

G. H. MAY & W. M. GROSVENOR.
 DRYING APPARATUS.

APPLICATION FILED MAR. 24, 1909

Patented Dec. 27, 1910.

979,781.

5 SHEETS—SHEET 1.

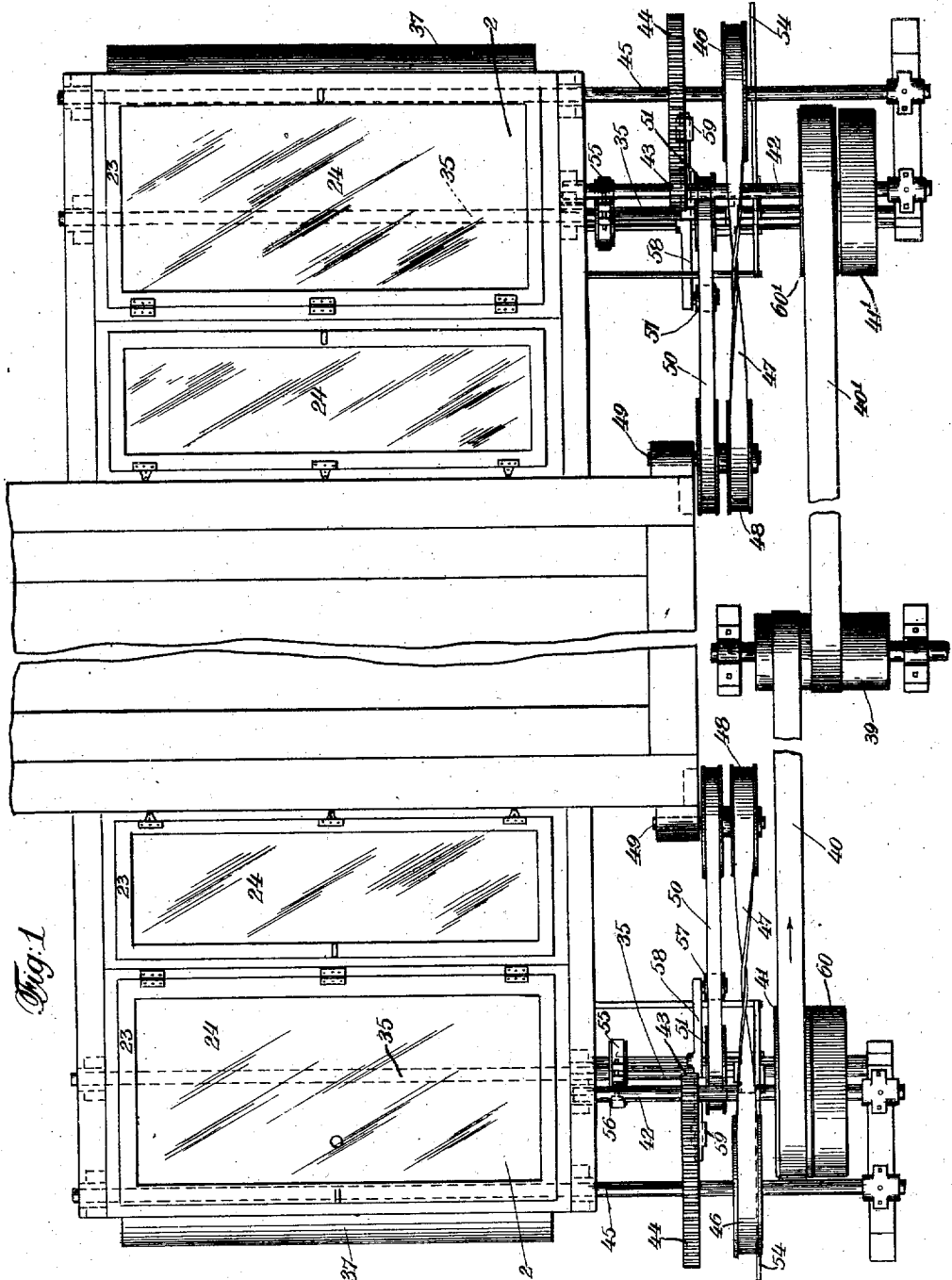


Fig. 1

Witnesses:
Edmund Harris
J. O. Hempler

Inventors
George H. May and William M. Grosvenor
 By their Attorneys
Kenyon Kenyon

G. H. MAY & W. M. GROSVENOR.

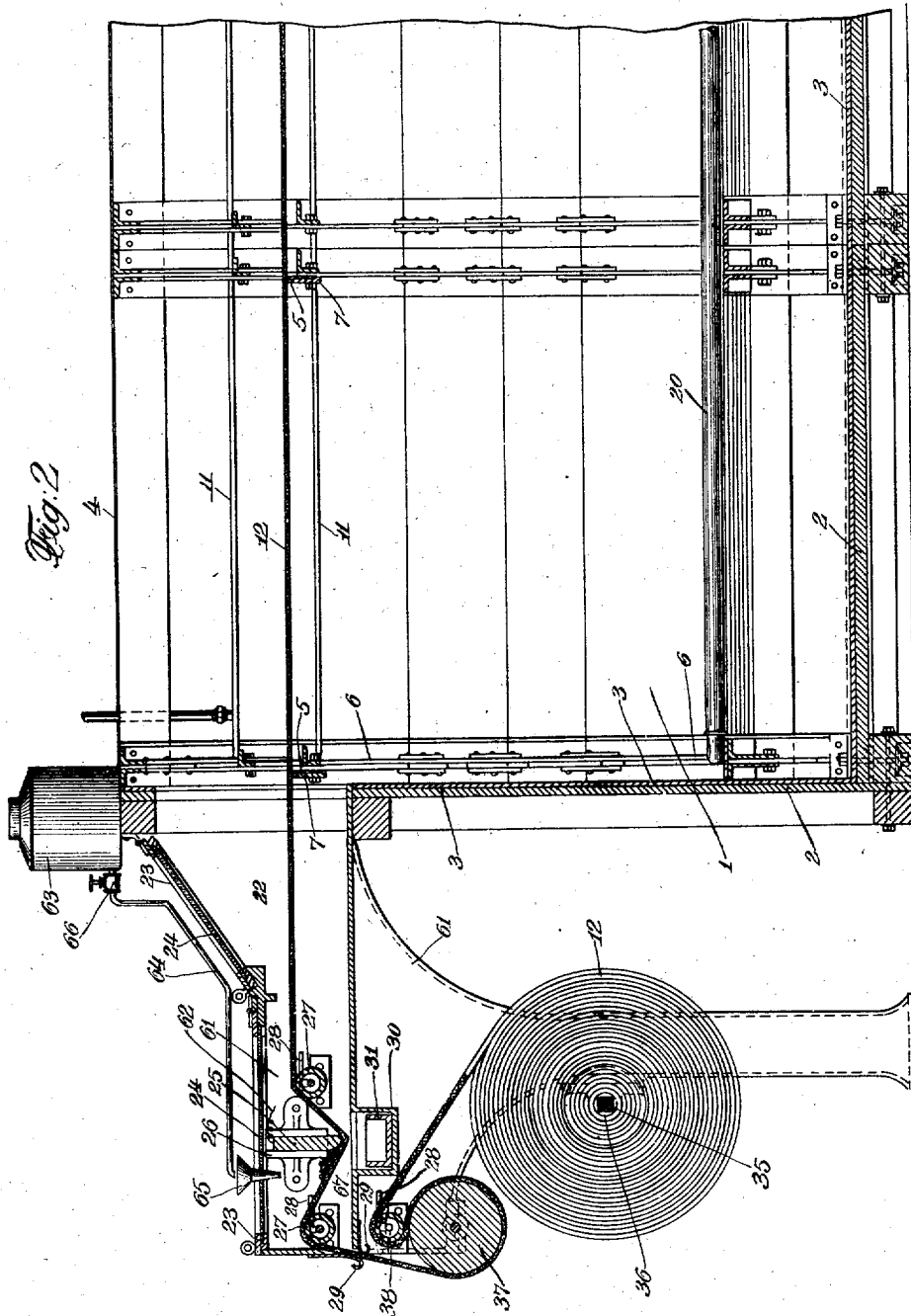
DRYING APPARATUS.

