FIG. 3; and

FIG. 6 is a schematic wiring diagram of the control system for the clothes dryer.

Although the invention could be employed to control machines for drying various types of materials, it is here shown embodied in a domestic type clothes drying machine, and referring to FIGS. 1 and 2 of the drawings, the machine shown is of conventional construction with the exception of the structure for supporting the drum in which the clothes to be dried are placed. The clothes dryer comprises a cabinet **10** having a shroud structure **11** inside thereof for enclosing a perforated clothes receiving drum **12**. As is common, cabinet **10** has a circular front opening **10***a* which is closed by a suitable door **10***b*, and basket or drum **12** has an opening **12***a* aligned with opening **10***a* for access to the drum. An electrical heating unit **13** is located within shroud **11**, and is arranged to heat air drawn into the shroud, after which the heated air is directed through the perforations in the drum and exhausted through an outlet **14** by operation of a blower **15**, the air flow being indicated in the drawings by arrows. The air enters cabinet **10** through louvers **16** and is directed over heater unit **13** by louvers **17**. This type of construction is conventional and further disclosure of details is not necessary to the understanding of the invention.

Drum **12** is suspended so that the weight of clothes placed therein depresses or deflects the drum from a normal empty position, and for this purpose the drum is rotatably suspended by an axle **20** which is journaled in a lever **21** pivoted at one end on a shaft **22** supported by a U-shaped bracket **23** secured to the side wall of cabinet **10**. A tension spring **25** is attached at one end to lever **21** and the opposite end is attached to an eye **11***a* on the shroud wall so that the drum **12** and the members carried therewith are counterbalanced by the spring.

Drum **12** is rotated by motor **19** through a drive mechanism which includes motor pulley **19***a* drivingly connected by belt **19***b* to a pulley **26** journaled on shaft **22** by a hub, not shown, integral therewith and attached to a second pulley **27** which is drivingly connected by a belt **28** to a wheel **29** attached to drum axle **20**. It is to be understood that suitable bearings are utilized for the journaled members so as to provide relatively low friction turning of the parts. It will be seen that as motor **19** operates blower **18**, it also revolves clothes drum **12**, and that the drum swings on lever **21** according to the change in weight of the drum and its contents.

The degree of depression of drum **12** depends upon the weight of clothes placed therein, and the degree of return of the drum towards its unloaded position is utilized to terminate the cessation of the drying cycles, and for this purpose lever **21** has a downwardly projecting finger **21***a* which projects into a control casing of a control apparatus **32** attached to a bracket **33** connected to the rear wall of cabinet **10**.

Control **32** comprises a casing **32***a* having a wall **32***b* therein on which a bar **34** is resiliently supported by two compression springs **34***a* at either end thereof, as seen in FIG. 5. Two guide posts **34***b* are attached to wall **32***b* and extend through springs **34***a* and openings in bar **34** to form guides for the bar and to locate the springs. Bar **34** is positioned to be engaged by finger **21***a* projecting through an opening in the top wall of the control casing, and it will be apparent that the finger depresses the control bar according to the weight of material placed in drum **12**.

Bar **34** is arranged to actuate a switching mechanism comprising a first contact plate **36**, supported by a coil spring **37** bottomed on wall **32***b*. Plate **36** has a post

36*a* thereon, preferably of a suitable dielectric material, which engages the underside of bar **34**. A contact **36***b* is attached to plate **36** at one end thereof and is arranged to engage with a contact **38***a* attached to the underside of plate **38**. By the arrangement shown, the elevation of plate **36** is controlled directly by the bar **34** and its deflection and rise will be the same as that of drum **12**.

The elevation of plate **38** is controlled by a lever **40** which is pivoted on a bracket **41** by a pin **40***a*, the plate being connected with the lever by a post **38***b*, which is preferably of dielectric material. The left hand end of lever **40** engages the underside of bar **34** and the point of engagement of post **38***b* with the lever, in the embodiment shown, is approximately one-third the distance between pivot **40***a* and the point of engagement of the lever with bar **34**. By this arrangement, when bar **34** is depressed contact plate **38** will be depressed but approximately two-thirds the distance plate **36** is depressed, and contacts **36***b* and **38***a* will be separated accordingly. It may be desirable to locate the point of connection of **38***b* with lever **40** at different locations to obtain different degrees of dryness of the clothes, as will be understood as the description proceeds.

