B. R. ANDREWS.

DRYING APPARATUS.

APPLICATION FILED JULY 8, 1920.

1,373,396.

Patented Apr. 5, 1921.

2 SHEETS—SHEET 1.

Fig. 1.

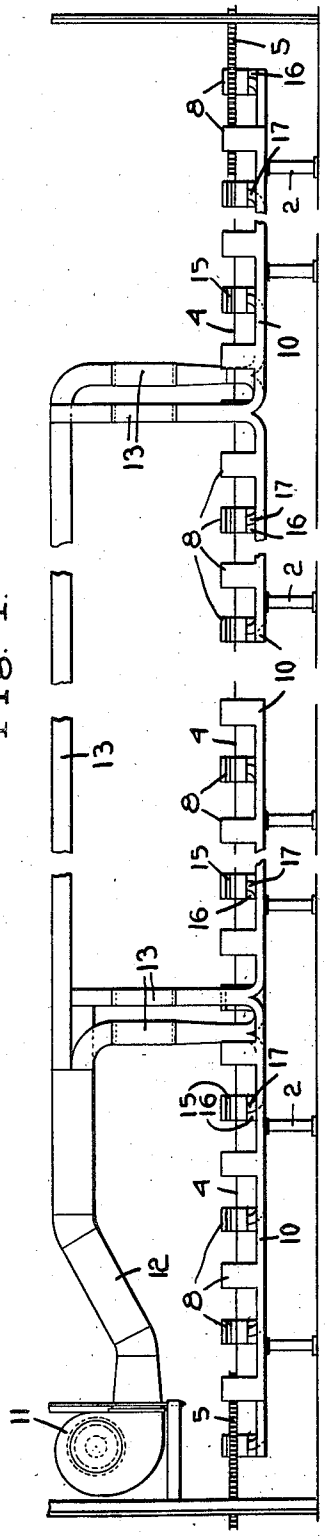
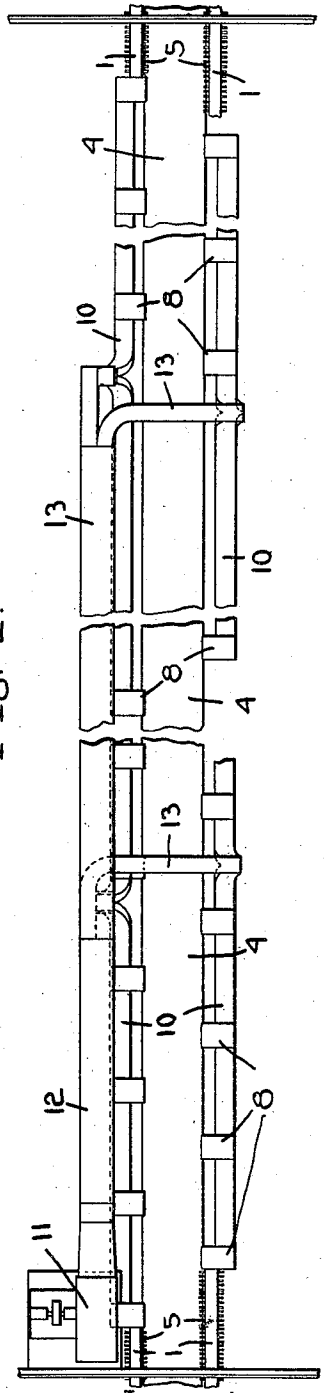


Fig. 2.



Inventor.

Bernard R. Andrews

by Heard Smith & Tennant.

Attys.

B. R. ANDREWS.

DRYING APPARATUS.

APPLICATION FILED JULY 8, 1920.

1,373,396.

Patented Apr. 5, 1921.

2 SHEETS—SHEET 2.

Fig. 3.