APPLICATION FILED MAR. 24, 1909.

Patented Dec. 27, 1910.

5 SHEETS—SHEET 2.

979,781.



Witnesses:
Edmund J. O. Kempler

Inventors,
George H. May and William M. Grosvenor,
By their Attorneys,
Kennyon Kenyon

G. H. MAY & W. M. GROSVENOR.

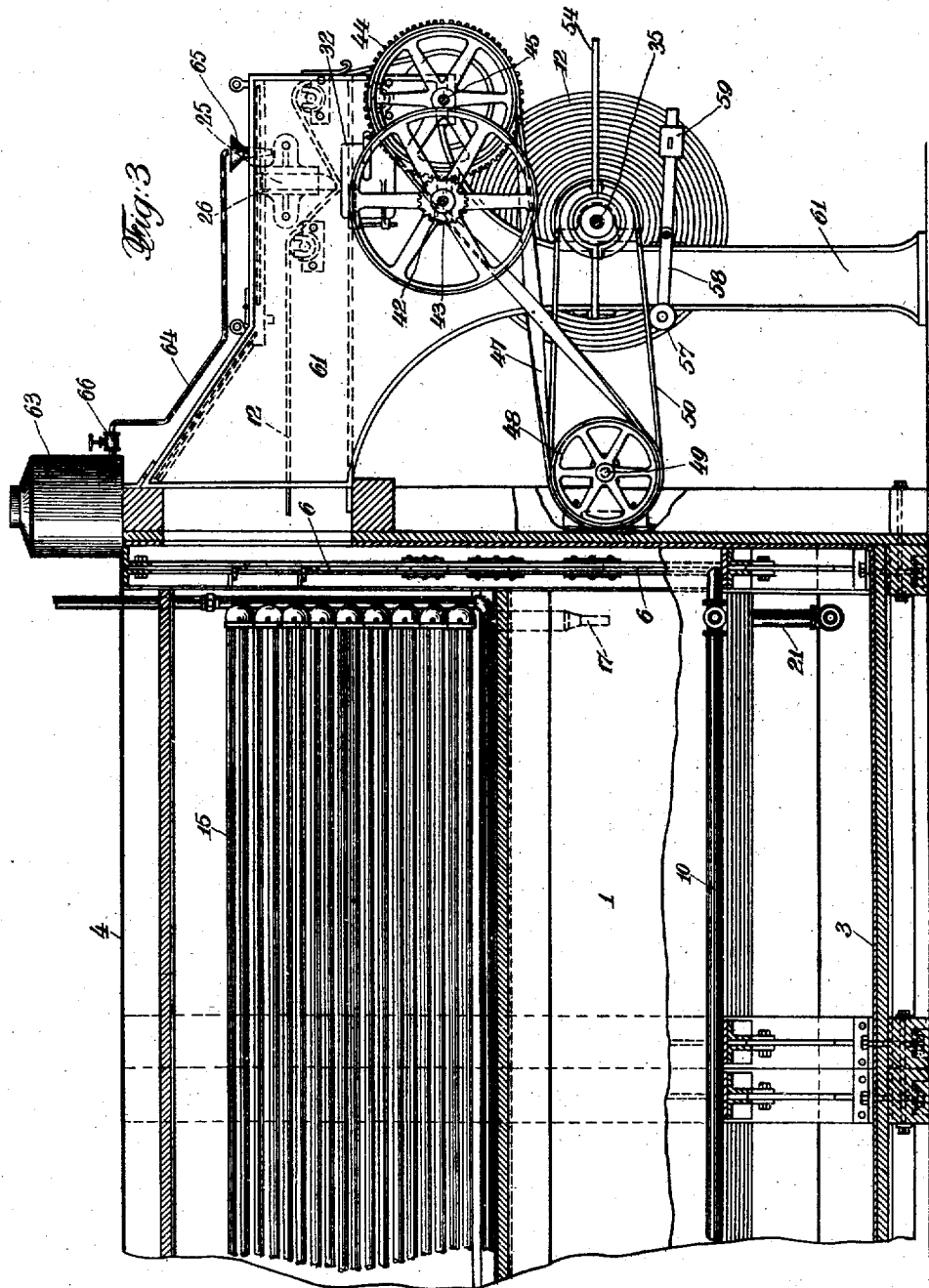
DRYING APPARATUS.

APPLICATION FILED MAR. 24, 1909.

Patented Dec. 27, 1910.

5 SHEETS-SHEET 3.

979,781.