Lever **40** is adapted to be latched in its ultimate depressed position by a ratchet toothed bar **43** having suitably shaped teeth **43***a* thereon which are engaged by the right hand end of lever **40**, which is tapered to engage the teeth. Latch bar **43** is pivoted to bracket **41** by a pin **43***b* and is urged counterclockwise by a spring **44** interconnecting the bracket and the bar. The form of teeth **43***a* permit lever **40** to slide upwardly thereover as bar **34** depresses the left hand end of the lever **40** and latch the lever in the position to which the lever is depressed so that contact plate **38** will remain stationary although bar **34** rises as the load in drum **12** is reduced.

Latch bar **43** is moved to lever releasing position when drum **12** is empty by a projection **43***c* thereon which engages an upstanding cam surface **34***c* formed on bar **34**, the cam surface having a surface **34***d* which slopes toward the left and which is brought opposite projection **43***c* when a load is placed in drum **12** which permits spring **44** to move latch **43** into latching position. Thus, the latch for retaining contact plate **38** in a lowered position is effective only when drum **12** has a load therein.

Contact plate **36** is connected by a lead wire **50** to a line **L1** of a conventional three-wire 240 volt power supply system, and contact plate **38** is connected by lead wire **51** to one terminal of a timer driven switching mechanism **53**, described more fully hereinafter. Lead wires **50** and **51** are partially enclosed in an insulated cover **32***b* attached to the bottom of casing **32**.

Referring now to the control system for the dryer, power is supplied through the three-line, 240 v. system mentioned, which comprises lines **L1**, **L2** and neutral line **N**. The circuit for heater **13** includes line **L1**, wire **55**, central contact **56** of a conventional synchronous motor-driven timer switch **57**, contact **58** of the timer switch, wire **59** to one terminal of a commercially available thermostatic control **60**, which is normally closed but opens when the air temperature reaches a predetermined high degree and which recloses at a slightly lower temperature to thereby maintain a satisfactory drying temperature of the air passing through the clothes drum, then through heater **13** to line **L2**.

The circuit for motor **19** includes line **L1**, wire **54**, contacts **56** and **62**, wire **63** to one side of the motor, and wire **64** to line **N**.

The dryer timer switch **57** includes a cam **57***a* which is driven by suitable synchronous motor **57***b* at a relatively slow rate, and the profile of the cam is such that when it is set to the "on" position, as by a manual knob **57***c*, contacts **56**, **58**, and **62** are all closed to complete the heater circuit and motor circuit **19**.

The circuit for synchronous motor **57***b* includes line **L1**, contact **56**, **62**, wire **50**, contacts **36***b* and **38***a*, wire **51** to one side of the timer motor, and wire **65** to line **N**. Cam **57***a* has two depressions, one at **57***d* which causes contact **56** to drop from contact **58** while maintaining contact with **62**. A second depression **57***e* causes contact **62** to separate from contact **56**. The timer motor may be set to rotate the cam in a clockwise direction from the rise portion to the left of depression **57***d* in approximately eight minutes and to move the cam through depression **57***d* in approximately four minutes prior to opening of the blower circuit so that the drum may rotate while cool air is drawn through the material therein to cool the clothes to a comfortable handling temperature after which cooling operation the timer motor is discontinued by separation of contacts **56** and **62**.

The operation of the control apparatus is as follows: A load of wet clothes is placed in drum **12** which depresses lever **21** causing contact member **36***b* to be moved well below contact member **38***a*, as described previously, which opens the circuit for timer motor **57***b*. Timer knob **57***c* is then turned to the "on" position in which position contacts **56**, **58** and **62** are closed to energize the circuits for heater **13** and drive motor **19** so that a drying cycle is commenced. Since contacts **36***b* and **38***a* are open, the timer motor remains in the drying cycle starting position. As moisture is removed from the clothes during the drying cycle the weight of drum **12** is reduced, whereby lever **21** moves upwardly causing contact **36***b* to move toward contact **38***a*, which is held stationary by lever **40** latched with teeth **43***a*, and when contact **36***b* finally engages contact **38***a*, due to reduction in weight of moisture in the material in the drum, timer motor **57***b* is energized and rotates cam **57***a* to terminate the drying cycle as described. The clothes are then removed from drum **12** which causes bar **34** to actuate projection **43***c* to shift latch bar **43** and to release contact plate **38** so that the control apparatus **32** is in condition for the next cycle.

It will be seen that the degree of dryness is determined by the proprotionate degree of depression of contact plate **38** with respect to contact plate **36** which is determined by the position of post **38***b* along lever **40**. The smaller proportionate depression movements, resulting in drier clothes. The particular proportion desired for various types of materials can be determined by experiment, after which the control is adjusted accordingly. While no adjustment is shown here for sake of simplicity, it is apparent that such provision could be readily effected.

By my invention the degree of dryness of wet clothes can be accurately determined according to the percentage of moisture actually removed during the drying cycle.

