April 28, 1936. G. LOCKER 2,039,176

PROCESS OF MANUFACTURING IMPREGNATED AND/OR COATED TEXTILES AND AN APPARATUS THEREFOR

Filed Feb. 20, 1934 2 Sheets-Sheet 1

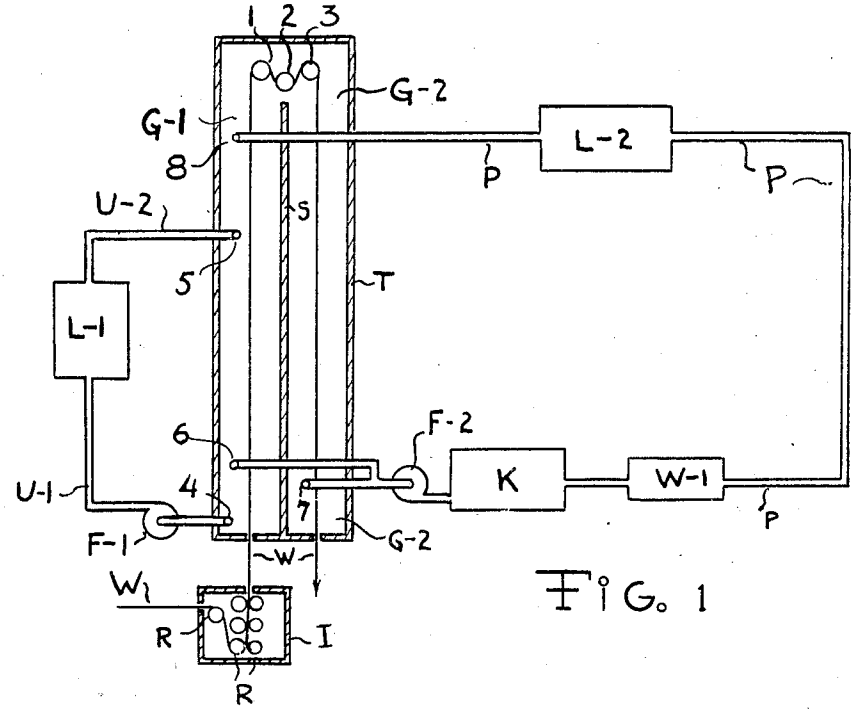


Fig. 1

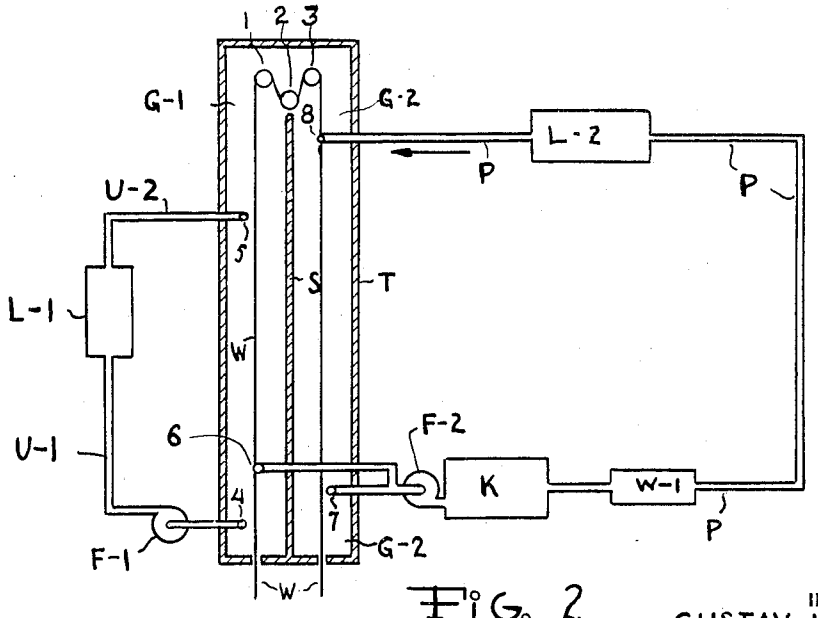


Fig. 2

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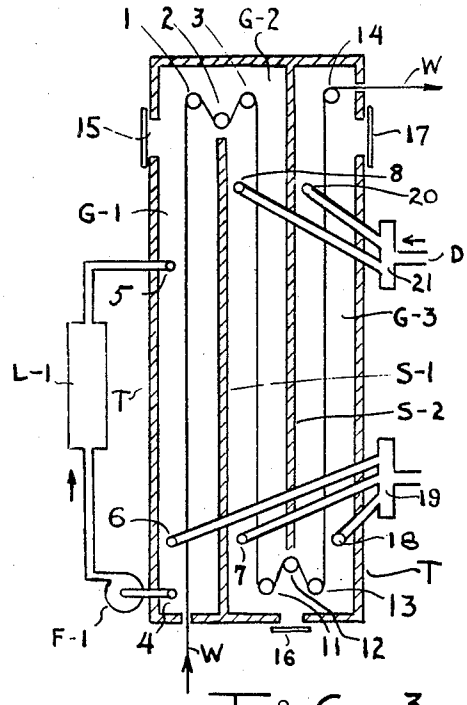


FIG. 3

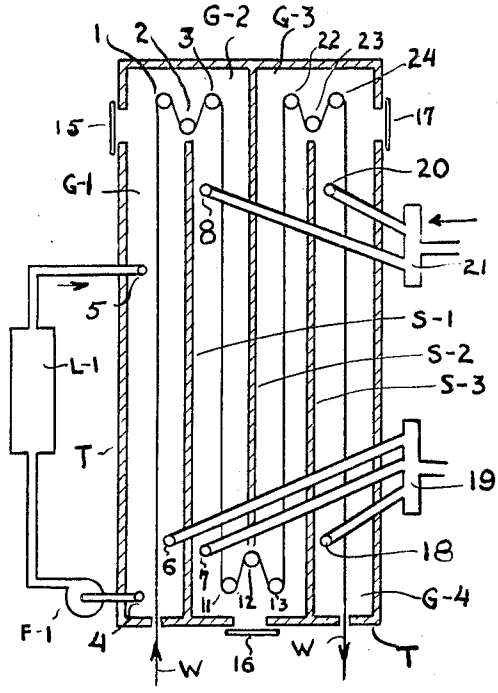


FIG. 4

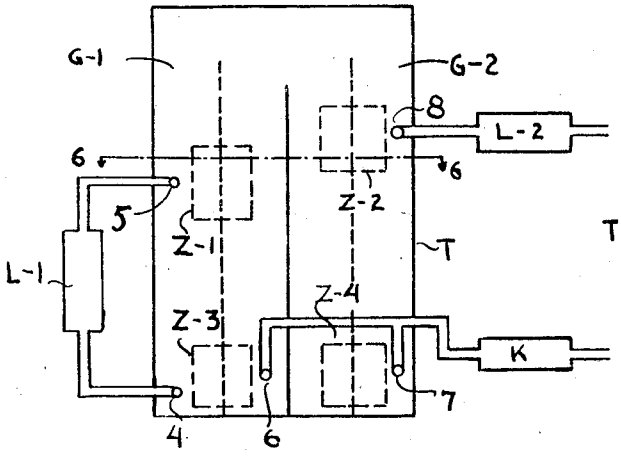


FIG. 5

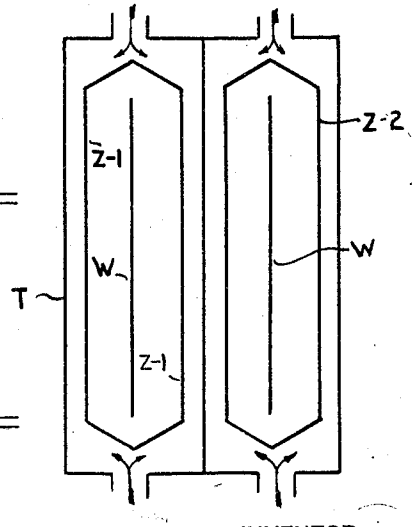


FIG. 6

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2,039,176

PROCESS OF MANUFACTURING IMPREGNATED AND/OR COATED TEXTILES AND AN APPARATUS THEREFOR

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Application February 20, 1934, Serial No. 712,104
In Germany January 27, 1934

4 Claims. (Cl. 34—48)

The present invention relates to a process of manufacturing impregnated and coated textiles and an apparatus therefor.

