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S. A. STAEGE

TEMPERATURE CONTROL SYSTEM

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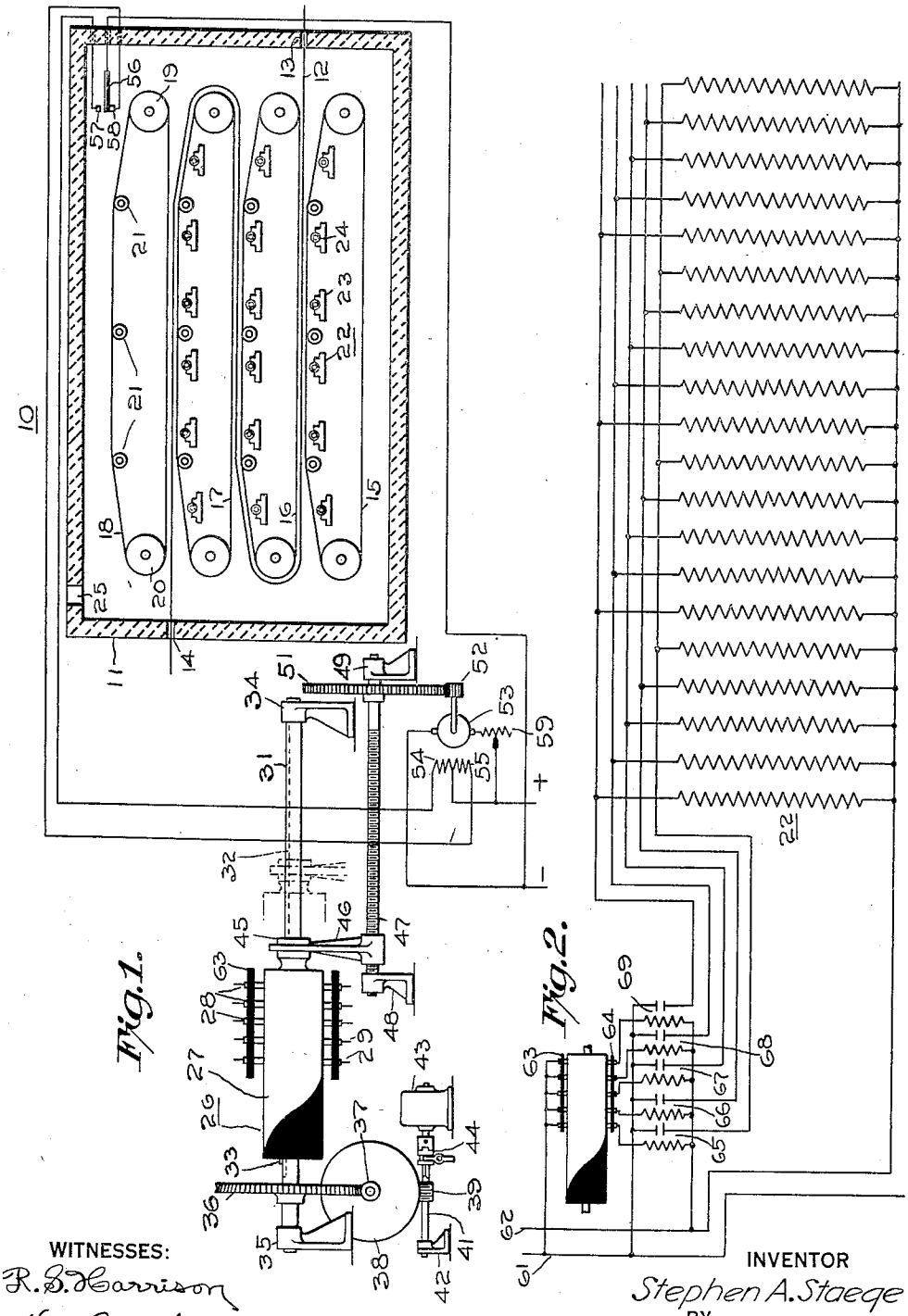


Fig. 1.

Fig. 2.

WITNESSES:

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TEMPERATURE-CONTROL SYSTEM.

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My invention relates to dryer systems, and particularly to temperature control system therefor.

One object of my invention is to provide a relatively simple and rugged means for controlling the temperature of a dryer unit.

Another object of my invention is to provide a motor-actuated, thermally-controlled means for controlling the temperature in a drying system.

In practicing my invention I provide a plurality of heating units and circuit-controlling means cooperating therewith, that are controlled by a motor-driven contact drum that is rotated at slow speed and that has contact members associated therewith.

A thermally-controlled, motor-acting means moves the drum longitudinally to vary the number of heating units energized at any time.

In the single sheet of drawing,

Fig. 1 is a view, partially in longitudinal vertical section and partially in side elevation, of a dryer unit and control means therefor, and

Fig. 2 is a schematic diagram of connections constituting a part of the control means and system embodying my invention.

