April 12, 1927. 1,624,371

S. A. STAEGE

DRYING MACHINE

Filed May 4, 1925

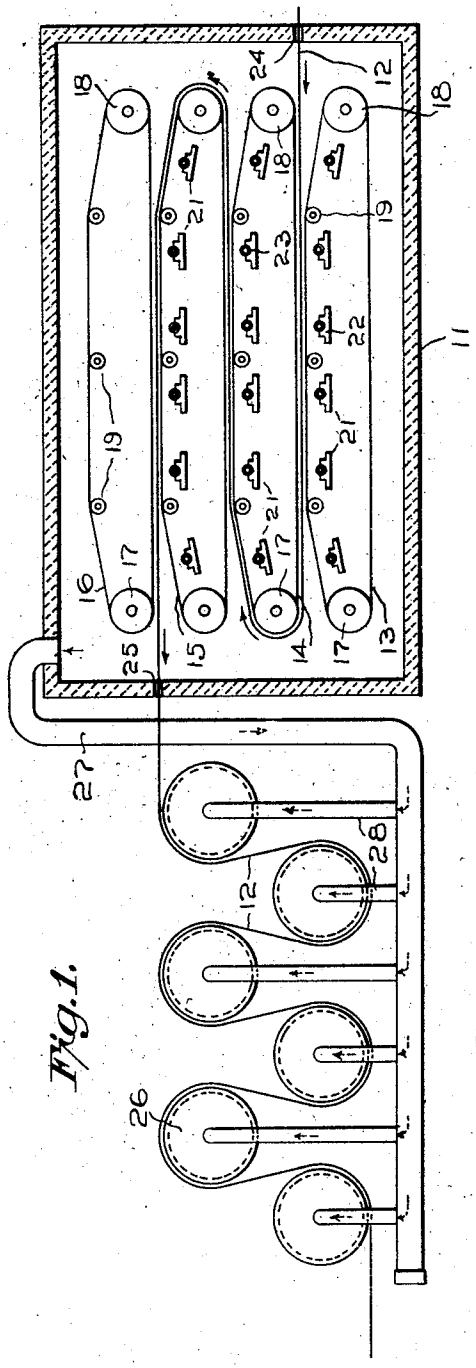


Fig. 1.

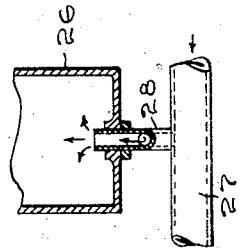


Fig. 3.

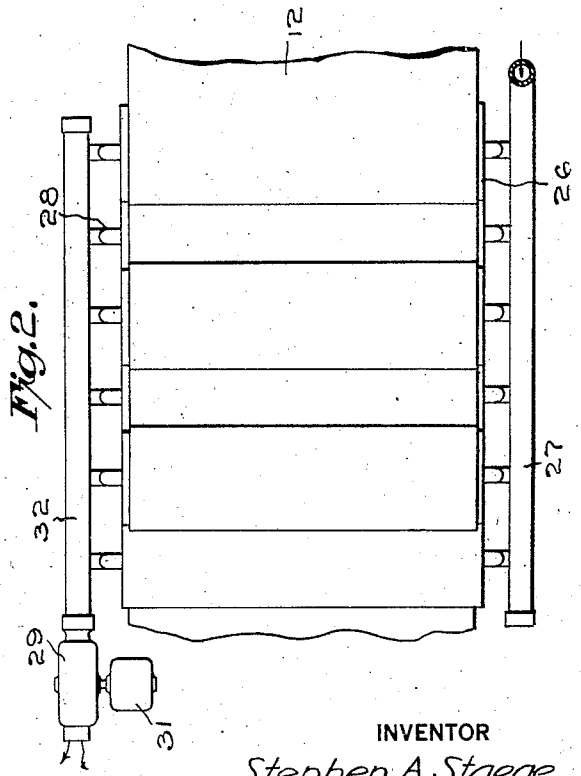


Fig. 2.

WITNESSES:

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UNITED STATES PATENT OFFICE.

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DRYING MACHINE.

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My invention relates to drying machines and particularly to means for drying a continuous web of material.

One object of my invention is to provide a drier system comprising a plurality of co-operating drier units.