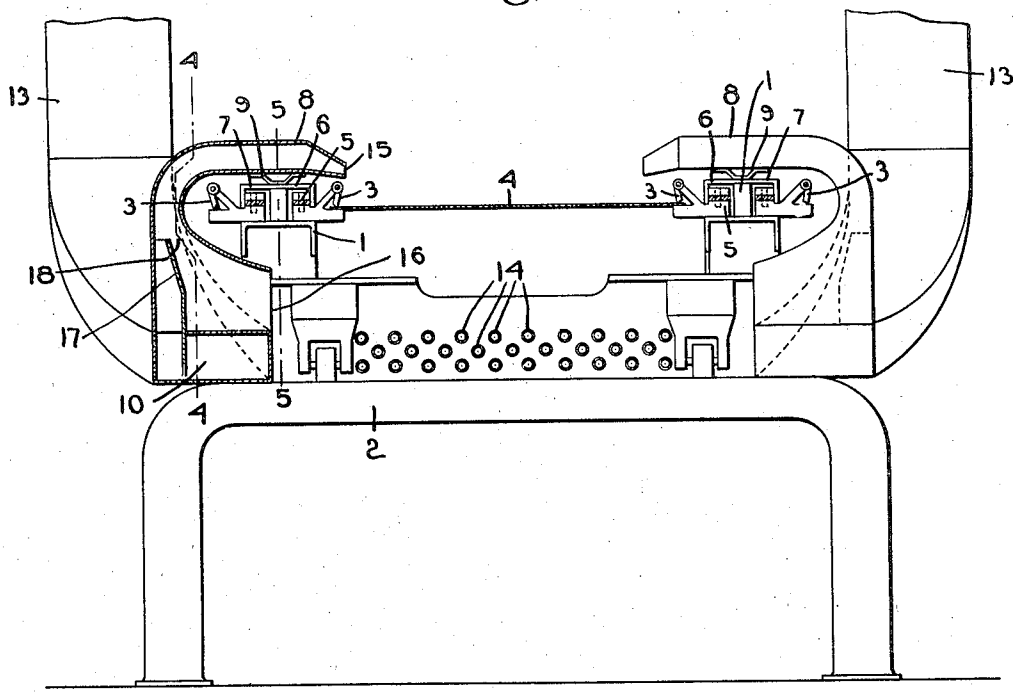


Fig. 4.

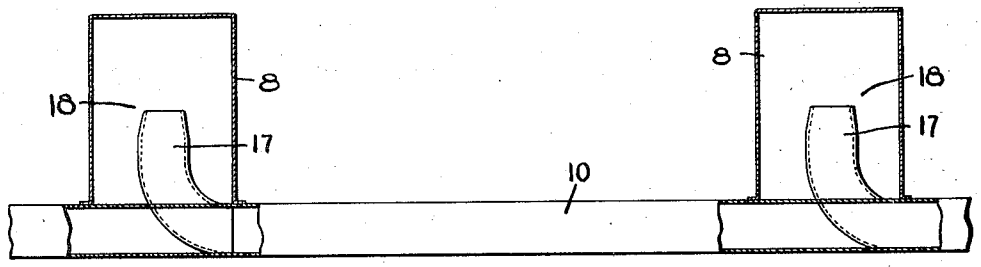
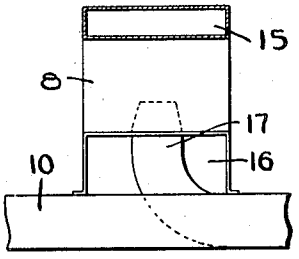


Fig. 5.



Inventor.
Bernard R. Andrews
by Heard Smith & Tennant.
Attys.

UNITED STATES PATENT OFFICE.

BERNARD R. ANDREWS, OF BRAINTREE, MASSACHUSETTS.

DRYING APPARATUS.

1,373,396. Specification of Letters Patent. Patented Apr. 5, 1921.

Application filed July 8, 1920. Serial No. 394,715.

To all whom it may concern:

Be it known that I, BERNARD R. ANDREWS, a citizen of the United States, residing at Braintree, county of Norfolk, State of Massachusetts, have invented an Improvement in Drying Apparatus, of which the following description, in connection with the accompanying drawing, is a specification, like characters on the drawing representing like parts.