I have elected to illustrate and describe my invention as applied to an electric dryer unit 10 comprising a casing 11 through which a web of paper 12 may be passed in order to dry the same. While the description of the system and its operation will be applied to such an installation, it is not restricted thereto in its operation, but is applicable to a large range of drying means, as well as to various sources of heat.

The dryer 10 comprises a substantially enclosing casing 11 that is preferably made of heat-insulating material and that is of such dimensions, particularly in the lateral width thereof, that a web of initially wet material 12, such as a web of paper, may be passed therethrough. An entering slot 13 and a leaving slot 14 are provided to permit the web of material to be moved into and out of the casing.

Means for supporting the web of material within the casing and for causing it to move in a circuitous path therethrough, comprises a plurality of superposed endless belts 15, 16, 17 and 18 that severally pass over drums 19 and 20 that are suitably supported. The upper portions of the endless belts are supported by rollers 21, the location thereof being such that the upper portion of a lower belt and the lower portion of the next superposed belt are located closely adjacent to each other and are therefore adapted to support and move the web of material while it is being dried in the casing. The web of paper is prevented from cockling or wrinkling by the upper and lower endless belts, which, as is usual in the art, are of relatively small-mesh woven wire.

Heating means for effecting the drying operation comprise heating units 22 that are constituted respectively by refractory resistor-supporting members 23 having located thereon suitable resistor members 24. As the particular construction of heating means forms no part of my invention, they are not illustrated or described in detail, as any type of heating means may be employed. The essential consideration in the particular form of dryer unit herein illustrated is that the heating means shall be distributed substantially uniformly relatively to the various passes of the web of material in order that it may be uniformly dried in its passage through the casing.

In the particularly embodiment illustrated, the resistor members 24 are operated at relatively high temperatures, and the fluid initially in the web of material is transformed into dry superheated steam which is permitted to flow out of the casing 11 through an opening 25, and a suitable conduit (not shown) to other devices or apparatus where its heat may be extracted and profitably used.

The heating means 22 are divided into a plurality of individual circuits that are illustrated schematically in Fig. 2 of the drawing, which is intended to show that a relatively large number of individual heating units employed, which heating units are uniformly distributed so that individual circuits or combinations thereof may be energized or deenergized in order to vary the energy translated into heat, without appreciably varying the uniform distribution thereof relatively to the moving web of paper.

Means for controlling the energization of the respective groups of heating units 22 comprises a drum 26 that is provided with a contact plate 27, of electric-conducting material thereon. The plate 27 extends entire-

ly around the drum at one end thereof and has an angularly disposed edge portion at the other end thereof, the surface of the drum and of the contact plate being continuous in order that a plurality of contact brushes 28 and 29 may remain in operative engagement therewith without jarring the same.

The drum 26 is mounted on a shaft 31, that has a keyway 32 extending longitudinally thereof, and a key 33 within the drum 26 fitting into the keyway 32 and permitting the movement of the drum 26 longitudinally of its own length, while causing it to rotate with the shaft. The shaft 31 is mounted in suitable bearing members 34 and 35.

Means for causing a relatively slow rotation of the shaft 31 and the drum 26 comprises a worm gear 36 secured on the shaft 31 adjacent to the bearing member 35, that is operatively engaged by a worm 37 mounted on a suitable shaft which also carries a worm gear 38 that is operatively engaged by a worm 39 mounted on a shaft 41, one end of which is supported in a bearing member 42 and the other end of which is mechanically connected with the shaft of a motor 43 through a multiple jaw coupling 44. These members are illustrated generally only, as any suitable or desired mechanical arrangement of these members may be employed.

Means for effecting the movement of the drum 26 longitudinally of the shaft 31 comprises an extension 45 on the drum 26 having a peripherally-extending groove therein that is engaged by the forked end of an arm 46, which has its other end mounted on a screw-threaded shaft 47, the respective ends of which are supported by bearing members 48 and 49. The arm 46 is prevented from turning with the screw-threaded shaft 47 as the same is rotated, by reason of its engagement with the extension 45 and moves longitudinally of the shaft 47, as the same is rotated by reason of its screw threaded engagement therewith.

A relatively large gear wheel 51 is mounted on the shaft 47 at one end thereof adjacent to the bearing member 49 and is operatively engaged by a pinion 52 that is mounted on the shaft of a motor 53 having two field windings 54 and 55 to permit of reversible operation of the motor armature 53. The operation of the motor armature 53 effects rotation of the shaft 47 in the one direction or the other, a movement of the arm 46 thereon and a movement of the drum 26 longitudinally of the shaft 31.

Means for effecting the reversible operation of the motor armature 53 comprise a thermostatic member 56 that may be located within the casing 11, the free end thereof being adapted to operatively engage relatively fixed contact members 57 and 58, to thereby complete a circuit through either the field winding 54 or 55 of the motor. The motor may be provided with an adjustable resistor 59 in the armature circuit to permit of varying the speed of rotation thereof, and any desired means for limiting its operation to prevent jamming of the arm 46 at the ends of the threaded shaft 47 may be provided.

