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S. A. STAEGE

DRYNESS CONTROLLER

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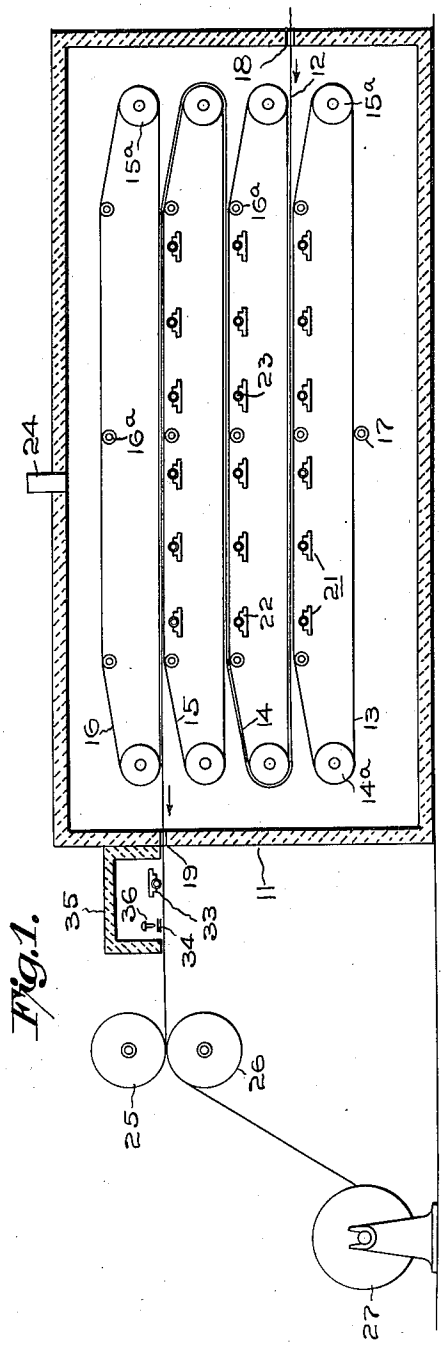


Fig. 1.

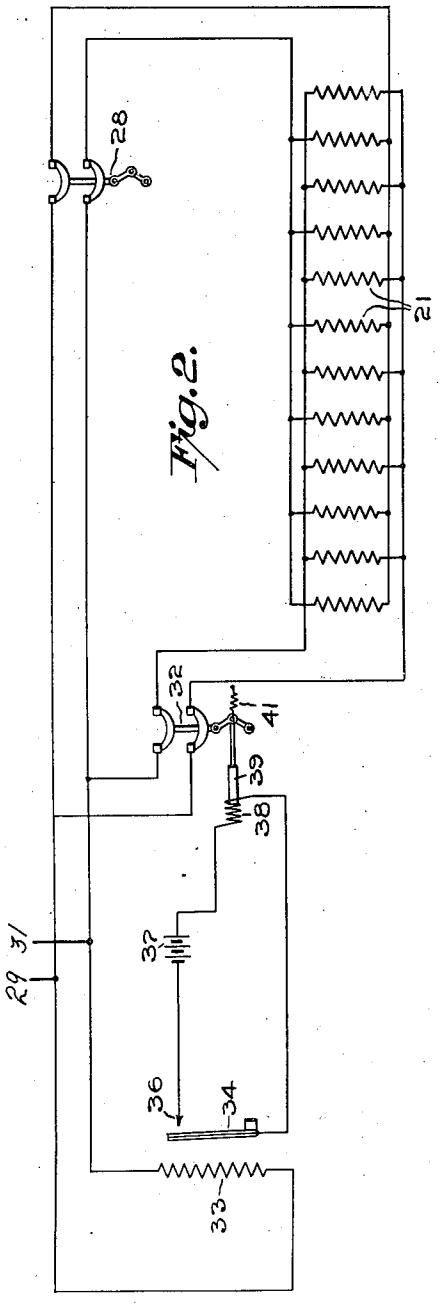


Fig. 2.

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UNITED STATES PATENT OFFICE.

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DRYNESS CONTROLLER.

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My invention relates to dryers and particularly to dryness controllers.

One object of my invention is to provide a relatively simple and inexpensive means for controlling the dryness of material in a dryer installation.

In practicing my invention, I provide a main heating means for drying a web of initially-wet material, an auxiliary heating means located in heat-interchanging relation to the leaving web, and a thermal means also located in heat-interchanging relation to the leaving web and effective to control the energization of the main heating means.

In the single sheet of drawings:

Figure 1 is a view, in vertical longitudinal section, of a system embodying my invention, and,

Fig. 2 is a schematic diagram of connections employed with the dryer illustrated in Fig. 1.