It is well known that textiles have been impregnated and coated by passing a web of textile from a roll through a trough containing an impregnating substance. A variety of impregnating substances has been used, but generally solutions of synthetic or natural resins or solutions of cellulose esters or cellulose ethers were used. For effecting a thorough impregnation of textile, the web was passed between rollers. A scraping device, usually a doctor's blade, was employed to remove the surplus solution and to leave a predetermined thickness of coating on the surface of the textile. The impregnated and coated web was passed into and through a drying chamber to evaporate the solvent of the solution and to dry the textile. In the drying, blisters and other blemishes marring the beauty of the textile developed. Various proposals were made to avoid the foregoing disadvantages. Thus, it was suggested to decrease the temperature in the drying chamber. Due to the slow drying with a lower temperature, the impregnating substance penetrated deeply into the meshes of the textile or into the intercellular spaces of the felt and the structure of the textile or felt was clearly visible through the coating in the finished product. The surface was uneven and rough and the product was unattractive. Although attempts have been made to overcome the prior defects, none, as far as I am aware, has been wholly satisfactory and successful in practice.

I have discovered a process which overcomes the disadvantages and defects of prior procedures and which functions satisfactorily when conducted on a practical scale.

It is an object of the invention to provide a process of manufacturing impregnated and coated textiles by regulating the temperatures lengthwise of the web undergoing drying.

It is another object of the invention to introduce the reheated air or gases from a recovery circuit and an auxiliary recirculation circuit at various regions along the length of the web.

It is a further object of the invention to provide an auxiliary recirculation circuit capable of withdrawing a certain portion of the gases from the dryer, of reheating the withdrawn gases to a selected temperature and of reintroducing the reheated gases at a selected speed and at a special region to the dryer.

It is also within the contemplation of the invention to provide an apparatus with special connections for a recirculation circuit and for a recovery circuit and with a special internal arrangement for the drying of impregnated and coated textiles.

A further object is to provide an apparatus for the drying of impregnated and coated textiles with a protective shield to prevent the reintroduced gases from directly impinging upon the web of textile.

Other objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which:—

Fig. 1 represents diagrammatically an embodiment for carrying the invention into practice.

Figs. 2, 3, and 4 are similar to Fig. 1 and depict modified embodiments;

Fig. 5 shows diagrammatically the incorporation of protective shields in a drying apparatus; and

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5.

Referring more particularly to Fig. 1, the reference character T designates the dryer which is preferably of a tower-like shaft type and which is completely closed except for certain special inlet and outlet ports, etc. as described more fully hereinafter. Associated with dryer T and preferably located directly below the bottom thereof is an impregnation tank I. Within tank I is a plurality of rolls R around and between which the web W of textile passes. During travel of the web through the tank the web is impregnated and coated with the impregnating or coating substance with which the tank is filled. For instance, solutions of synthetic or natural resins may be used or solutions of cellulose esters or cellulose ethers might likewise be used. The rollers effect a good impregnation of the web. A scraping device such as the well known doctor's blade (not shown), may be used to wipe off the surplus of the impregnating or coating substance and may be used to determine the exact thickness of the coating to remain on the surface of the web.

It will be noted that the web passes directly into dryer T which is located above the impregnation tank. The impregnated and/or coated web passes over a guide roller 1, then under a guide roller 2, and finally over a guide roller 3. These rollers are located at the top of the dryer and carry the web from chamber G—1 to chamber G—2. Separating the two chambers is a partition S which extends from the bottom of the dryer to a region near the top of the dryer and preferably just below the guide rollers. The

outlet for dried web is covered with a very thick felt to prevent leakage of gases from the dryer or leakage of air into the dryer. In the same way, the inlet for the web is provided with felt or the like to close the dryer.

