May 8, 1945. M. CROCE 2,375,403

PROCESS OF IMPREGNATING A WEB

Filed Sept. 14, 1940

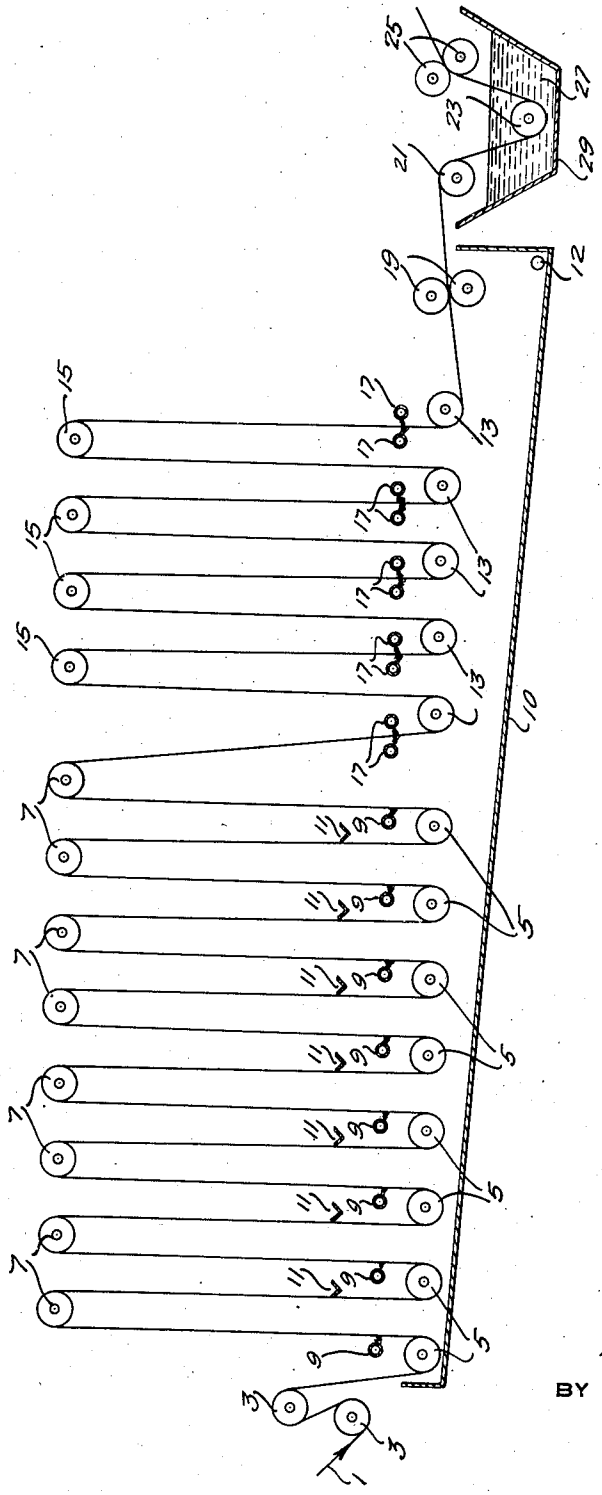


Fig. 1.

INVENTOR
MICHELE CROCE
BY Alfred F. Ernst
ATTORNEY

Patented May 8, 1945 2,375,403

UNITED STATES PATENT OFFICE

2,375,403

PROCESS OF IMPREGNATING WEBS

Michele Croce, Buffalo, N. Y., assignor to Certain-Teed Products Corporation, New York, N. Y., a corporation of Maryland

Application September 14, 1940, Serial No. 356,788

2 Claims. (Cl. 117—68)

This invention relates to processes of and apparatus for impregnating a felted web. The invention especially relates to the impregnation of felted webs with thermoplastic materials, and particularly with asphalt saturants, for weatherproof roofing.

In the practice of impregnating felted webs, such as those which are prepared in a paper making process, impregnating materials of various kinds are used, especially those which are of such character that, after absorption in liquid form by the felted structure of the web, they fill up and more or less solidify in the pores of the fibrous material and the interstices or voids between the fibres. In the manufacture of weatherproof roofing materials it is common to impregnate with a bituminous saturant, such as asphalt, a felted web formed on a paper-making machine from stocks of rags, paper, wood and other fibrous materials. Especially with thermoplastic impregnating materials, such as asphalt, which for practical impregnation processes require heating to produce the fluidity and reduce the viscosity of the saturant to be absorbed by the felted web, there arises the condition that the amount of such saturant which is carried by the sheet after it is cooled to normal temperatures is limited because the thermoplastic saturant in its expanded condition upon heating fills the felted structure and upon subsequent cooling thereof contracts within the felted structure of the web. In the manufacture of roofing by ordinary methods this problem is well recognized and it is known that not as much asphalt is contained within the cooled impregnated felted web as would be the case if the voids or spaces formed by the contraction of the asphalt, particularly as it recedes from the surface of the sheet toward the center of the felted structure, could be filled up with asphalt.