A dryer casing, designated by the numeral 11, comprises a heat-insulating casing of any suitable or desired construction that is of sufficient width, in lateral section, to permit of moving therethrough a web 12 of initially-wet material, such as paper. The dryer casing 11 is adapted to be located adjacent to the "wet end" of a paper-making machine. As the dryer and system embodying my invention may be employed with any type of paper machine, it is not thought necessary to illustrate or further describe this part of the mechanism.

Means for moving the initially-wet web of material 12 through the casing 11 comprises a plurality of endless wire belts 13, 14, 15 and 16 that are supported, at their respective ends, by rollers 14^a and 15^a. All of the rollers 14^a and 15^a are identical in construction and are supported by suitable bearing means (not shown) that may be supported by the side walls of the casing 11 or by frame work of structural steel that is built up inside of the casing 11.

Smaller roller members 16^a are provided to support the upper portions of each of the endless belts 13 to 16, inclusive, and one or more lower rollers 17 may be provided to support the lower part of the endless belt 13. The locations of the respective end rollers 14^a and 15^a and of the upper rollers 16^a are such that the upper portions of the lower endless belt and the lower portion of the superposed endless belt are located closely together and are supported by the smaller rollers 16^a.

The rollers and endless belts are caused to move in such manner that the web 12 is passed through the casing in a circuitous path, and, as shown in Fig. 1 of the drawing, the endless web has three passes in its movement through the casing 11. A relatively narrow entering slot 18 is provided at one end of the casing 11 and a leaving slot 19 is provided at the proper location to permit of the web 12 leaving the casing 11. While I have illustrated the web 12 as moving in an upward path, this is not essential and I may start the web at the upper portion of the casing and cause it to leave at the lower portion thereof, and any desired number of passes through the casing may be used.

Means for drying the initially-wet web of material comprises a plurality of heating elements 21 that are located between the upper and lower portions of the respective endless wires, with the exception of the upper wire. These heating means may embody a refractory resistor-supporting member 22 and a suitable resistor wire 23 mounted thereon and located in properly spaced relation relatively to, and beneath, the web of material 12.

As the particular construction and method of support of the individual electric heating elements 21 constitutes no part of my invention, no further detailed description thereof is given. It is essential that the heating elements extend laterally for the full width of the web of material and that they be spaced substantially uniformly.

In general, the drying of the initially-wet web of material is effected by causing the resistors 23 to be traversed by a suitable electric current that causes them to operate at a relatively high temperature and to transfer the largest part of the heat generated therein by direct radiation against not only the web of material but also against the endless belt. The web of material, is, therefore, dried not only by high-temperature radiant heat, but also by heat conducted thereto from the endless woven-wire belts.

As the temperature of the resistor members 23 may be as high as 1200° F., a very rapid drying action is obtained and the

water originally in the web of material when it enters the casing is quickly transformed into steam at 212° F. and is then heated to a much higher temperature, which temperature has been found by actual test to be in the neighborhood of 500° F. This means that the steam is in a dry and superheated condition and is, therefore, also effective to dry the web of material.

As the casing is substantially closed and as the dry superheated steam is generated within the casing itself, there will be a slight pressure within the casing over that existing in the air immediately surrounding the casing, and an outlet conduit 24 is provided in a suitable portion of the casing to permit the dry superheated steam to either flow out of the casing and through the conduit 24 into a suitable receiver for other use, or to permit a suitable suction means being connected to the conduit 24 to aid in removing the steam from the interior of the casing 11.

When the wet web of material 12 is a web of paper, such as news print, the amount of water in the web when it enters the casing 11 is substantially 70% of the total weight thereof and I have found it advisable to so effect the drying operation within the casing that the amount of moisture or water remaining in the web of paper when it leaves the casing through the leaving opening 19 is approximately 7% or less.

The leaving web of paper is led to a plurality of calender rolls 25 and 26 that are effective to impart a finish to the surface of the paper and it is then led to a suitable reel 27. As the calender rolls and the reel are old and well known in the art and constitute no part of my invention, they are illustrated schematically only and will not be further described.

The heating means 21 are illustrated schematically in Fig. 2 of the drawing as being divided into two groups or sets, one set being controlled through a suitable circuit breaker 28 from a supply circuit 29 and 31. The other set of heating elements 21 is energized through a circuit breaker 32 from the supply circuit 29 and 31.

Means for automatically controlling the supply of energy to the one group of heating elements through the circuit interrupting means 32 in accordance with the dryness of the leaving web of material, comprises an auxiliary heating element 33 and a thermostatic element 34 suitably located in a heat-insulated, open-bottom casing 35 that is located closely adjacent to the main casing 11 and in such position that the leaving web of material will move past the open side of the casing 35. Any desired method of supporting the heating element 33 and the thermostatic element 34 may be employed and I have illustrated them schematically only as the main consideration is that both the auxiliary heating element and the thermal means be located relatively closely adjacent to the leaving web of paper.