Associated with chamber G—1 of dryer T is an auxiliary air or gas circulation system. An outlet port 4 is provided in chamber G—1 near the bottom of the dryer. A fan F—1 is connected to outlet 4 and is adapted to suck a predetermined amount of air or gas from the dryer and then to blow the withdrawn air and gas through a circulating pipe U—1 to a heater L—1. In the heater the air and gas is heated to a selected and predetermined temperature. From the heater, the heated air and gas is returned to a special region located in the upper part of the dryer via inlet 5. By controlled regulation of fan F—1, the returned air and gas can be given any selected and predetermined velocity. In this manner, the amount of air and gas recirculated can be carefully controlled as well as the temperature and velocity thereof. It is also within the purview of the present invention to carefully introduce the recirculated and reheated air and gas at a special region.

A recovery system is provided for recovering the solvents of the impregnating and/or coating substances. The solvent vapors, which are usually heavier than air, are sucked from chambers G—1 and G—2 of the dryer by means of a fan F—2 via outlets 6 and 7. The fan F—2 is connected to cooler K in which the withdrawn vapors and gases are cooled and the solvent condensed. From the cooler the condensed solvent may be recovered as a liquid. The cooled gas is passed to a washer W—1 where it is cleaned in the usual manner. In the washer the non-condensed vapors are completely, or to a greater or lesser degree, washed out of the gas stream by means of suitable washing mediums. The cleaned and cooled gas is returned to the dryer through a recovery circuit pipe P. Before being introduced into the dryer the cleaned and cooled gas and air mixture is reheated to a selected and predetermined temperature by means of heater L—2. From the heater L—2, the heated gas-air mixture is returned to chamber G—1 via inlet 8. The inlet 8 is located at a special region in the upper part of the dryer and preferably above inlet 5 of the auxiliary re-circulating system. By utilizing the foregoing arrangement a strong and effective air and gas circulation is developed in the dryer which is very helpful and conducive to the efficient and quick evaporation of the solvents and the drying of the impregnated and/or coated web.

In Fig. 2 a modified embodiment of the invention is disclosed. The modified system is practically the same as the system shown in Fig. 1 with the exception that the inlet 8 of the solvent recovery system is located in the upper part of chamber G—2 of the dryer instead of in the chamber G—1. In view of the fact that the entire arrangement of the apparatus in Fig. 2 is the same as in Fig. 1, with the one exception as noted hereinabove, it is not necessary to repeat the description given in connection with Fig. 1.

In some instances, depending upon the product to be manufactured, the kind of solvent used, and the type of impregnating substance employed, it is desirable to utilize a modified dryer such as shown in Fig. 3. It will be observed that the general arrangement is the same as in Fig. 1 but the differences pointed out hereinafter are employed. In addition to partition S—1, a second partition S—2 is employed. By having a second partition, a third chamber G—3 is provided in addition to chambers G—1 and G—2. Guide rollers 11, 12, and 13 are provided at the bottom of partition S—2 and a guide roller 14 at the top of chamber G—3 directly in line with the outlet for the dried web W. The web of textile may be threaded around the guide rollers by use of doors 15, 16, and 17.

The auxiliary circulating system is practically located in the same place as shown in Fig. 1. The solvent recovery system has the same arrangement as shown in Fig. 1 but has additional inlets and outlets. A third outlet 18 is positioned in the bottom of the third chamber G—3. The connections from outlets 6, 7, and 18 in the bottom of the dryer may be connected to a common conduit or junction 19 which is connected to fan F—2 in the usual manner. In the same way, an additional inlet 20 is provided for the solvent recovery system. Inlets 8 and 20 may be connected to a common inlet pipe or junction 21 which is connected to heater L—2 by means of pipe P. By the use of the additional inlets and outlets, a complete circulation may be established in the dryer and a very effective and efficient evaporation of solvent and drying of the vapor can be effected. With the foregoing arrangement, it is possible to widely regulate the drying arrangement and to effect a wide regulation of temperature and distribution of heat, air and gas.