It is an object of the invention to carry out the process of impregnating the felted web, particularly a felt to be impregnated with a thermoplastic saturant such as asphalt, in such a manner that the voids or spaces formed by contraction of the cooled saturant shall be filled up with saturant to the greatest practical extent.

It is especially an object of the invention so to carry on the filling up of these voids or spaces that access of air or moisture to these voids or spaces is prevented until the usual sealing coating is applied to the faces of the web thereafter to prevent entrance of air or moisture.

In the manufacture of roofing it is common practice to apply such a sealing coating upon both faces of the saturated web, said coating being of such character and of such thickness as effectively to seal the impregnated structure against further access of air and moisture. The material used as coating upon a roofing sheet is usually a so-called high melting point asphalt which melts at a higher temperature than that which is used for the saturating of the web. Such a high melting point asphalt is less fluid and more cohesive and, therefore, serves as a better seal for the web when applied upon the surface of the impregnated web. Moreover, it resists being drawn into the felted structure more than the low melting point asphalt used as saturant. On the other hand, the low melting point asphalt used for impregnation of the web makes it possible to secure the fluidity of the heated asphalt necessary for easily wetting the fibres and complete filling of the pores and voids without increasing the temperature of the asphalt above atmospheric temperature to such a degree as to injure the fibres by overheating and scorching. In the saturant asphalt of low melting point it is desired to have a sufficient fluidity and a viscosity of such low degree that the capillary action of the fibres of the felted web will rapidly take up the saturant and that this absorptive action will continue even though the temperature of the asphalt saturant reduces during the process of impregnation.

The invention purposes to fulfill the requisite conditions for impregnating a sheet, particularly a roofing sheet, as above outlined, while preventing entrance of air and moisture into the impregnated structure during the cooling of the sheet and its absorbed saturant and to continue this safeguard against entrance of air and moisture until the sheet has reached a condition, particularly a condition of reduced temperature, at which the coating of high melting point may be applied to the impregnated web. Moreover, the invention secures an increased content of saturant so that the web or finished sheet of greater weather-resisting capacity is obtained. By the practice of the invention the impregnated web becomes prepared for receiving the sealing coatings in a condition which insures a minimum of subsequent contraction of the impregnating saturant and with a minimum but sufficient entering of the higher melting point asphalt into the voids created by the receding saturant to insure that the coating is securely bonded to the impregnated web.

It has heretofore been proposed to apply saturants, such as asphalt, to a web with reduction of the temperature of the saturant. In some

cases the proposal has been to pass the web containing a certain amount of saturant through a cooling zone to insure the contraction of the saturant and thereafter to fill up the voids created by this contraction with subsequent applications of saturant at a cooler temperature. It also has been proposed to pass a web impregnated with a saturant and cooled to a certain degree into a bath of higher melting point saturant at a higher temperature. Thereafter the web is passed successively through successive baths of said high melting point asphalt at successively lower temperatures.

The invention proposes to apply a saturant, such as asphalt, to a felted web, preferably in the manner disclosed in the patent to Miller No. 1,636,750. In this patent a continuously moving felted web passes adjacent a series of sprays or jets spaced apart in the direction of the movement of the web. The jets are arranged with respect to one face of the web so as to direct thereagainst a jet or spray of the saturant heated to a temperature to secure the necessary fluidity for capillary absorption of the saturant by the felted structure of the web. The temperature of the saturant for such absorption may be between 350° to 500° F. With the ordinary asphalt saturants commonly used in the manufacture of roofing the temperature of the saturant preferably is between 425° to 475° F. In the practice of the process of the Miller patent the saturant is delivered to all of the sprays or jets substantially at the same temperature, being pumped thereto from a still or other source of heated saturant by a common pump in excess of the amount which can be absorbed by the felted structure in the passage thereof from one jet to another. As disclosed in said patent, the application of saturant at one face of the web serves to drive out the air and moisture at the other face of the web. The application of saturant at said one face may be continued until the saturant appears at the opposite face of the web so as to color the whole area of said opposite face of the web or such part thereof as will indicate substantial approach to complete filling of the felted structure with the saturant at its temperature so that upon subsequent dipping of the web in the bath of asphalt the saturation of the web will be complete.