This invention relates to drying apparatus constructed to dry sheet material, and it has for its objects to provide a novel drying apparatus by which the drying operation can be greatly facilitated; to provide a drying apparatus which is especially adapted for drying long strips of sheet material; to provide a novel form of drier which is arranged to act on a long strip of sheet material in horizontal position and is constructed to heat the under side of said sheet material and at the same time to deliver drying currents of air to the upper side; to provide a drier which operates in this way without the necessity of conveying all the heated air through long pipes, and otherwise to improve drying apparatus of this type, all as will be more fully hereinafter set forth.

My invention is capable of use for drying sheet material of various kinds, and is especially useful in drying long strips of sheet material when they are placed in a horizontal position. While, as stated above, the invention is capable of being used to dry sheet material of various kinds, yet for the purposes of disclosing the principle and operation of the invention, I have chosen to illustrate it as it would be used in drying sheet material in the form of cloth stretched on a tenter frame. I wish to state, however, that this is merely illustrative of the operation of the invention and that the latter is by no means confined to the drying of cloth.

Figure 1 is a side view of a tenter-frame having my improvements applied thereto with portions broken out;

Fig. 2 is a top plan view with portions broken out;

Fig. 3 is an enlarged sectional view taken transversely through Fig. 1.

Fig. 4 is a section on the line 4—4, Fig. 3.

Fig. 5 is a section on the line 5—5, Fig. 3.

The tenter-frame itself may have any suitable or usual construction. It comprises two longitudinally-extending guiding members 1 which are supported at appropriate intervals on suitable supports 2, and each of which forms a guideway for an endless-chain device 5 provided with grippers 3 to engage the edge of the cloth 4. Each guiding member 1 is provided with two guideways 6 and 7, each guideway receiving one run of the endless-chain device, and as the endless-chain devices are operated, the grippers 3 are moved forwardly along the inside of the guiding member 1 and then returned on the outside thereof. As is well-known to those skilled in the art, the grippers 3 engage the edges of the cloth 4 and hold it stretched while it is being carried the length of the tenter-frame. The cloth 4 is the sheet material to be dried.

The parts thus far described are or may be all as usual in tenter-frames and form no part of my present invention which relates to means for drying the cloth while it is thus held stretched and is being moved longitudinally of the tenter-frame.

In the treatment of cloth in a tenter-frame it is customary to apply some suitable stiffening or sizing material to the cloth before it is passed through the tenter-frame, and it is also customary to provide means for drying the cloth while it is stretched in the tenter-frame, the sizing or stiffening compound operating to hold the cloth in its stretched condition after it has become dried.

The speed with which the cloth can be passed through the tenter-frame depends upon the efficiency of the drying operation, and one of the objects of my present invention is to provide a novel drying apparatus which when applied to the drying of sheet material in the form of cloth stretched on a tenter-frame enables the drying operation to be greatly facilitated, thus providing for the cloth being moved faster through the tenter-frame or enabling a shorter tenter-frame to be used. To secure this object, I provide means for heating one side of the sheet material (which in this embodiment of the invention is the cloth 4), thereby causing evaporation of moisture therein, and means to take a portion of the heated air from said side of the sheet material and deliver it onto the other side thereof. This heated air which is thus delivered onto said other side is preferably delivered so as to pass across the sheet material in a direction transversely

thereto, but the particular direction in which it is thrown onto the sheet material is not so important. For many reasons I find it most convenient to place the heater beneath the cloth or other sheet material so that the cloth is heated from the under side and to take some of the heated air from beneath the cloth and deliver it onto the top of the cloth.

The heater which I will preferably employ for the purpose of heating one side of the cloth or other sheet material is in the form of steam pipes 14 which in the embodiment of the invention shown are suitably supported on the tenter-frame and are located an appropriate distance directly beneath the cloth 4. These steam pipes serve to heat the air beneath the cloth and also to heat the cloth.