Witnesses:
Edmundus
J. C. Campbell

Inventors,
 George H. May and William M. Grosvenor
 By their Attorneys,
 Kenyon Kenyon

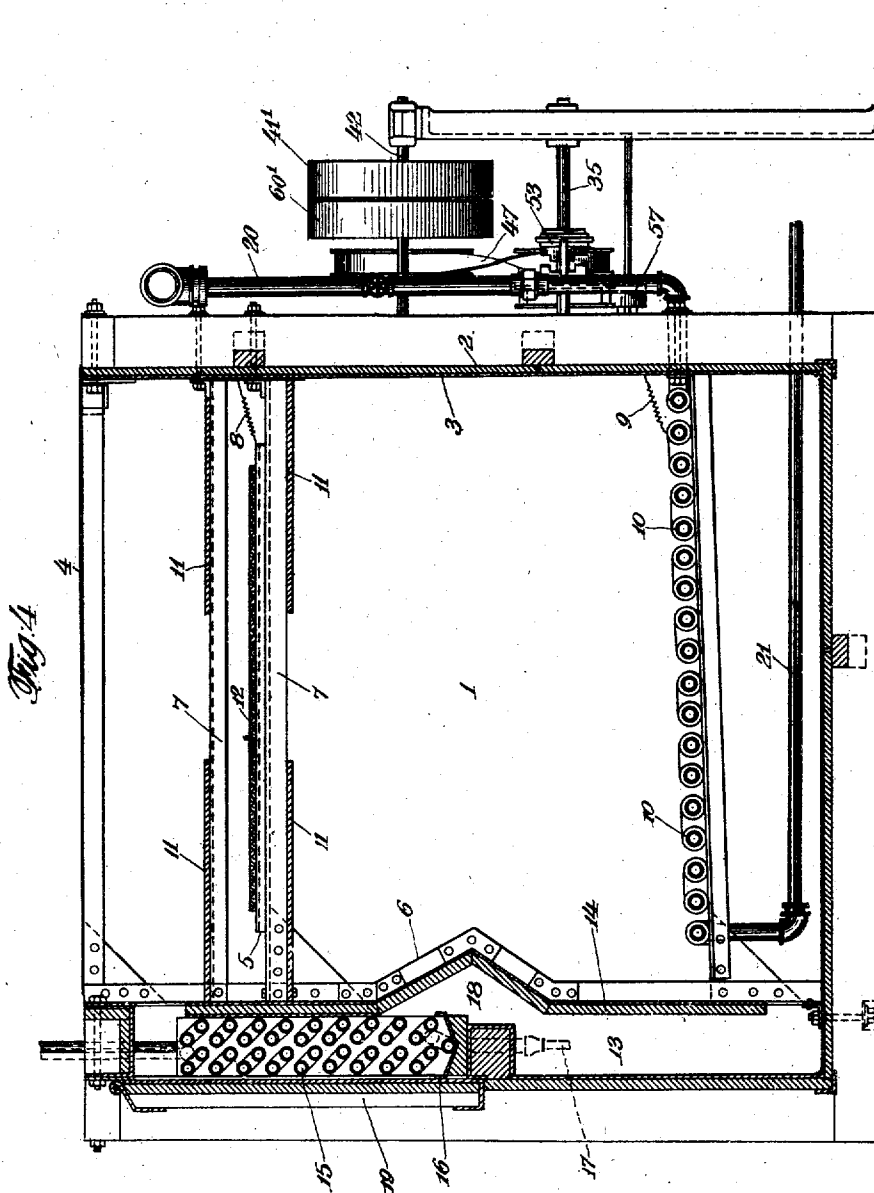
G. H. MAY & W. M. GROSVENOR.
 DRYING APPARATUS.

APPLICATION FILED MAR. 24, 1909.

Patented Dec. 27, 1910.

5 SHEETS—SHEET 4.

979,781.



Witnesses:
Edmond Harris
J. O. Kemper

Inventors,
George H. May and William M. Grosvenor,
 By their Attorneys,
Kearney & Kearney.

G. H. MAY & W. M. GROSVENOR.

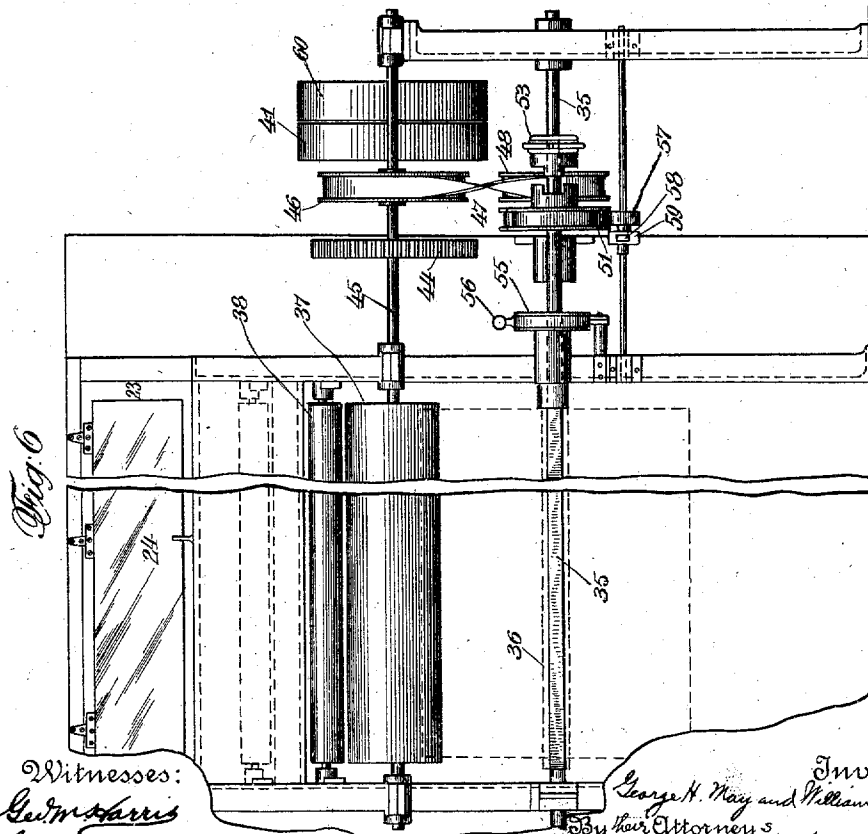
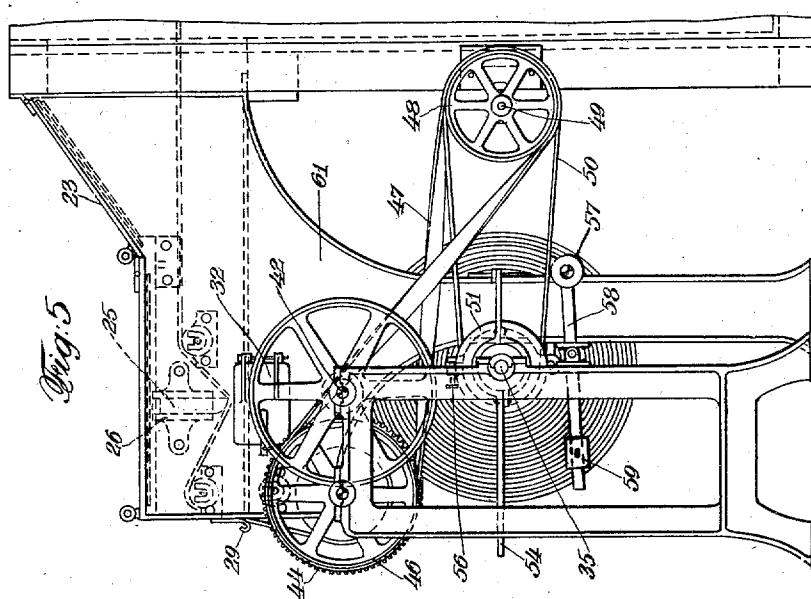
DRYING APPARATUS.