The thermostatic element 34 is provided with an adjustable contact member 36 which is connected to one terminal of a source 37 of electric energy. The other terminal of the source 37 is connected to one terminal of an actuating coil 38, the other terminal of which is connected to the fixed end of the thermostat 34. The circuit-interrupting device 32 has operatively connected thereto a core member 39 that is adapted to be energized by the coil 38 when the same is traversed by an electric current and to thereby cause the opening of the circuit-interrupting means 32.

If it be assumed that the electric heating elements in the casing 11 have been energized a sufficient length of time to bring all of the parts located within the casing 11 to the normal operating temperature, and if it be further assumed that the web of material 12 has been properly threaded through between the endless belts and that the drying operation has been so effected that the desired dryness of the leaving web is obtained, it may be assumed that the conditions of the electrical circuits are substantially as illustrated in Fig. 2 of the drawing, that is, both sets of heating elements 21 are being energized. If now, for any reason, the temperature within the casing should become too high, the immediate result would be that the web of material would be dried to too great an extent and the amount of heat that will be absorbed by the leaving web of material as it moves past the auxiliary heating element 33 in the open auxiliary casing 35 will become less. The thermostat 34 will, therefore, reach a higher temperature than heretofore, not only because the temperature of the leaving web of material is higher than it was but also because of the fact that the amount of heat absorbed by the leaving web of material from the auxiliary heating element 33 becomes less and the temperature of the interior of the auxiliary casing 35 rises.

When the temperature of the thermostatic element 34 has reached a predetermined higher value, the free end thereof will operatively engage the adjustable and normally fixed contact member 36, whereby the actuating coil 38 will be energized and cause a movement of the core member 39 which effects an opening of the circuit-interrupting means 32, whereby one set of the heating elements 21 is deenergized.

As soon as the heating elements 21 of one set have cooled sufficiently to reduce the temperature within the casing, the web of mate-

rial will be dried to a lesser degree, and the amount of heat that will be absorbed thereby from the auxiliary heating element 33 will again increase and this, together with the fact that the temperature of the leaving web is lower than theretofore will cause the thermostat 34 to be disengaged from the fixed contact member 36 which will cause deenergization of the actuating coil 38 and permit a spring member 41, operatively associated with the breaker 32, to again close the same and reenergize the second set of heating elements.

It is evident, of course, that the amount of heat which such a web of material can absorb will vary inversely with the dryness thereof or will vary directly with the moisture content thereof. While it is possible to employ the thermostat element 34 without the auxiliary heat 33, I am of the opinion that a more sensitive control device is obtained when the two members are employed simultaneously and when they are so located that they are in heat-interchanging relation to the leaving web of paper.

While I have illustrated and described a particular form of dryer and of cooperating heating means, the system embodying my invention is not limited thereto. It may be employed with equal success with other forms of dryers now in use and with other forms of heating means. It may, for instance, be employed with the present type of steam heated drum dryers and it is only necessary that the web of material move past the primary control means described as being located in the auxiliary casing.

Any desired means for controlling the amount of heat supplied to the dryer may be provided, such as varying the number of electric heating units that are energized, or varying the voltage supplied thereto, if electric heating means is employed, or varying the amount of heating fluid or its temperature, if steam is employed in dryer drums, or hot air to move past the web of paper.

Various modifications may be made in the device and system embodying my invention without departing from the spirit and scope thereof and all such modifications are intended to be covered by the appended claims.

I claim as my invention:

1. In a dryer system, the combination with heating means for drying an initially wet web of material, of an auxiliary heating means located in heat-interchanging relation to the dried web, and thermal means actuated in accordance with the amount of heat absorbed by said web from said auxiliary heater for controlling the heating means.

2. In a dryer system, the combination with a dryer casing, and heating means in said casing for drying an initially wet web of material passed therethrough, of an auxiliary open casing located outside of said casing and adjacent to the leaving web of material, an auxiliary heating means in said auxiliary casing in heat-interchanging relation with the web, and a thermal means in said auxiliary casing actuated in accordance with the amount of heat absorbed by said dried web from said auxiliary heating means for controlling said heating means.

3. In a dryer system, the combination with a main heating means for drying an initially wet web of material, of an auxiliary heating means located in heat, interchanging relation to the dried web, and a thermal means located in heat-interchanging relation to the leaving web and the auxiliary heating means and actuated in accordance with the heat from the auxiliary heater and with the amount of heat absorbed by said web from the auxiliary heating means for controlling the main heating means.

In testimony whereof, I have hereunto subscribed my name this 29th day of April, 1925.

STEPHEN A. STAEGE.