The brushes 28 may be connected together and to one conductor 61 of a suitable source of supply comprising conductors 61 and 62. The brushes 28 are supported by an insulating means, indicated schematically only as a suitable bar of material 63. The brushes 29 are similarly supported by a bar 64 and are connected to the respective actuating coils of a plurality of contactors 65, 66, 67, 68 and 69, comprising the usual actuating and holding coils and cooperating contact members. The contact members of the respective contactors are adapted to control the energization of the groups of distributed heating elements, as was hereinbefore described.

In the position shown in the two figures of the drawings, the energizing circuit through the respective actuating coils of the contactors 65 to 69, inclusive, are closed continuously, the drum 26 being rotated at a relatively slow speed, such as approximately two revolutions per minute. This is for the reason that the motor 53, under the influence of the thermostat 56, has been operated in such direction and to such extent, that the rotation of the shaft 47 has caused the arm 46 to move toward the bearing 48 and to thereby move the drum 26 so that all of the brushes are in operative engagement with the portion of the conducting contact plate 27 which extends peripherally around the entire surface of the drum. This permits the energizing current to traverse the actuating coils of the respective contactors continuously, thereby holding the contactors in closed position and continuously energizing all of the heating elements.

If the temperature within the dryer casing should increase beyond a predetermined value for which the thermal element is adjusted, it will engage one of the two relatively fixed contact members and energize one of the two field windings 54 or 55 in accordance therewith to cause the operation of the motor armature to effect a rotative movement of the shaft 47, whereby the arm 46 is caused to travel along the shaft and to move the drum 26 longitudinally of its supporting shaft. This effects a relative longitudinal movement between the brushes and the drum, and the left-hand brush of each of the two sets of brushes will be the first to intermittently interrupt the circuit through the actuating coil of the contactor, in this case, brush 65.

If the temperature is relatively high and the drum is moved to the right on its supporting shaft until several of the left-hand sets of brushes are so located that they engage the contact plate 27 for only a portion of the revolution, the actuating coils will be energized for only corresponding periods of time and thereby periodically interrupt the current through the heating elements controlled thereby.

The effect of this operation is to periodically and intermittently deenergize certain of the heating elements, the time of deenergization depending upon the peripheral extent of the non-conducting portion of the drum located between the conducting portions. By moving the drum toward the right or left in such manner that more or less of the number of brushes 28 and 29 are caused to intermittently engage the non-conducting surface, a corresponding number of heating elements will be deenergized for different lengths of time, the heating elements controlled by the contactor 65 being deenergized for a greater portion of the time than those controlled by the contactor 66.

The system embodying my invention thus provides motor-actuated and motor-driven means for determining the length of time that a selective plurality of heating elements will be energized, and thermally-controlled, motor-operated means to determine the number of heating means that are energized.

As hereinbefore stated, the system embodying my invention is applicable to a wide variety of uses, and is effective to provide a control system wherein little or no energy is lost in the control devices proper. Control is effected by varying the number of heating elements energized and the length of time that the respective heating elements are so deenergized.

Various modifications may be made without departing from the spirit and scope of my invention, and all such modifications are intended to be covered by the appended claims which are to be limited only by the prior art.

I claim as my invention:

1. In a temperature control system, the combination with a plurality of heating means, and controlling means for the respective heating means, of temperature-controlled means for selectively energizing the controlling means for predetermined and variable lengths of time to maintain a substantially constant temperature.

2. In a temperature control system, the combination with a plurality of heating means, of means for controlling the energization of said heating means in predetermined sequence, and thermally-controlled motor actuated means for determining the number of heating means energized.

3. In a temperature control system, the combination with a plurality of heating means, of means for controlling the energization of said heating means in predetermined sequence and for predetermined lengths of time, and thermally-controlled means for determining the number of heating means energized.

4. In a temperature control system, the combination with a plurality of heating means, of means for controlling the energization of said heating means in predetermined sequence, and thermally-controlled motor-actuated means for determining the number of heating means energized.

5. In a temperature control system, the combination with a plurality of electric heating units, and electro-magnetic circuit-controlling means therefor, of means for controlling the energization of said circuit-controlling means, and motor-actuated, thermally-controlled means for determining the number of heating units energized.

6. In a temperature control system, the combination with a plurality of heating units, and electric circuit-controlling means therefor, of a motor-driven contact drum and means cooperating therewith for effecting energization and deenergization of said heating units for predetermined lengths of time, and motor-actuated means for moving said drum to vary the number of heating units energized and deenergized.

7. In a temperature control system, the combination with a plurality of heating units, and electric circuit-controlling means therefor, of a motor-driven contact drum having a peripherally-varying electric-conducting member thereon, contact members associated with the drum and electrically connected to the respective circuit controlling means, and thermally-controlled and motor-driven means for moving said drum relatively to said contact members to vary the number of heating units energized.

8. In a temperature control system, the combination with a plurality of heating units, of a drum controller for controlling the sequence of connections of said units and thermally-controlled motor actuated means for varying the number of heating units energized.

In testimony whereof, I have hereunto subscribed my name this 8th day of July, 1925.

STEPHEN A. STAEGE.