In order to withdraw from beneath the cloth some of the air heated by the steam pipes and deliver it onto the top of the cloth, I provide a plurality of nozzle-like elements 8, each having a delivery opening 15 situated above the cloth at one side thereof and constructed to deliver a current of air downwardly onto the cloth and in an inclined direction transversely of the width of the cloth so that the air delivered from the nozzle will strike the cloth and spread out on the surface thereof and pass across the top of the cloth in a transverse direction. Each nozzle element 8 has a general C-shape and embraces the guiding element 1. The lower end of the nozzle element has the open side 16 directed toward the steam pipes 14, and suitable means are provided for drawing heated air through this opening 16 and forcing it through the nozzle and delivering it through the end 15 thereof onto the upper side of the cloth.

I propose to use a plurality of nozzle elements 8 on each side of the tenter-frame, and to place them as closely together as may be necessary to accomplish the desired object. I also propose to place the nozzle elements on opposite sides of the frame in staggered relation so that those on one side are situated between those on the other side. In this way as the cloth passes longitudinally of the tenter-frame, it will be subjected to drying currents directed in both directions and any particular portion of cloth will be subjected to successive currents of air passing first in one direction and then in the other.

The steam pipes 14 thus provide the heat necessary to heat the cloth and also provide the heat for heating the current of air which is delivered across the top of the cloth.

In order to provide for withdrawing the heated air from beneath the cloth and delivering it through the nozzles 8 onto the top of the cloth, I propose to employ an apparatus somewhat on the order of an injector. Each nozzle 8 has associated therewith a supplementary nozzle 17 which is situated above the opening 16, as shown in Fig. 3, and means are provided for delivering air under pressure through these supplementary nozzles 17, thereby creating a suction at the point 18 which will operate to draw the heated air through the opening 16.

This heated air becomes commingled with the air jet issuing from the supplementary nozzle 17 and the two air currents thus commingled are delivered from the end 15 of the nozzle onto the top of the cloth. The various supplementary nozzles 17 are connected to conduits 10 which in turn are connected to a suitable air-forcing mechanism by which air under pressure may be forced through the conduit. Such air-forcing mechanism is indicated as a fan 11 located at some suitable point and this fan has a delivery pipe 12 which is provided with branches 13 leading to the various conduits 10. The operation of the air-forcing device 11, therefore, will result in delivering air under pressure through the various nozzles 17 thereby creating the suction at 18 which draws the heated air through the openings 16 and forces said air onto the top of the cloth through the delivery end 15 of the nozzle. It will be noted that the heated air which is taken from beneath the cloth only has to travel from the opening 16 around to the end of the nozzle so that there is practically no chance for loss of heat by radiation. The air which is delivered through the air-forcing device and pipes 12, 13 and 10, may be non-heated air, or may be heated more or less as desired. The air-forcing apparatus 11 may be constructed to deliver a relatively small volume of air under high pressure, and this air under relatively high pressure issuing from the nozzle 17 results in delivering a larger volume of heated air from the nozzles 8. Since the heated air has a small distance to travel, the loss from radiation will be negligible compared with what it would be if all the heated air were carried through long conduits.

This method of drying sheet material by heating the sheet material from one side and then directing a heated air current against the other side thereof is an extremely effective method, and with the apparatus herein shown, the same heating element which is used for heating the sheet material also provides the heated air to be delivered against the sheet material.

It will be noted that the nozzles 8 are situated entirely outside of the edge of the cloth. This is a decided advantage because no part of the drier is placed above the cloth, and, therefore, there is no possibility of the cloth being soiled by anything drop-

ping or dripping from the drying apparatus.

The device is simple and can be readily applied to any tenter frame.

While the invention is herein shown as operating to dry sheet material while in a horizontal position, yet it is not essential that the sheet material should be thus placed so long as means are provided for heating one side of the sheet material and then taking some of the heated air from said side and delivering it onto the other side of the sheet material. Neither is it necessary that the underside of the sheet material should be the side which is heated, as the invention might be embodied in apparatus adapted to heat either side of sheet material. Furthermore, while the sheet material which is shown and described in the illustrated embodiment of my invention is cloth supported on a tenter-frame, yet the invention is adapted for use with drying sheet material of various kinds supported in various ways. Therefore, I do not wish to be limited to the use of the invention in connection with a tenter-frame.

