T. F. PINDER.

DRYING MACHINE.

APPLICATION FILED JUNE 7, 1921.

1,432,729.

Patented Oct. 17, 1922.

2 SHEETS—SHEET 1.

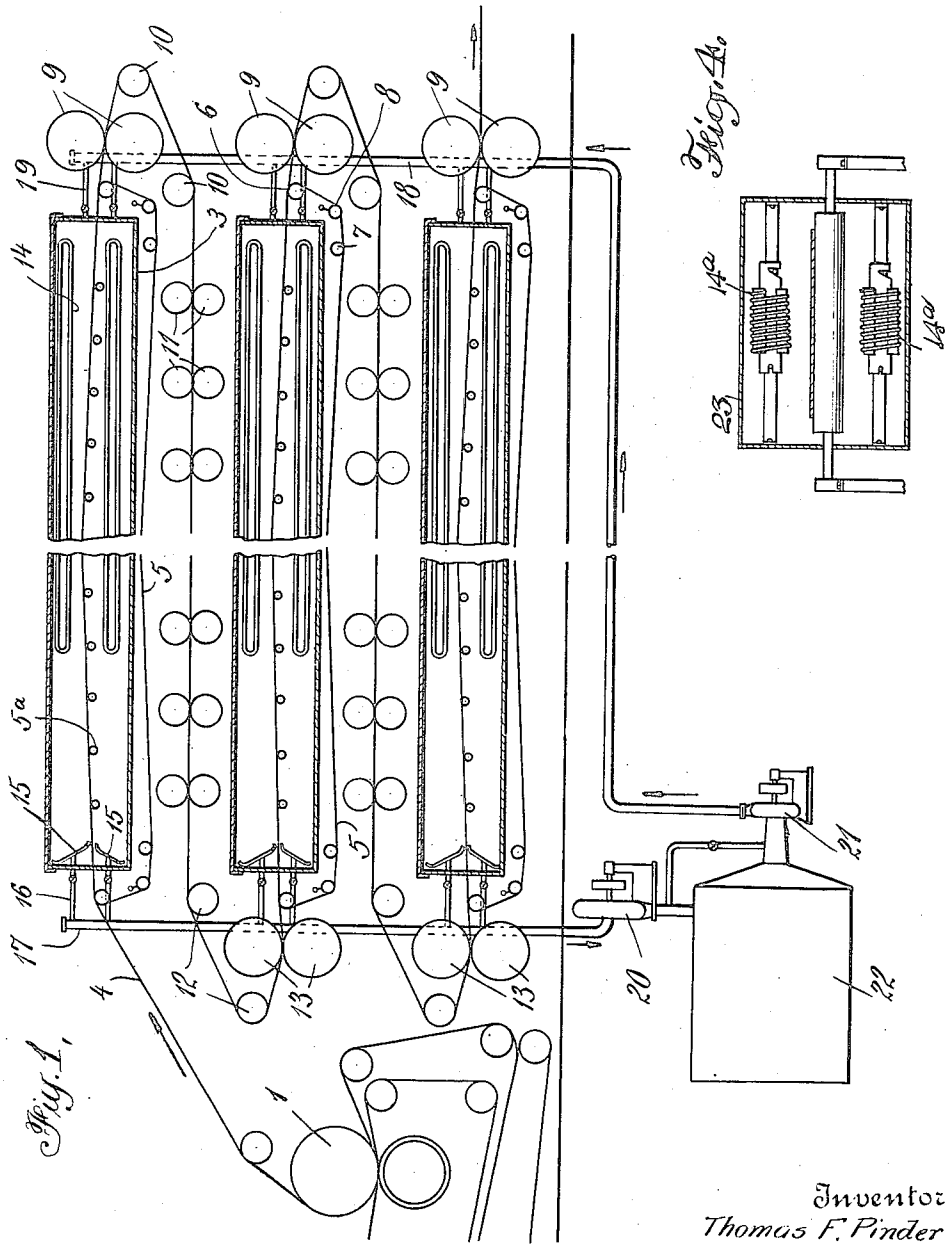


Fig. 1.