APPLICATION FILED MAR. 24, 1909.

Patented Dec. 27, 1910.

979,781.

5 SHEETS—SHEET 5.



Witnesses:
Edmund Harris
J. O. Kemper

Inventors,
George H. May and William M. Grosvenor,
By their Attorneys,
Kempson & Mayhew.

UNITED STATES PATENT OFFICE.

GEORGE H. MAY, OF NEWBURGH, NEW YORK, AND WILLIAM M. GROSVENOR, OF GRANTWOOD, NEW JERSEY.

DRYING APPARATUS.

979,781.

Specification of Letters Patent. Patented Dec. 27, 1910.

Application filed March 24, 1909. Serial No. 485,401.

To all whom it may concern:

Be it known that we, GEORGE H. MAY and WILLIAM M. GROSVENOR, citizens of the United States, and residents, respectively, of Newburgh, Orange county, New York, and Grantwood, Bergen county, New Jersey, have invented a certain new and useful Drying Apparatus, of which the following is a specification.

10 The invention relates to an improvement in drying apparatus for drying paper, or cloth, or other material, in the web, and it is especially applicable to the coating and drying of materials such as water-proofed cloth or paper in which there is applied to the surface of the material some composition containing solvents, such as benzin or turpentine.

The objects of the invention are to enable the material to be passed through the apparatus continuously, and to be dried while passing therethrough; to dry the material quickly and uniformly, and thereby to secure economy and at the same time to produce a superior quality of goods; to enable the solvents to be recovered so that they may be used over and over again, thus securing economy and preventing waste; to enable substantially the same body of air or heating medium to be used over and over again, thereby preventing loss of heat and aiding in the recovery of the solvents, and securing more uniform drying; to enable the material to be passed backward and forward through the apparatus without having to remove the same from its supporting devices and without relieving the same from tension while it is passing through the apparatus, and without substantial loss of time; to keep the material under the proper tension so as to prevent it from becoming warped or wrinkled or uneven; to prevent sparking in the apparatus which might lead to explosions, and to provide means whereby any explosion that may occur will be rendered relatively harmless; to provide a coating device for coating the material, which shall be accessible and visible, and which shall be so arranged as to substantially prevent the escape of vapors from the evaporating chamber; and in other ways to improve the construction and operation of the apparatus.

The invention consists first in the combination with an evaporating chamber which

is provided with any suitable form of heating device for heating the drying medium, of means at each end of the evaporating chamber for holding the material to be dried, and means for moving the material to be dried in either direction through the evaporating chamber so that the material may first be passed through the evaporating chamber in one direction, and then be passed back through the evaporating chamber in the reverse direction.

The invention also consists in the combination of an evaporating chamber, a condensing chamber connected therewith at or near the ends thereof so as to permit a continuous circulation of the drying medium, and condensing means in said condensing chamber, heating means suitably placed in connection with the evaporating and condensing chambers so as to heat the drying medium after passing through the condensing chamber and before it comes into contact with the material which is being dried, supporting devices to support the material while it is passing through the evaporating chamber, and tension and holding and driving devices by means of which the material can be continuously passed through the evaporating chamber and subjected to the action of the drying medium, whereby the material can be dried in a continuous operation, and can be supported and held under such tension and in such a manner as to dry the same uniformly and without causing it to warp or wrinkle. This part of the invention also consists in providing such driving and holding and tension devices at each end of the apparatus, so that the material can be passed in either direction through the evaporating chamber, and back and forth as many times as may be necessary without disturbing the material or relieving it from tension, and without substantial loss of time.

The invention also consists in providing means for applying the coating to the material within the evaporating chamber, or an extension thereof, so constructed as to prevent, so far as is possible, the loss of the vapor from the evaporating chamber, and so constructed that the apparatus for applying the coating may be readily seen and easily accessible.

The invention also consists in certain driving and supporting mechanism by means of which the direction in which the material

passes through the evaporating chamber can be readily reversed, and the material held under a suitable tension at all points including the supply end.

- 5 The invention also consists of devices by means of which the entire material may be passed through the evaporating chamber in either direction so that the ends of the material are dried as thoroughly and uniformly as any other portion thereof, and so that when one roll of material has been dried, another roll may be conveniently applied to the machine.

- 15 The invention also consists in providing bearing surfaces against which the material bears and by which it is supported in its passage through the evaporating chamber, and in grounding these devices so as to prevent sparking and thereby prevent or diminish the danger of explosion of the gases, which may be more or less inflammable in character. This part of the invention also consists in providing the evaporating chamber with one or more walls of yielding material, and making the other walls substantially rigid whereby if any explosion occurs the yielding wall or walls will be rent but the rest of the apparatus will be uninjured.

- 25 The invention consists of other features of construction and combinations of parts hereinafter described and claimed.

- The apparatus is shown in the accompanying drawings in which Figure 1 is a plan view of the two ends of the apparatus showing the driving and holding and tension devices, the middle portion of the machine being broken away; Fig. 2 is a vertical longitudinal sectional view of one end of the apparatus, including a portion of the evaporating chamber; Fig. 3 is a vertical longitudinal sectional view of the other end of the apparatus, said view passing through the condensing chamber so as to show the pipes therein; Fig. 4 is a vertical cross-sectional view through the middle of the apparatus; Fig. 5 is a side elevation of one end of the machine; and Fig. 6 is an end elevation of the same end of the machine, being partly broken away.

- 35 Similar numbers indicate similar parts in the different figures.