In the passage of the web as it is being saturated between jets or sprays, particularly in view of the feature of the process of the Miller patent by virtue of which the sheet travels through a distance providing a substantial time for the absorption of the saturant, some cooling of the web and its absorbed saturant takes place. In order to insure the absorption of the asphalt received by the sheet from subsequent sprays scrapers are provided as disclosed in the patent to remove any skin of congealed asphalt which may have developed during such travel of the web. In the further travel of the web between sprays, and subsequent to the last spray before dipping the sheet into a dip tank as disclosed in the patent, cooling of the sheet causes contraction of the asphalt and may cause the formation of voids into which air and moisture may enter and in which they may become entrapped. This air and moisture may be sealed in the felted structure by the saturant applied to the web as the web passes through the dip tank.

It is a feature of the invention that the application of the asphalt saturant to one face of the web, as proposed in the Miller patent, in what may be called the "hot section" of the apparatus, is carried out with such repeated applications of the hot saturant at points spaced sufficiently close together that a continuous film or layer of the saturant is carried upon said face of the web. This continuous film or layer of saturant upon said face of the web acts as a barrier to prevent the access of air and moisture at that face during the time necessary for the saturant to impregnate the web and be carried completely therethrough. When the saturant appears at the opposite face of the web, and especially when it has colored the opposite face to a high degree, preferably when it has completely colored said opposite face, application of saturant is continued at said first face of the web and saturant also then is applied at said opposite face of the web. The application of the saturant may be made to said opposite face by sprays or jets in the same manner as to said first face of the web. Said application of saturant at both faces is made, according to the invention, before the saturant and the web have cooled to such substantial degree as to draw into the felted structure so much of the saturant carried by the web as to leave portions without the barrier layer. It is desirable in impregnating the web at the first face thereof that said impregnation be carried out until a substantial layer of the saturant forms upon the opposite face of the web. By maintaining the temperature of the applied asphalt during its application at said first face of the web the impregnation is insured and the air and moisture are completely driven from the web. Immediately thereafter the barrier layers of saturant which prevent the access of air or return thereof into the felted structure are applied to and are maintained upon both faces of the web while it cools. These barrier layers of saturant preferably are maintained upon the impregnated web until the web has cooled to the greatest possible extent, that is, until further application of saturant no longer can be made because sufficient fluidity for absorption and for handling thereof cannot be secured.

Within the scope of the invention, and utilizing the ordinary asphalt saturants commonly used in the manufacture of roofing, the temperature of the saturant applied to both faces of the web, in this second part of the process in what may be called the "cold section" of the apparatus, may gradually be reduced from that first applied to both faces, which may be of the degree of 350° to 500° F., until the temperature of the saturant so applied to both faces is of the degree of 225° to 275° F. In some cases and with some asphalts a lower temperature of the saturant finally applied at both faces may be used. Part of the saturant thus carried as barrier layers upon the faces of the web will be absorbed into the felted structure as the impregnating saturant therein contracts and recedes from the surface of the web upon cooling thereof. Suitable limitation of the amount of the saturant so carried by the faces of the web may be made and any excess thereof may finally be removed just prior to delivery of the fully impregnated and filled up web to the usual coating apparatus for applying to the faces of the web the high melting point asphalt forming the sealing coating.

This sealing coating, being applied to the completely filled up web impregnated with the saturant substantially at the lowest practical temperature of the web and its impregnating saturant, for practical purposes may be at a temperature somewhat above the temperature of the impregnated web as it arrives at the coating

apparatus. Any expansion of the saturant contained within the felted structure of the web caused by the hotter sealing coating will be counteracted and the saturant thus expanded will be reabsorbed by the felted structure of the web upon again cooling as the coated web passes from the coating apparatus. Preferably, however, the coating operation is also carried out at as low a temperature as is practical for maintenance of sufficient fluidity in the high melting point asphalt for said application thereof to the impregnated web.