Fig. 4.

Inventor
Thomas F. Pinder

By his Attorneys
Penne Davis Marvin & Edmonds

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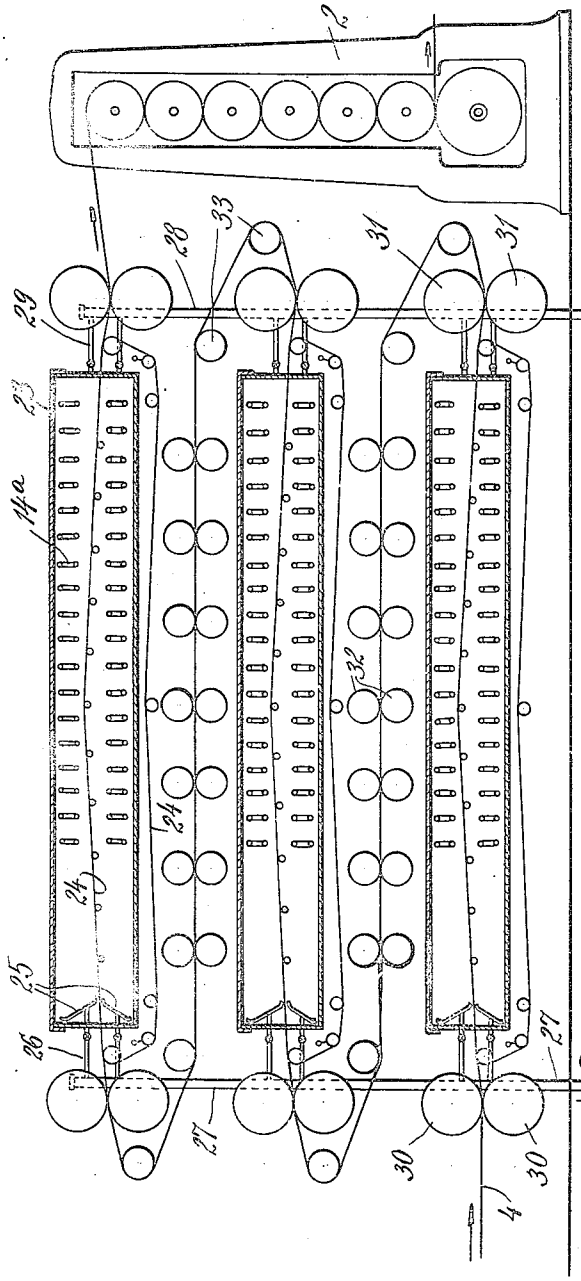


Fig. 2.

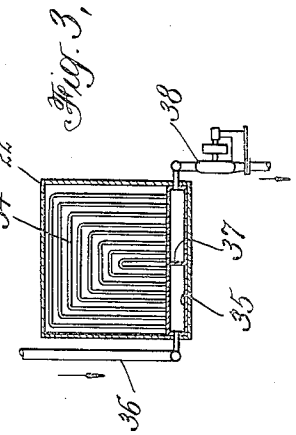


Fig. 3.

Inventor

Thomas F. Pinder

By his Attorneys

Pennie Davis Marvin & Edmonds

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UNITED STATES PATENT OFFICE.

THOMAS FENN PINDER, OF ARDMORE, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CHARLES C. ORCUTT.

DRYING MACHINE.

Application filed June 7, 1921. Serial No. 475,795.