- Referring to the drawings, 1 is the evaporating chamber, which may be made of any suitable form and size. It is provided with walls 2, 2 of any suitable material, which are constructed so as to be substantially rigid, and thus to withstand the force of any explosion that may occur within the apparatus. These walls are constructed so as to be substantially impervious to the gases, and so as not to be affected by the temperatures employed in the apparatus and so as to be substantially fireproof. These walls are preferably provided with a metal lining 3 made of suitable material. This material

must be of such a nature as not to be acted upon by the vapors or gases which are used or produced in the apparatus. This metal lining aids in making the walls of the apparatus rigid, and also aids in grounding the bearing surfaces upon which the material rides as hereinafter explained. In the form shown in the drawings the upper wall or covering 4 is made of a thin cloth or webbing which can be easily torn so as not to confine the gases in case of such explosions as may occur with the mixture of gases present in the apparatus.

5, 5 are bearing surfaces made of metal, preferably of copper plate, upon which or over which the material moves. These bearing surfaces are supported in any suitable manner. In the form shown in the drawings the wall of the evaporating chamber is provided with supporting or strengthening ribs 6 suitably bolted in place, and these ribs support the crossbars 7 which carry the bearing surfaces 5. The crossbars 7 are bolted to the other side wall of the evaporating chamber in any convenient manner. The bearing pieces 5 are grounded electrically by electrical conductors arranged in any suitable manner. In the form shown 8 are the wires connecting the bearing pieces 5 with the metal lining 3 of the evaporating chamber, and 9 are wires connecting the metal lining with the heating pipes 10 placed at the lower part of the evaporating chamber, or in any other suitable location.

11, 11 are baffle plates extending through the length of the evaporating chamber, and projecting from the sides of the chamber toward the middle thereof in the manner clearly shown in Fig. 4. These baffle plates cause the ascending current of air to pass to the middle of the chamber and then underneath the material, to the edges thereof, and then across the top of the material to the middle thereof, and then upwardly to the top of the evaporating chamber.

12 represents the material which is being dried.

13 is the condensing chamber which is separated from the evaporating chamber by the wall 14, and which is connected with the evaporating chamber at the top and the bottom, as shown, to permit of a continuous circulation of the drying medium up through the evaporating chamber, then into the top of the condensing chamber, then down through the condensing chamber, and then into the bottom of the evaporating chamber where it is re-heated. The condensing chamber is provided with a condensing coil 15 through which the cold water or other refrigerating fluid may be passed so as to maintain a suitable temperature in the condensing chamber.

16 is a trough or receptacle to receive or catch the condensed liquid or solvent which

is condensed out of the drying medium. The pipe 15 is continued to the very bottom of tank 16 so as to keep the liquid or solvent in the tank at a sufficiently low temperature to prevent any substantial reëvaporation.

17 is a discharge pipe leading from the receptacle 16 through which the liquid or solvent can be discharged and recovered from the apparatus so that it can be again used in preparing the material which is being fed into the apparatus, or in preparing the coating to be applied thereto.

18 is a by-pass in the condensing chamber to permit the drying medium to escape past the receptacle 16.

19 is a hinged door forming one side of the condensing chamber by means of which ready access may be had to the condensing chamber and the condensing pipes.

20 is the supply pipe of the heating coil, and 21 is the return pipe of the same.

22 is a chamber for inclosing the coating device. This chamber forms an extension of the evaporating chamber, and the walls of it are made substantially tight so as to prevent so far as is possible the vapor or solvent in the evaporating chamber from escaping from the apparatus.

23, 23 are movable or hinged covers in the upper wall of the chamber 22, provided with panes of glass 24, or other transparent material, through which the operation of the coating and spreading devices can be easily observed, and by means of which ready access can be had to these devices.

25 is a spreading device or knife which is adapted to slide up and down in the bearings 26 in the side walls of the chamber 22. This knife can be inserted in place or removed from the apparatus by opening the hinged cover 23 immediately above, and slipping the knife into or out of the bearings 26. The knife is made entirely of metal or is made with a metal bearing piece and is suitably grounded by connecting it electrically with the metal frame 61, as by the wire 62. This frame is electrically connected in any suitable manner with the metal lining 3 or the heating pipes. Any other suitable form of coating or spreading or dipping device, such as rollers or brushes, may be used.

27, 27 are rolls for supporting the material on either side of the spreading device. These rolls are made of any suitable material. If made of metal, or with a metal face, they must be suitably grounded; for example, they may be provided with contact brushes 28. These contact brushes may be connected electrically with the metal lining of the chamber, so as to be electrically grounded. The rolls 27 are supported in any suitable bearings supported by the walls of the chamber 22.

29, 29 are pieces made of some spring material, preferably spring metal or sheet rubber,

between which the material passes into the chamber 22. These spring pieces form a tight joint at the point where the material passes into the chamber 22 and so prevent the substantial leakage of vapor from the apparatus. If the pieces 29 are made of metal they must be suitably grounded.

The coating composition is held in any suitable reservoir such as the tank 63, which is connected by a pipe 64 with a funnel 65 extending through an opening in the hinged cover 23 at a point outside of the knife 25. The pipe 64 is provided with a valve 66, and in this manner the coating composition can be fed at any rate desired into the chamber 22 and on to the material in front of the spreading device.

In Fig. 2, 67 represents a quantity of coating composition which has been fed on to the material.

The chamber 22 is provided with a recess or depression 30 formed by the wall of the chamber and adapted to receive the drip tank 31 which is placed immediately below the spreading device so as to receive or catch any surplus of the coating composition which may drop down from the material. When the tank 31 is full it can be withdrawn through the door 32 which is in the side of the chamber 22 and which is constructed so as to make when closed a substantially air-tight joint with the wall of the chamber 22. Each end of the machine is provided with a chamber 22 such as already described, with all the parts from 23 to 32 inclusive. Each end of the apparatus is provided with driving, holding and tension devices. These devices are of the same construction at both ends.

Referring to the drawings, 36 is a roller which acts as a receiving roller when its end of the machine is used as the discharge end, and as the supply roller when its end of the machine is used as the supply end. This roller is slipped on to a square shaft 35 mounted in suitable bearings in the frame of the machine.

37 is a driving roller or drum, and 38 is an intermediate roll.

Referring to Fig. 2, and assuming that the end of the machine there shown is the discharge end, the material 12 passes out of the chamber 22, after being dried, and over the driving roller 37, and then over the intermediate roller 38 and is then wound upon the receiving roller 36. These rollers are driven as follows. 39 is a drum or pulley (see Fig. 1), which is driven by any suitable means. 40 is a belt connecting the drum 39 with the pulley 41 which is fast upon the shaft 42. This shaft carries the pinion 43 which meshes with the gear 44 on the shaft 45. The shaft 45 carries the driving roller 37. 46 is a pulley fastened to the shaft 45. 47 is a belt connecting the pulley

46 with the double pulley 48 mounted on the shaft 49 which turns loosely in bearings in the frame of the machine. The belt 47 is half turned so that the pulley 48 runs in the reverse direction from the pulley 46. 50 is a belt connecting the pulley 48 with the pulley 51 on the shaft 52, which is an extension of the square shaft 35 which carries the receiving roller 36.