In Fig. 4 a further modification of the invention is shown. In this figure the drying tower is similar to that shown in Fig. 3. It is, therefore, unnecessary to repeat the description of Fig. 3 except to point out that the dryer in Fig. 4 has an additional partition S—3 and an additional chamber G—4. A third set of guide rollers 22, 23, and 24 are mounted over partition S—3. The same number of inlets and outlets are used with the exception that outlet 18 is positioned in chamber G—4 near the bottom of the dryer and inlet 20 is positioned in the same chamber near the top of the dryer. In view of the fact that the arrangements and operations are the same as described hereinbefore they will not be repeated.

In some instances, it is desirable to prevent the reheated gas and air mixture from blowing or impinging directly upon the web of impregnated and/or textile material. For the purpose of eliminating this feature, an arrangement such as shown in Figs. 5 and 6 is employed.

For convenience and simplicity, the present drying arrangement as described and illustrated completely hereinabove is shown in Fig. 5 with most of the parts omitted. It will be observed that a shield Z—1 is provided where the gas streams from inlet 5 enter a drying chamber. Shield Z—1 completely encircles and surrounds web W. For purpose of clarity, outlet 8 is shown in chamber G—2. For the protection of web W, a shield Z—2 is provided. This shield completely encircles and surrounds the web as may be seen from Fig. 6. At the bottom of the drying tower shields Z—3 and Z—4 are located adjacent to outlets 4 and 6 and outlet 7, respectively. By the use of the arrangement of protective shields, it has been found that better results are obtained and that more uniform and even drying is effected. By making the shields of sufficient size, indirect heating may in effect be obtained and a substantially constant and uniform temperature maintained.

By the use of the present invention, it has been found that the formation of blisters, blemishes, and the like, in the impregnating and/or coating layer on a web of textile can be avoided. As is well known, these blisters, blemishes, etc., in prior procedures, had a very detrimental effect on the quality of the finished product and even in some instances rendered fine products useless and unsaleable. The new results have been achieved by conducting the web through chambers formed by means of partitions in a dryer to which a solvent recovery circuit or system and an auxiliary gas-air circulating system are connected. By introducing the reheated gas-air mixture from the auxiliary system and the solvent recovery system at different points or regions in the dryer, it is possible to regulate and control the temperatures lengthwise of the web and also locally, if desired, of the breadth of the web. By fully utilizing the control of the auxiliary circulating system and the solvent recovery system, it is possible to regulate the drying at various depths of the impregnated web and to have the drying proceed gradually. In this manner, the blisters, blemishes, etc., heretofore encountered with prior procedures can be eliminated.

The application of the new principles to dryers with vertical chambers and an associated apparatus as illustrated in the drawings and described hereinabove, makes it possible to obtain the following air-gas feeding and temperature regulations.

If hot air or gas is introduced into the upper part of the chambers of the dryer, then the web conducted into the chamber from below will give up a part of its solvents by the time it reaches the hot air zone. By using the outlets in the lower part of the chambers of the dryer, the hot air blown in near the top of the dryer goes down through the drying chambers and thus cools. This cooling is caused partly by using heat necessary for the evaporation of solvents and partly by inserting heat to the metal parts, etc. of the dryer. In the lower part of the drying chambers only slightly heated air comes in contact with the web, particularly in contact with the incoming freshly impregnated web. Due to the use of a special arrangement of inlets, the heated air is used mainly in the first drying chamber where there are only two chambers. Some of the hot air passes over the partition into the second drying chamber and is sucked downwardly to the outlet. The freshly impregnated web upon entering the dryer has the solvents gradually evaporated therefrom by coming in contact with hotter and hotter air. In the upper part of the first chamber a substantial part of the drying is effected. During the passage through the second chamber the drying is completed. The dry web is withdrawn from the bottom of the dryer in a cool or, in any event, not in a highly heated condition. By using a dryer having a structure similar to the one shown in Fig. 2, it is possible to effect a closer regulation of the temperatures. The amount, temperature and velocity of the stream of hot air introduced at the top of the first chamber and at the top of the second chamber can be carefully controlled so that the desired and selected amount of drying can be accomplished in the first chamber and in the second chamber. In this manner, a finished product having desirable and valuable properties can be obtained. In passing, it is to be noted that the present procedure eliminates uneven and rough surfaces which are produced on webs due to strong drying at first and then followed by slow drying. With the drying of celluloid coatings, it was found that a certain swelling occurred which gave a smooth and even surface when a higher temperature was used in the second chamber as in the present procedure. The swelling caused an increase of thickness in the finished product while materials treated at lower temperatures in accordance with prior procedures showed smaller thicknesses. The difference in thicknesses is between 0.1 to 0.15 mm. It has been found that by use of the present procedure, the impregnating layer and the web of the material remain practically uniform in their cross-section and that there is an even union throughout of the celluloid, particularly with the meshes of the web of textile and that the binding of the coating to the web is intimate and strong.