To all whom it may concern:

Be it known that I, THOMAS F. PINDER, a citizen of the United States, residing at Ardmore, in the county of Montgomery, State of Pennsylvania, have invented certain new and useful Improvements in Drying Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention is an improvement in drying machines, and relates especially to an improved machine for drying paper and the like as it passes from the wet end of a paper making machine, as for instance a Fourdrinier machine. In machines of the character in question, now in use, the formed web is drawn over heated cylinders to dry the same, the opposite faces of the web being alternately engaged with the cylinders. When the web is in contact with the cylinders, the moisture is evaporated rapidly, and is in part condensed by the cooler air at the opposite face of the web, and at portions of the web adjacent to the cylinder, but out of contact therewith. Thus the opposite faces of the web are exposed in alternation to high temperatures with low humidity, and to lower temperatures with high humidity, that is to periods of intense drying, alternating with periods of cooling and moistening.

The object of the present invention is to provide a machine of the character specified, by means of which the opposite faces of the web may be dried at a substantially uniform temperature, in an atmosphere having a substantially constant moisture content, regardless of the quantity evaporated from the web, and wherein the drying action is steadily progressive from the inlet to the outlet end of the machine.

Another object is to provide a dryer composed of sections, independently heated, each having means for circulating dry air along the faces of the web in the opposite direction to its travel, to remove the vapor as it forms, and wherein the section at the dry end of the machine is heated by electrically controlled units, so arranged that the temperature of the section may be nicely controlled in accordance with conditions.

Another object is to provide means in connection with the dryer for pressing and ironing the web during the drying thereof, to impart to the dried web a semi-finish, a plurality of such means being provided, and arranged to act upon the web as it passes from one dryer unit to another.

In the drawings;

Figures 1 and 2, taken together, constitute a diagrammatic view of the improved machine, with parts in section,

Figure 3 is a section on the line 3—3 of Figure 2.

Fig. 4 is a transverse section of a unit casing.

In the embodiment of the invention shown in the drawings the improved dryer is composed of two sections, that adjacent to the wet end of the paper making machine indicated at 1 being steam controlled, while that remote from the paper machine and adjacent to the calender rolls indicated at 2, is electrically controlled. The sections of the machine shown in Figure 1 is composed of a series of dryer units, three in the present instance, each consisting of a closed casing 3 having in its ends passages for permitting the entrance and exit of the paper web to be dried, indicated at 4.

The web is supported and guided through the machine in any suitable manner, as for instance by an endless belt 5 of foraminous material, of the character shown and described in application, Serial No. 434.231, filed December 31, 1920. The upper run of the belt passes through the casing, at approximately the center, being supported by rollers 5^a and the rollers are so arranged that an arched formation, longitudinally of the casing, is imparted to the web, as it passes through the casing. Outside the casing the belt is supported by rollers 6, 7 and 8, the rollers 6 being at the ends of the casings and in alinement with the inlet and outlet passages, while the rollers 7 are beneath the casing, near the ends thereof. The rollers 8 are tension rollers, being supported by swingably mounted arms, the said rollers resting by gravity on the belt to tension, the same. The units of the sections are arranged one above the other, as shown in Figure 1, and the web to be dried passes through the casings in the same direction, namely from left to right. From the paper making machine 1, which may be a Fourdrinier, machine, the web passes through the first unit of the section.

As it emerges from this unit, the web passes between a pair of pressing and ironing rollers 9, and thence over guide rollers 10 to pairs of rollers 11, arranged between the first unit of the series and the succeeding unit. The web passes between the members of the pairs, and these rollers assist in finishing the web, and they may also be heated if desired, to assist in drying the web. After the web leaves the rollers 11, it passes over guide rollers 12, and between another pair of pressing and ironing rollers 13, similar to the rollers 9. The succeeding units are precisely like the first unit, pressing and ironing rollers 9 being arranged at the outlet ends of the casings, while pressing and ironing rollers 13 are arranged at the inlet ends. Each unit has a supporting belt for the web, and heating means indicated at 14 are arranged in the casings, the said heating means being steam pipes in the present instance. It will be noticed that a heating means is arranged at each face of the web, one of the said means being above the web and one below the web, and the said means are at that end of the casing having the outlet for the paper web. The heating pipes in the present instance extend from the said end approximately two-thirds the length of the unit, and at the opposite end there is arranged means for withdrawing the vapor from the casing as it forms, to insure a circulation of dry air through the unit.