Referring to Fig. 1, when the drum 39 is driven in such a direction as to drive the belt 40 in the direction indicated by the arrow in this figure, the driving roller 37 will be driven in such a direction as to draw the material through the evaporating chamber and toward its end of the same, and the receiving roll 36 will be driven so as to wind the material on said roll. By reason of the respective sizes of the connecting pinions and gear wheels and pulleys, the tendency will be to drive the receiving roller 36 faster than the roller 37, which will keep the goods taut and under the proper tension, but the belt and pulley arrangement will permit the belts to slip upon the pulleys, and this slip motion will cause the speed of the receiving roller to be properly adjusted with reference to the speed of the roller 37. 53 is a clutch of any suitable form fastened to the shaft 52 and adapted to be moved longitudinally thereon and to engage with the pulley 51. By means of this clutch the pulley 51 can be fastened to the shaft 52 so as to revolve therewith, or can be unlocked from the said shaft so as to turn freely thereon. 54 is a handle for operating said clutch. 55 is a brake or friction device of any suitable form adapted to encircle and bear against a disk on the shaft 52 so as to retard the motion of said shaft when the roller 36 is being used as a supply roller, and thus to maintain a tension on the goods as they pass from said roller. Any suitable form of brake may be employed, and its friction on the shaft 52 may be regulated by any suitable adjusting device, for example the screw 56. 57 is a pressure roll adapted to bear against the under side of the belt 50 to maintain the proper tension on said belt. It is mounted on the end of an arm 58 suitably pivoted to the frame of the machine, and carrying a weight 59 at its other end which can be moved so as to adjust the pressure. 60 is a loose pulley on the shaft 42. 40' is a belt connecting the pulley 39 with the loose pulley 60' on the shaft 42 at the other end of the machine. 41' is a fast pulley on the shaft 42 at the other end of the machine. The rollers and driving mechanism at the other end of the machine are the same as those already described. When the drum 39 is revolved in such a direction as to move the belt 40, as indicated by the arrow in Fig. 1, the belt 40' is running on the loose pulley 60' on the shaft 42 at the other end

of the machine, and the roller 36 at the other end of the machine is acting as a supply roller and is being revolved by the material itself which is being drawn through the machine by the roller 36 and the roller 37 at the discharge end. The roller 36 at the supply end is retarded in its motion, and the goods are thereby held under tension by the operation of the brake 55. The roller 36 is provided with an end wrapper, that is to say, with a strip of material which is fastened at one end to the roller, or which is wound upon it a sufficient number of times to be secured thereto, and which is adapted to be attached at the other end to the end of the material which is to be dried in the apparatus. When a roll of material has been drawn through the apparatus, the end wrapper connected with it is drawn through the apparatus, and after its end has passed out of the discharge end of the apparatus, this wrapper is disconnected from the material unless the material is to be drawn back through the apparatus. When the drying of the material is completed the material is separated from the end of the wrapper, and the wrapper is then ready to be attached to the next piece of material to be dried in the apparatus. This end wrapper must be long enough to extend entirely through the apparatus without being disconnected or wholly unwound from its roller 36. This affords an easy means of drawing any material into the apparatus, and it also enables the material to be drawn entirely through the apparatus, and then drawn back again, and so on as many times as may be desired, thereby drying the ends of the material as thoroughly as the middle portions.

The operation of our machine is as follows: A roller 36 with a roll of goods wound thereon is placed upon the shaft 35. The inner end of this roll is attached to the end of the wrapper connected with the roller 36. The free end of the roll of goods is then attached to the wrapper extending through the machine from the roller 36 at the other end of the apparatus. The roller 36 bearing the roll of goods is disconnected from the driving mechanism by throwing out the clutch 53. The roller 36 at the discharge end is connected by its clutch 53 to the driving mechanism, and is driven so as to wind the end wrapper on said roller 36, and to draw the material at the desired speed through the evaporating chamber. The composition which is to be applied to the material is placed in the tank 63, and the valve 66 is so adjusted that this composition will be fed through the pipe 64 and the funnel 65 on to the material in suitable quantity. The knife or spearing device 25 is inserted in its bearings at the supply end of the machine, and is properly adjusted therein so as to bear upon the material with

suitable pressure. This adjustment may be made in any desirable way, as by a key driven between the knife and the wall of the chamber. The knife is withdrawn from the other end of the apparatus. The heating pipes 10 are heated in any suitable manner as by steam, and a suitable cooling fluid is passed through the condensing pipe 15 at such a temperature as to condense the vapor or solvent which is evaporated from the material in the evaporating chamber. The air within the evaporating chamber is heated at the bottom thereof, and rises through that chamber, and is deflected by the baffle plates 11 and caused to flow first underneath the material, and then across its upper surface, and thereby heats and dries the same and carries off the evaporated moisture or solvent into the upper part of the evaporating chamber, and then flows down through the condensing chamber in which the moisture or solvent is condensed, being caught in the receptacle 16 and recovered through the discharge pipe 17. The solvent can then be used over again in preparing the coating material. The current of drying medium passes through the bypass 18 and down into the lower part of the evaporating chamber, and is then reheated, and thus a continuous circulation of drying medium is maintained by gravity or other suitable means. The surfaces of the material are exposed uniformly and thoroughly to the current of drying medium, and thus all parts of the material are dried uniformly, and at the same rate. The material can be fed through the machine at any rate of speed desired, and any desired temperature may be maintained in the evaporating chamber. The material passes from the roller 36 at the supply end over the intermediate roll 38, and then around the driving roller 37, and then between the spring pieces 29 into the chamber 22, and over the rollers 27 and underneath the knife 25, and then through the evaporating chamber, being supported therein by the bearing surfaces 5, 5. The material then passes over the rolls 27 at the discharge end, out between the spring pieces 29 and over the roller 37 and the intermediate roller 38, and is then wound on the receiving roller 36. During all this time the material is held taut and under such tension as may be desired. It is thus prevented from wrinkling or warping or bending, and is exposed to the operation of the drying medium in a uniform condition. This greatly improves the quality of the product.

The coating devices are contained in chambers which form extensions of the evaporating chamber, and which are tight so that the escape of moisture or solvent vapor contained in the evaporating chamber is prevented as far as possible. The points

of entry of the material, and of exit between the spring pieces 29, are also tight, so that there is no leakage of gas therethrough. This results in substantial economy especially where solvents are being used which are valuable, as in the manufacture of waterproofed cloth or paper. As the openings through which the goods enter and leave the apparatus are on the same level, there is not the same tendency for the heated gases to escape, as there would be if these openings were at different levels.