Another object of my invention is to provide a drier system in which steam generated in one part of the drying operation is employed in another part of the operation as the source of heat for drying the web of material.

In practicing my invention, I provide a substantially enclosed drier casing through which the initially wet web of material is passed and having high-temperature heating means therein. The dry superheated steam generated in the drier casing is conducted into and through a plurality of drums which operatively engage the web of material.

In the single sheet of drawings,

Figure 1 is a view, partially in side elevation and partially in vertical longitudinal section, of a device embodying my invention,

Fig. 2 is a top plan view, of a portion of the assembly illustrated in Fig. 1 of the drawing, and

Fig. 3 is a fragmentary view, partially in plan and partially in horizontal section, of the device illustrated in Fig. 2.

My invention has reference more particularly to the drying of a continuous web of material such as paper. While the invention will be described in connection with such a use, it is not limited thereto.

A casing designated generally by the numeral 11, may be of any suitable or desired construction but is preferably made of heat-insulating material and is of such width, in lateral section, as to permit of passing a web 12 of initially-wet material therethrough, which web may be of any predetermined width in accordance with the ultimate use to which the web, such as news print, may be put. The structural features of the casing 11 constitute no part of my invention and I have, therefore, not illustrated them in detail.

Means for moving or conveying the web 12 through the casing 11 in a plurality of passes comprises a plurality of endless woven-wire belts 13, 14, 15 and 16, located one above another and each belt being supported by end rollers or drums 17 and 18, respectively. The endless belts 13 to 16 inclusive, and the rollers 17 and 18 are of the standard type usually employed in paper machine work and are illustrated generally only, as they form no part of my invention.

The rollers 17 and 18 are supported in any suitable or desired manner, either by the side walls of the casing or by structural steel means built up within the casing 11, as may be found necessary or desirable. Smaller intermediate roller members 19 are provided to support the upper portions of the endless belts 13 to 16 inclusive. The locations of the drums 17 and 18 and of the smaller rollers 19 are such that the upper portions of the respective endless belts are located closely adjacent to the lower portions of the belts located immediately thereabove, as is illustrated in Fig. 1 of the drawing.

Means for heating the interior of the casing and causing evaporation of the water or fluid contained in the initially-wet web of material 12 comprises a plurality of electric heating elements 21. The heating elements severally comprise a suitable refractory supporting member 22, of electric-insulating material, upon which suitable resistor members 23 are located, the construction being such that substantially all of the heat generated by the heating elements 21 is in the form of high-temperature radiant heat. To this end, I permit the elements 23 to be traversed by an electric current of such value that the resistors become radiant, whereby the greater part, if not all, of the heat, is transferred by radiation to the wet web of material and to the endless belts with which the web is in operative engagement.

As the temperature of the heating means is relatively high, up to approximately 1200° F., the water initially in the web of material is quickly heated to, and changed into, steam at 212° F., and is then further heated to a temperature that is in accordance with the amount of heat transformed into energy within the casing 11 and also in accordance with the amount of water that is subjected to the heat from the heating means. These elements are so co-ordinated that the web of material which may contain initially approximately 70% water, is dried to such an extent that it contains a much less percentage of water, and a portion of the water has been transformed into a dry superheated steam that is effective to pro-

duce a slight positive pressure within the casing.

A relatively narrow entering slot 24 is provided to permit the entrance of the web 12, and a similar leaving slot 25 is provided to permit the egress of the partially dried web of paper. While I have illustrated the web as entering the casing near the bottom thereof and leaving near the top thereof, this is not essential, as the points of entering and leaving may be reversed. It is to be noted also that the movements of the respective endless belts are such, relatively to each other, that those portions in substantially operative engagement with each other and the web of material supported and moved thereby will travel in the same direction.

A plurality of drums 26 are located in the path of travel of the web of material 12, and, as shown in Fig. 1 of the drawing, the drums 26 may be located back of the casing 11 relatively to the travel of the web 12, so that the web 12 will operatively engage a portion of each of the drums 26, which are located in two layers, whereby further drying of the web will be effected if the drums are heated.

The heating of the drums 26 is effected by the dry superheated steam generated in the casing 11 by the action of the relatively high-temperature heating units 21, as was hereinbefore described, which steam is conducted through a conduit 27 connected to the casing 11 into and through the hollow drums 26 through suitable branch conduits 28.