The means for withdrawing the air comprises nozzles 15, the said nozzles being arranged above and below the web, and each nozzle is connected by a valved pipe 16, with a collector pipe 17 at the end of the section. Dry air is supplied to the units at the opposite ends from the nozzles by a header pipe 18, which communicates with the casings above and below the web, by means of valved controlled branch pipes 19. The vapor laden air is withdrawn from the units, and dry air is supplied thereto, by means of fans or pumps 20 and 21, the pump 20 being connected with the collector pipe 17, while the pump 21 is connected with the header pipe 18. Dry air may be preheated by the vapor laden air, by the mechanism indicated generally at 22, and shown in detail in Figures 2 and 3.

The section shown in Figure 2, is also composed of a series of units, three in the present instance, closely resembling those of Figure 1. Each unit consists of a casing 23, having at one end an inlet passage for the web 4, and at the other an outlet passage, and the web is supported in its passage by a belt 24 of foraminous material, similar to the belts 5, and similarly supported. The vapor laden air is withdrawn from the units by means of nozzles 25, communicating by valved pipes 26, with a collector pipe 27, and dry air is supplied by a header pipe 28, communicating with the units by valved branch pipes 29. The nozzles 25 are arranged above and below the web, as are also the branches 29, the arrangement of the support for the belt, and the means for withdrawing and supplying air being precisely the same as shown in Figure 1. The heaters of the dryer units are electrically controlled. A series of heating units 14ª is arranged at each face of the web, one series being above the web and the other below. The units are of the character shown in application, Serial No. 434,231, filed December 31, 1920, and may be similarly supported in the casing. They are connected to the circuit in such manner, that the heat may be nicely regulated, and the units are grouped at the inlet end of the casing, corresponding in arrangement to that of the heating pipes in Figure 1. Pairs of pressing and ironing rollers 30 and 31 are arranged adjacent to each unit, the rollers 30 being at the inlet ends of the units, while the rollers 31 are at the outlet ends. Between the casings the web is supported by pairs of rollers 32, corresponding to the rollers 11 of Figure 1, and the web is guided by direction elements 33, in the form of rollers, corresponding to the rollers 10 and 12 of Figure 1. In Figure 1 the web enters first the topmost dryer unit, and passes through the units in succession. In Figure 2, the web enters the lowermost unit, this unit being in substantial alinement with the lowermost unit of Figure 1, from which the web emerges. From the topmost unit of Figure 2, the web passes to the calendering mechanism 2. Fans or pumps 20 and 21 are connected with the pipes 27 and 28, and if desired mechanism for preheating the fresh air by means of the vapor laden air withdrawn may be connected with either or both sections.

Such mechanism is shown in Figures 2 and 3, wherein the preheater comprises the casing 22 having one end open, and the other end funnel shaped, and communicating with the fan 21 at its axis. A series of coils 34 is arranged in the casing 22, the said coils being U shaped as shown, and communicating at their lower ends with an auxiliary casing 35 in the casing 22. The vapor laden air discharged by the fan 20, passes by way of a pipe 36 into the auxiliary casing 35. This casing has a longitudinally extending partition 37 dividing it into two compartments, and the arms of the coils 34 communicate with the compartments, one arm of each coil connecting with a compartment. The pipe 36 is connected with one of the compartments, and a fan or pump 38 is connected with the other. The air discharged by the fan 20 passes into one compartment, through the coils to the other compartment, and is withdrawn by the fan or pump 38. The air entering the casing 22 passes over

the coils heated by the vapor laden air, and is preheated and dried before being delivered to the heater units. The fans 20, 21 and 38 may be driven in any suitable or desired manner.