Although but one form of the invention has been disclosed, other forms, modifications and adaptations can be made, all falling within the scope of the claims which follow.

I claim:

1. In a drying apparatus including a container for material to be dried and power means to effect drying of materials placed in said container, means to resiliently support said container whereby said container is depressed from a normal elevation when a load is placed therein and returns toward said normal position as the load is reduced, and control means for said power means operative in response to a predetermined upward return movement of said container comprising first and second control members arranged for cooperation with one another to terminate a drying cycle of said power means, the first of said members being moved according to movement of said container, the second of said members being moved according to movement of said container but at a proportionately less degree per unit of movement of said container, and means to block movement of said second member in the direction of the return of said container towards its normal position so that the return movement will bring said first control member into cooperative relation with said second control member to terminate the drying cycle.

2. In a drying apparatus including a material container and power means to effect drying of materials placed in said container, means movable according to the weight of material in said container, control apparatus for said power means including two members movable relative to one another and having control means thereon which are operative when in predetermined relative positions to effect termination of a drying operation by said power means, one of said members being moved by said movable means through a given range of movement in one direction in response to a given weight of material in said container, means to move the other of said members through a different range of movement in said one direction in response to said movement of said movable means, and means to block movement of said other member in the opposite direction so that movement of said one member in said opposite direction will bring said control means into said predetermined relative positions.

3. Drying apparatus as defined in claim 2 including means to release said other member for movement in the opposite direction in response to the return of said container to said normal elevation.

4. In a drying apparatus including a material container and power means to effect drying of materials placed in said container, means movable according to the weight of material in said container, control apparatus for said power means including two contact members movable relative to one another and operative when engaged to effect termination of a drying operation by said power means, one of said contact members being moved by said movable means through a given range of movement in one direction in response to a given weight of material in said container, means to move the other of said contact members through a different range of movement in said one direction in response to said movement of said movable means, and means to latch said other contact member against movement in the opposite direction so that the movement of said one contact member in said opposite direction will effect engagement thereof with said other contact member.

5. In a drying apparatus including a material container and power means to effect drying of materials placed in said container, a lever for supporting said container, means to counterbalance the weight of said container so as to move said container to a predetermined elevation when said container is empty, control apparatus for said power means including two members movable relative to one another and having control means thereon which are operative when in predetermined relative positions to effect termination of a drying operation by said power means, one of said members being moved by said lever through a given range of movement in one direction in response to deflection of said lever, a second lever operative to move the other of said members through a different range of movement in said one direction in response to the deflection of the first mentioned lever, and means to block movement of said second lever in the opposite direction, said control means being operated upon movement of said one member in said opposite direction through a distance equal to the difference in movements of said two members in said one direction.

6. In a drying apparatus including a container for material to be dried and power means to effect drying of

materials placed in said container, weight sensitive means having a range of movement corresponding to the weight of material in said container, control apparatus for said power means including first and second members movable relative to one another and having first and second contacts respectively connected thereto which are operative when in a predetermined relative position to effect termination of a drying operation by said power means, said first member being moved by said weight sensitive means through a given range of movement in opposite directions according to the weight of material in said container, means to move said second member by said weight sensitive means in one direction a distance corresponding to an increase of weight in said container and at a different distance per unit of movement of said weight sensitive means than the movement of said first member by said weight sensitive means, and means to restrain movement of said second member according to movement of said weight sensitive means in response to a decrease in weight of material in said container, movement of said first member in response to a decrease in weight of material in said container and relative to the restrained second member being effective to bring said first and second contacts into said predetermined relative position.

7. In a drying apparatus including a container for material to be dried and power means to effect drying of materials placed in said container, weight sensitive means connected to said container and comprising an arm adapted to move in first and second directions through distance proportionate to increases and decreases in weight of material in said container, a first electrical contact means connected in operative relation with said arm to follow the movements thereof, a second electrical contact means adapted to cooperate with said first contact means for controlling said power means to terminate said drying, lever means connecting said second contact means in operative relation with said arm and adapted thereby to follow movements of said arm in said first direction, said lever means providing a difference in rates of said movements of said first and second contact means in following said arm, whereby movements of said arm in said one direction serves to move said contact means out of cooperative relation with one another to a distance dependent upon said difference in rate and upon the initial weight of material in said container, and ratchet means associated with said lever means for releasably restraining said second contact means against movement in said second direction, whereby movement of said arm in said second direction an amount corresponding to the last mentioned distance will bring said contact means into said cooperative relation.

8. A drying apparatus as defined in claim 7 and including cam means connected with said arm and operative to release said ratchet means upon movement of said arm in said second direction to a position corresponding to an empty container.

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