The construction and mounting of the rotatable steam drums 26 is well known in the art, and hence no details are shown of this part of the construction. As hereinbefore noted, the dry superheated steam generated within the casing 11 is under a slight pressure by reason of the fact that the casing 11 is substantially enclosed and that the heating means is located directly within the casing and does not employ air for its operation. Hence, it is possible to cause steam to traverse the conduit 27, the branch conduits 28 and into and through the drums 26 without any additional means. However, if necessary, I provide a suction fan 29 that may be driven by a suitable electric motor 31. The suction means 29 is connected to a collecting conduit 32 on the other side of the steam drums 26. The fragmentary view, shown in Fig. 3, is intended merely to illustrate the general construction of the conduits and the respective hollow drums and to illustrate the flow of steam therethrough.

At the present time, substantially all of the paper machines in operation employ either a plurality of steam-heated drums 26 or a single very large steam heated drum, with the external surface of which the moving web of material is in operative engagement to be dried thereby. The steam is generated in any suitable or desired manner, as in steam boilers heated by coal or gas, or in electric steam boilers. I prefer to so dimension the various parts of the electrically heated drier unit that the amount of steam generated within the casing by a transformation of a part of the water or fluid in the initially wet web of material into steam is just sufficient to complete the drying operation when it is conducted into and through the hollow drums 26. This means that the amount of electrical energy transformed into heat in the casing 11 must be coordinated with the speed of the initially wet web of material and with the fluid contents thereof when entering the casing in order that the above suggested balance may be maintained within proper limits in the ordinary course of operation.

It is possible to introduce such an electrically heated drier casing into paper machines that are already in operation and that employ steam-heated drums for drying. It may be necessary, in such a case, that the drier casing be located below the floor level upon which the present paper machine is located and that the location and arrangement of the means for moving the web of material through the casing be varied in accordance with the path of travel prescribed by the general arrangement of the present already installed machine. The electrically heated drier unit may be located either ahead of the steam drum unit or back of it, relatively to the travel of the web, as may be desired or suitable.

It may be noted that the device embodying my invention provides a means for partially drying an initially-wet web of material, transforming the fluid into a relatively dry and superheated steam and then immediately using the steam thus generated in another type of drier, the web of material being completely dried by the two co-operating units.

The web of material is led through suitable calender rolls and to suitable reeling devices, after leaving the drums 26, but, as these devices are old and well known in the art, they are not illustrated or described.

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 drier system, the combination with a plurality of drier drums, of an auxiliary drier unit, heating means therein for transforming a part of the water in said web into steam, and means for conducting said steam into and through said drums to heat the same.

2. In a drier system, the combination with a plurality of drier drums, of an auxiliary drier unit, high-temperature heating means therein for transforming a part of the fluid in said web into dry superheated vapor, and means for conducting said vapor into said drums to heat the same.

3. In a drier system, the combination with a plurality of drums for operatively engaging a web of material to dry the same, of an auxiliary drier unit for effecting a partial drying of said web, high temperature heating means in said drier unit for transforming the water in said web into dry superheated steam, and means for conducting the steam from the auxiliary drier unit into and through said drums to heat the same.

4. In a drier system, the combination with a plurality of rotatable drums for operatively engaging a web of material to be dried, of an auxiliary, substantially enclosed, drier casing located in the path of said web, high temperature electric heating means in said casing for transforming a portion of the water in said web into dry superheated steam, and means for conducting said steam into and through said drums to heat the same.

5. In a drier system, the combination with a plurality of rotatable drums for operatively engaging an initially wet web of material to be dried, of an auxiliary drier casing, means for moving said web through said drier casing, means in said drier casing for transforming a part of the water in said web into dry superheated steam, and means for conducting the steam into said drums to heat the same and to dry the web.

6. In a drier system, in combination, a substantially enclosed drier casing, means for moving an initially wet web of material through said casing, a plurality of rotatable drums for operatively engaging said web of material, heating means in said casing for transforming a part of the water in said web into dry superheated steam, and means for conducting said steam into and through said drums to heat the same.

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

STEPHEN A. STAEGE.