In operation, the material to be dried, which is usually in the form of a continuous web, and may be of paper, felt, or the like, passes from the web forming mechanism to the topmost unit of the first section. The heated air within the casing, heated by the steam coils, has free access to both faces of the web, and this air is continuously changing, being withdrawn as it becomes vapor laden, to be replaced by fresh, dry, preheated air. As the web leaves the unit, it is subjected to the pressing and ironing action of the rollers 9, and of the rollers 11. The web now enters the second unit, and the process is repeated. As many units may be used in each section as may be desired, or found necessary, and as the web leaves the last unit, it passes to the second section, which has electrically controlled heating units, permitting a more accurate, uniform and closer control of the temperature. The formed and partially dried web enters the lowermost unit in the second section, and the drying, pressing and ironing of the web is continued throughout the series of units. The dried and semi-finished web then passes to the calendering mechanism. In each unit both faces of the web are subjected to the action of dry, heated air, constantly changing, and there is no recondensation of the moisture evaporated from the web. The heating mechanism is within the dryer units, and the air is heated as it enters the units, passing longitudinally of the units to be withdrawn as it becomes laden with vapor.

I claim.

1. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms.

2. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry and preheated air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms.

3. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms, the units of the last section having electrically controlled heating units.

4. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms, the heating means of the units being at the inlet ends thereof.

5. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms, and means between the adjacent units for pressing the web to impart a semi-finish thereto when dry.

6. A paper drying machine, comprising a plurality of sections, each composed of a plurality of dryer units, means for supporting and guiding the web to be dried through the units of the sections in succession, and means for circulating a current of dry air through the units of the sections in the opposite direction to the travel of the web, to remove the vapor as it forms, and means between the units for imparting a semi-finish to the dry web.

7. A drying machine comprising a plurality of sections, each composed of a series of dryer units, means for supporting and guiding a web to be dried through the units in succession, means for circulating a current of dry air through the units at the opposite faces of the web, and in the opposite direction to the travel of the web, and heating means for the units grouped near the inlet end for the air.

8. A drying machine comprising a plurality of sections, each composed of a series of dryer units, means for supporting and guiding a web to be dried through the units in succession, means for circulating a current of dry air through the units at the opposite faces of the web and in the opposite direction to the travel of the web, heating means for the units grouped near the inlet end for the air, and means heated by the vapor removed from the machine for drying and preheating the incoming air.

9. A drying machine comprising a plurality of sections, each composed of a series of dryer units, means for supporting and guiding a web to be dried through the units in succession, means for circulating a cur-

rent of dry air through the units at the opposite faces of the web and in the opposite direction to the travel of the web, and heating means for the units grouped near the inlet end for the air, the section of the dryer at the dry end of the machine having electrically controlled heating units.

10. In a paper drying machine, a dryer unit comprising a casing, means for supporting and guiding a web to be dried through the casing, means for circulating a current of dry air through the casing in the opposite direction to the travel of the web, and means near the inlet end of the casing and at the opposite faces of the web for heating the air.

11. In a machine for drying a formed web, a series of dryer units, means for supporting and guiding the web through the units in succession, and means between adjacent units for imparting a semi-finish to the dried web.

12. In a machine for drying a formed web, a series of dryer units, means for supporting and guiding the web through the units in succession, and means between adjacent units for imparting a semi-finish to the dried web, said means comprising pairs of pressing and ironing rollers between which the web passes.

13. A drying machine comprising a plurality of sections each composed of a series of units, means for supporting and guiding the web to be dried through the units in succession, electrically controlled heating means for the units of one section, and vapor controlled heating means for the units of the other section.

14. A drying machine comprising a plurality of sections each composed of a series of units, means for supporting and guiding the web to be dried through the units in succession, electrically controlled heating means for the units of one section, and vapor controlled heating means for the units of the other section, the section having the vapor controlled heating means being in advance of the section having the electrically controlled heating means.

In testimony whereof I affix my signature.

THOMAS FENN PINDER.