Any suitable means may be provided for supporting the nozzles 8 in their proper position. I have herein shown rests or supports 9 which are secured to the guiding members 1 and on which the nozzles are sustained, said nozzles being secured to the rests in any appropriate way.

I claim:

1. In apparatus for drying sheet material, the combination with means for holding sheet material, of means to heat one side of said sheet material, and means to take heated air from said side of the sheet material and deliver it onto the other side thereof.

2. In a drying apparatus, the combination with means for holding sheet material, of a heater adjacent one side of said sheet material for heating the latter, and means to take heated air from said side of the sheet material and deliver it onto and cause it to pass across the other side of said sheet material.

3. In a drying apparatus, the combination with means for holding cloth stretched, of a heater beneath the cloth for heating the latter, means to take heated air from beneath the cloth and deliver it onto the upper side thereof in a direction transversely thereto.

4. In a drying apparatus, the combination with means for holding cloth stretched, of a heater beneath the cloth for heating the latter, means to take heated air from beneath the cloth and deliver it onto the upper side thereof adjacent the edge of the cloth in a downwardly-inclined direction transversely of the cloth.

5. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements situated outside of the line of travel of the cloth and each constructed to take air heated by the heater and deliver said air onto the top of the cloth.

6. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements situated outside of the line of travel of the cloth and each constructed to take air heated by the heater and deliver said air onto the top of the cloth in a direction transverse to the length of the cloth.

7. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements at each side of the cloth, each nozzle element having an inlet opening below the cloth and a delivery opening above the cloth, and means to cause air heated by the heater to be drawn into the inlet opening of each nozzle and delivered through the delivery opening onto the top of the cloth.

8. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements at each side of the cloth, each nozzle element having an inlet opening below the cloth and a delivery opening above the cloth and in position to direct an air current onto the top of the cloth in a direction transverse to the length thereof, and means to cause air to be drawn into the inlet opening of each nozzle element and delivered through the delivery opening thereof.

9. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements at each side of the cloth, each nozzle element having an inlet opening below the cloth and a delivery opening above the cloth, and means to create a suction in each nozzle at the inlet opening, and a pressure within each nozzle back of the delivery opening whereby air is drawn into the inlet opening and forced through the delivery opening.

10. In a tenter-frame, the combination with means for holding cloth stretched, of a heater beneath the cloth, a plurality of nozzle elements, each having an inlet opening beneath the cloth and a delivery opening above the cloth, a supplementary nozzle in each nozzle element, and means to deliver air under pressure through each supplementary nozzle thereby to draw heated air into the inlet opening and force said air through the outlet opening.

11. In a drying apparatus, the combination with means for holding a web of cloth stretched, of a heater beneath the cloth for heating the latter, means to take air which has been heated by the heater and deliver

said air onto the upper side of the cloth at different points in directions transversely thereto.

12. In a drying apparatus, the combination with means for holding a length of cloth stretched, of a heater beneath the cloth, and a plurality of nozzle elements, each constructed to take air heated by the heater and deliver said air onto the top of the cloth.

13. In an apparatus for drying sheet material, the combination with means for supporting said sheet material at its edges, of a heater adjacent one side of said sheet material for heating the latter, a plurality of nozzle elements at each side of the sheet material, each nozzle element having an inlet opening on one side of the sheet material and a delivery opening on the other side thereof, and means to cause air heated by the heater to be drawn into the inlet opening of each nozzle and delivered through the delivery opening onto said other side of the sheet material.

14. In a drying apparatus, the combination with means for holding sheet material, of a heater situated adjacent one side of said sheet material, a plurality of nozzle elements, each having an inlet opening at said side of the sheet material, and a delivery opening on the other side thereof, a supplementary nozzle in each nozzle element, and means to deliver air under pressure through each supplementary nozzle thereby to draw heated air into the inlet opening of each nozzle and force said air through the outlet opening onto said other side of the sheet material.

In testimony whereof, I have signed my name to this specification.

BERNARD R. ANDREWS.