When the gas and air mixture sucked in by the auxiliary circulating system is heated before introduction to the dryer, the heated air is made more receptive to the solvent vapors because the heating of the air greatly increases the saturation limit of the air for the solvent. It is known that such a condition causes a more favorable effect towards a smooth and blister-free drying of the impregnated web. Further, it permits a close regulation of the temperature in the first chamber of the dryer. The regulation of temperature is effected by means of the size of the selected air heater and by the volume of steam which is sent through the air heater at any given time as well as through the temperature of the steam fed through the air heater. A further adjustment is available by a selection of the fans and by a regulation of the speed of travel of the impregnated web through the impregnation and coating device and through the dryer. When carrying out a procedure in accordance with the foregoing invention, it has been found that the evaporation of the solvent from the impregnated web proceeds in an even and slow manner because the hot air required for the drying contains considerable solvent vapor.

I claim:—

1. The process of drying a web of textile which has been impregnated, coated and the like which comprises moving an impregnated textile web upwardly in a drying chamber, introducing hot gas at an intermediate region in the path of travel of the web, passing a stream of hot gas downwardly in contact with said upwardly moving web to evaporate the solvents from said web and to dry the same, removing a predetermined part of said gas from a region near the bottom of said chamber for recirculation, and withdrawing the remainder of said gas from said region for the recovery solvent therein.

2. The process of drying a web of textile which has been impregnated, coated and the like which comprises moving an impregnated textile web upwardly in a drying chamber, introducing hot gas at a plurality of points at an intermediate region in the path of travel of the web, passing a stream of hot gas downwardly in contact with said upwardly moving web to evaporate the solvents from said web and to dry the same, removing a predetermined part of said gas from one point in a region near the bottom of said chamber for recirculation, withdrawing the remainder of said gas from a second point in said region for the partial recovery of solvent therein and subsequently returning said gas containing residual solvent vapor to the drying chamber.

3. A dryer for drying a web of textile which has been impregnated, coated and the like which

comprises a vertical chamber divided into a plurality of vertical, connected compartments by at least one partition, a plurality of spaced inlet ports located near the top of the dryer for introducing hot gases for drying an impregnated web, a plurality of spaced outlet ports located near the bottom of the dryer for removing cooled gases and evaporated solvents, an auxiliary circulating system connected to one of said inlet ports and one of said outlet ports for withdrawing cooled gas and then reheating and returning it to the dryer, and a solvent recovery system connected to one of said inlet ports and one of said outlet ports for withdrawing cooled gas and evaporated solvent and for recovering the solvent and for reheating and returning the solvent-free gas to the dryer.

4. A dryer which comprises a plurality of vertical chambers connected together, inlet means located near the top of said chambers at different points for introducing hot gases, and outlet means located near the bottom of said chambers at different points for removing cooled gases and evaporated solvents, said inlet ports being provided with protective shields located at least at the inlet ports for protecting an impregnated web against direct impingement of an incoming stream of hot gas.

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