As the material or fabric to be treated passes through the machine, its passage and friction over the rollers and under the knife, are productive of static differences of potential, as are also the continued evaporation and condensation of liquid. This tends to produce a sparking within the apparatus. In spite of the regulation of condensation to obtain mixtures which shall not be explosive, there may be points where the vapor is locally enriched or impoverished to such an extent as to be explosive, and while this would not produce a violent explosion, unless there were a large proportion of the vapor more or less in this condition, it is important to avoid even such milder combustion, which would interrupt the operation of the apparatus and result in loss. By grounding all of the metallic rollers and bearing surfaces, and all other exposed metal surfaces in the apparatus as already described, such sparking is substantially prevented. Should any explosion occur, however, the explosion would merely tear the thin cover 4, and would not injure the rest of the apparatus, as the other walls of the apparatus are made substantially rigid so as to resist any such explosion.

Any surplus of the coating mixture will flow down past the edges of the material and into the tank 30. From time to time this tank may be withdrawn through the door 32, and emptied and then replaced. The hinged doors 24, 24 with their transparent panes enable the coating apparatus to be easily watched, and afford ready access to the same. After the material has been passed through the apparatus it can be returned through the apparatus in the opposite direction by merely shifting the belts 40 and 40' on the drum 39 so as to make the belt 40 run on the loose pulley 60, and the belt 40' run on the fast pulley 41', and by clutching the shaft 52 at what is to be the discharge end to its pulley 51, and unclutching the shaft 52 at the supply end from its pulley 51.

While in the form of apparatus shown the circulation of the drying medium is due to gravity, it will be apparent that the circulation may be produced in any other well known way.

Many advantages are secured by our in-

vention. The material is dried quickly, uniformly and economically. The quality of the product is greatly improved. The solvents are recovered and may be used over and over again. The escape of the solvent vapors from the apparatus is substantially prevented. The composition or coating material is applied within the apparatus itself so that there is no substantial loss of solvent vapor at this point. The danger of injury or loss through explosion is reduced to a minimum, and provision is made whereby, if an explosion occurs, no substantial damage results therefrom. The machine can be quickly reversed so as to pass the material back and forth through the apparatus without loss of time. The apparatus is simple and compact. Other advantages are also secured, as will be apparent from the above description.

What we claim as new and desire to secure by Letters Patent, is:

1. In a drying apparatus, the combination of an evaporating chamber, means for heating the drying medium before it comes into contact with the material being dried, means at each end of the evaporating chamber for holding the material to be dried, and means for moving the material in either direction through the evaporating chamber whereby the material may be passed back and forth through said evaporating chamber.

2. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, means for heating the drying medium before it comes into contact with the material being dried, electrical connections grounding the exposed metal surfaces in the evaporating chamber, means at each end of the evaporating chamber for holding the material, and means for moving the material through the evaporating chamber.

3. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium before it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, a driving roller at the discharge end, a receiving roller at the discharge end, means for driving the receiving roller, a supply roller at the supply end, and means for putting a tension on the material at the supply end.

4. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating

means to heat the drying medium before it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, a driving roller at the discharge end, a receiving roller at the discharge end, means for driving the driving roller, and means for driving the receiving roller at a variable speed so as to maintain the proper tension on the material, a supply roller at the supply end, and means for putting a tension on the material at the supply end.

5. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium before it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, a driving roller at the discharge end, a receiving roller at the discharge end, means for driving the driving roller, a belt and pulley connection between the shaft of the driving roller and the shaft of the receiving roller whereby the receiving roller is driven at a variable speed so as to maintain the proper tension on the material, a supply roller at the supply end, and means for putting a tension on the material at the supply end.

6. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material to be dried, means to support the material while passing through the evaporating chamber, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means for driving said roller, and a disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, a brake for the holding roller, and a driving roller, whereby the material may be passed back and forth through the evaporating chamber without being relieved from tension while passing through said chamber.

7. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means

for driving said roller at a variable speed so as to maintain the proper tension on the material, and a disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, a brake for the holding roller, and a driving roller, and means for driving the driving roller.

8. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, a receptacle to hold the condensed liquid, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, supporting devices to support the material while passing through the evaporating chamber, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means for driving said roller, and a disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, a brake for the holding roller, and a driving roller, a driving pulley and means for connecting and disconnecting the driving pulley alternately with and from the driving and holding devices at either end of the evaporating chamber.

9. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with and from the driving and holding device to hold the condensed liquid, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, supporting devices to support the material while passing through the evaporating chamber, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, a brake for the holding roller, and a driving roller, the driving pulley 39, the belts 40 and 40', the fast pulleys 41 and 41', the loose pulleys 60 and 60', the shafts 42, the shafts 45 carrying the driving rollers, and geared to the shafts 42, the shafts 52 of the holding rollers, and belt and pulley connections between the shafts 45 and the shafts 52.

10. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, a receiving roller at the discharge end, means for driving the receiving roller, a supply roller at the sup-

ply end, means for putting a tension on the material at the supply end, and an end wrapper connected with the supply roller.

11. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means for driving said roller, and a disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, means for holding the material under tension, and an end wrapper connected with the holding roller at each end whereby the entire material may be passed back and forth through the evaporating chamber.

12. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of suitable yielding material, and the other walls being comparatively rigid.

13. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means in said condensing chamber, heating means to heat the drying medium before it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of substantially impervious yielding material, and the other walls being comparatively rigid.

14. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of impervious yielding material, and the other walls being comparatively rigid, a driving roller at the discharge end, a receiving roller at the discharge end, means for driving the receiving

roller, a supply roller at the supply end, and means for putting a tension on the material at the supply end.

15. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of impervious yielding material, and the other walls being comparatively rigid, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means for driving said roller, and a disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, a brake for the holding roller, and a driving roller.

16. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, bearing surfaces to support the material while passing through the evaporating chamber, and electrical conductors connected with said bearing surfaces and grounding the same.

17. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, bearing surfaces to support the material while passing through the evaporating chamber, and electrical conductors connected with said bearing surfaces and grounding the same, some of the walls of said chamber being made of impervious yielding material, and the other walls being comparatively rigid.

18. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium before it comes into contact with the material being dried, bearing surfaces to support the material while passing through the evaporating chamber, and electrical conductors connected with said bearing surfaces and grounding the same, a driving and holding device at each end of the evaporating chamber consisting of a roller to hold the material, means for driving said roller, and a

disconnecting device between the roller and said driving means, whereby the roller can turn in the reverse direction, a brake for the holding roller, and a driving roller.

19. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, supporting devices to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of impervious yielding material, and the other walls being lined with metal.

20. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber thereof, condensing means connected with said condensing chamber, heating means to heat the drying medium before it comes into contact with the material being dried, bearing surfaces to support the material while passing through the evaporating chamber, some of the walls of said chamber being made of impervious yielding material, and the other walls being lined with metal, the bearing surfaces being connected electrically with the metal lining, and the metal lining being electrically grounded.

21. In a coating and drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material to be dried, means for coating the material with the coating substance, and for spreading it on said material, said coating and spreading means being inclosed in a chamber at the end of the evaporating chamber, and holding devices at each end of said evaporating chamber to maintain a tension on the material.

22. In a coating and drying machine, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material to be dried, means for coating the material with the coating substance and for spreading it on said material, said coating and spreading means being inclosed in a chamber forming an extension of the evaporating chamber, movable covers for said extension chamber, and holding devices at each end of said evaporating chamber to maintain a tension on the material.

23. In a coating and drying apparatus, the

combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means

5 heating means to heat the drying medium before it comes into contact with the material to be dried, means at each end of the evaporating chamber for coating the material with the coating substance and for
10 spreading it on said material, and holding and driving means at each end of said evaporating chamber.

24. In a coating and drying apparatus, the combination of an evaporating chamber,
15 a condensing chamber suitably connected with the evaporating chamber, condensing means in said condensing chamber, heating means to heat the drying medium before it comes into contact with the material to be
20 dried, means to support the material while passing through the evaporating chamber, means at each end of the evaporating chamber for coating the material with the coating substance, and for spreading it on said
25 material, said coating and spreading means being inclosed in a chamber forming an extension of the evaporating chamber at each end thereof, and holding and driving means at each end of said evaporating chamber.

30 25. In a coating and drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating means to heat the drying
35 medium on its passage from the condensing chamber to the material to be dried, bearing surfaces to support the material while passing through the evaporating chamber, and
40 electrical conductors connected with said bearing surfaces and grounding the same, means for coating the material with the coating substance and for spreading it on said material, said coating and spreading
45 means being inclosed in a chamber forming an extension of the evaporating chamber, and holding devices at each end of said evaporating chamber to maintain a tension on the material.

50 26. In a coating and drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing
55 chamber, a receptacle to hold the condensed liquid, heating means to heat the drying medium on its passage from the condensing chamber to the material to be dried, bearing surfaces to support the material while passing
60 through the evaporating chamber and electrical conductors connected with said bearing surfaces and grounding the same, means at each end of the evaporating chamber for coating the material with the coating substance and for spreading it on said

material, said coating and spreading means being inclosed in a chamber forming an extension of the evaporating chamber at each end thereof, and holding devices at each end of said evaporating chamber to maintain a
70 tension on the material.

27. In a coating and drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing
75 means connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material to be dried, means to support the material while passing
80 through the evaporating chamber, means for coating the material with the coating substance and for spreading it on said material, said coating and spreading means being inclosed in a chamber at the end of the
85 evaporating chamber, and a removable drip tank in said last mentioned chamber to catch the surplus of the coating substance and a door forming a substantially tight joint with said chamber for the withdrawal of
90 the tank.

28. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means
95 connected with said condensing chamber, heating means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the
100 evaporating chamber, inlet and outlet openings for the material in the evaporating chamber on the same level with each other and holding devices at each end of said evaporating chamber to maintain a tension
105 on the material.

29. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means connected with said condensing chamber, heating
110 means to heat the drying medium on its passage from the condensing chamber to the material being dried, means to support the material while passing through the evaporating chamber, inlet and outlet openings for the material in the evaporating chamber provided with spring pieces to bear against and inclose the material and holding devices at each end of said evaporating chamber to maintain a tension on the material.
115
120

30. In a drying apparatus, the combination of an evaporating chamber, a condensing chamber suitably connected with the evaporating chamber, condensing means
125 connected with said condensing chamber, a receptacle to hold the condensed liquid, the condensing tubes extending down substantially to the bottom of said receptacle, heating means to heat the drying medium before
130

5 it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, and holding devices at each end of said evaporating chamber to maintain a tension on the material.

In testimony whereof, we have signed our

names to this specification, in the presence of two subscribing witnesses.

GEORGE H. MAY.

WILLIAM M. GROSVENOR.

Witnesses:

T. E. RAFTERY,

EDWIN SEGER.

Corrections in Letters Patent No. 979,781.

It is hereby certified that in Letters Patent No. 979,781, granted December 27, 1910, upon the application of George H. May, of Newburgh, New York, and William M. Grosvenor, of Grantwood, New Jersey, for an improvement in "Drying Apparatus," errors appear in the printed specification requiring correction as follows: Page 4, line 127, the word "spearing" should read *spreading*, and page 7, line 36, the words and syllable "and from the driving and holding de-" should be stricken out and the words *said condensing chamber, a receptacle* be inserted instead; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D., 1911.

[SEAL.]

E. B. MOORE,

Commissioner of Patents.

5 it comes into contact with the material being dried, means to support the material while passing through the evaporating chamber, and holding devices at each end of said evaporating chamber to maintain a tension on the material.

In testimony whereof, we have signed our

names to this specification, in the presence of two subscribing witnesses.

GEORGE H. MAY.

WILLIAM M. GROSVENOR.

Witnesses:

T. E. RAFTERY,

EDWIN SEGER.

Corrections in Letters Patent No. 979,781.

It is hereby certified that in Letters Patent No. 979,781, granted December 27, 1910, upon the application of George H. May, of Newburgh, New York, and William M. Grosvenor, of Grantwood, New Jersey, for an improvement in "Drying Apparatus," errors appear in the printed specification requiring correction as follows: Page 4, line 127, the word "spearing" should read *spreading*, and page 7, line 36, the words and syllable "and from the driving and holding de-" should be stricken out and the words *said condensing chamber, a receptacle* be inserted instead; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D., 1911.

[SEAL.]

E. B. MOORE,

Commissioner of Patents.

It is hereby certified that in Letters Patent No. 979,781, granted December 27, 1910, upon the application of George H. May, of Newburgh, New York, and William M. Grosvenor, of Grantwood, New Jersey, for an improvement in "Drying Apparatus," errors appear in the printed specification requiring correction as follows: Page 4, line 127, the word "spearing" should read *spreading*, and page 7, line 36, the words and syllable "and from the driving and holding de-" should be stricken out and the words *said condensing chamber, a receptacle* be inserted instead; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D., 1911.

[SEAL.]

E. B. MOORE,
Commissioner of Patents.