From the above description it will be understood that the invention improves upon the processes of the prior art by providing a barrier layer of the impregnating saturant itself, which may be the same type of material as that contained in the "hot impregnated" web. These barrier layers, however, within the scope of the invention may be of such type compatible with said hot impregnation of low melting point that the barrier layers can be applied at temperatures still lower than those at which the hot impregnation can be applied and in some cases below the melting point of said hot impregnation. The invention thus provides for control of the temperature of the barrier layers of saturant so that further absorption may take place from these barrier layers as the web cools to secure a web impregnated with a homogeneous impregnating material or a web filled up with compatible saturants to the greatest practical extent. During this period of absorption with concomitant cooling of the web prevention of access of air and moisture to the web structure is accomplished by the barrier layer which makes effective the subsequent application of the sealing coating heretofore commonly used and used likewise in the product of the invention.

Within the scope of the invention, also, the temperature of the saturant applied at both faces of the web whether of the same type as the saturant applied in the "hot section" or one of lower melting point compatible therewith, may be substantially lower than the temperature of the web fully impregnated with "hot saturant" throughout the whole of said application at both faces of the web. Thus, for example, immediately after completely filling the web from one face with saturant at the relatively high temperature of 425° to 475° F., "cold saturant" at a temperature of 250° to 275° F. may be applied at both faces. This cooler saturant continuously applied will serve to cool the web and its impregnating "hot saturant." The heat thus absorbed by the "cold saturant" applied at both faces of the web will serve to keep it fluid and offset to that degree the chilling which occurs at the outer face of the sealing film or layer of "cold saturant." Moreover, further application of saturant, if need be, may be made to both faces of the web to maintain the temperature of the barrier layers at the degree of 250° to 275° F. to maintain the necessary fluidity for absorption and filling up of the voids and spaces created by the contraction of the previously absorbed "hot saturant."

By using saturants which are compatible with the hot saturant impregnating the web applied thereto at one face thereof in order to drive out the air and moisture from the opposite face thereof but which have a melting point below and in some cases a marked degree below that of the hot saturant, further advantages are obtained by the process of the invention. If, for example, a saturant having a melting point of 90° F. and of such composition as to be compatible with the hot saturant having a melting point of 150° F. is used as the "cold saturant" applied as barrier layers as above described, the temperature at which this "cold saturant" may be applied may be of the degree of 125° to 150° F. in order to obtain the requisite fluidity for such application. The temperature at which "hot saturant" must be applied when used as "cold saturant," however, must be of the degree of at least 200° to 225° F. in order to obtain the necessary fluidity for delivery of this saturant to both faces of the web to form the barrier layers. Thus a lowering of the temperature of the barrier layers is used to the degree of 50° to 100° F. below what would be possible by the use of the usual saturant for the barrier layers, that is, one which is the same as that used for the "hot saturant" in the "hot section" of the apparatus. A substantial increase in the amount of contraction of the impregnating asphalts thus may be accomplished before delivering the web, filled up with an increased amount of saturant, to the coating apparatus for applying the sealing coating of high melting point. The invention includes within its scope the application of saturants of such low melting point at such low temperatures, as compared with the melting point of the saturant which impregnates the main portion of the felted structure of the web and its temperature of application, that a substantial increase in the contraction of the saturant so impregnating the main portion of the web is secured with concomitant increase in the total amount of the saturant which is carried by the web and the substantially complete avoidance of voids and air pockets which otherwise would become sealed in the impregnated web by the sealing coating of higher melting point.

The difference in temperature between the hot saturated sheet and the cold saturant secures a marked increase in the amount of saturant which will be carried by the completely impregnated and coated web. This increase may be of the degree of 8 to 13% and in some cases greater. As the coefficient of the contraction of asphalt is about .0004 per degree F. of temperature, a reduction in the temperature of the asphalt saturant impregnating the web, for example, from 450° to 250° F., that is 200° F., corresponds to 8% increase in the amount of saturant contained in the impregnated web when filled up with saturant drawn from the barrier layers. If the temperature reduction were effected by barrier layers at 125° F., representing a reduction of 325° below 450° F., the increase in saturant carried by the web would be 13%.

For the purpose of applying the barrier films or layers of saturant to both faces of the web any suitable apparatus may be used. Preferably, however, in addition to the "hot section" such as is shown in the Miller patent a similar set of rolls is provided in the "cold section" affording a substantial length of travel of the web, with sprays or jets placed at both sides of each stretch of the web between rolls. It is an important advantage of this arrangement that the cooling of the web and its contained saturant is rapidly effected in the air where the heat may be readily dissipated.

The drawing shows a diagrammatic elevation of the apparatus of the invention.

In the drawing the web 1 of dry felt of the character commonly used in asphalt roofing is delivered to the apparatus over tension rolls 3 from which, in the manner illustrated in the Miller

Patent No. 1,636,750, the web passes under lower rolls 5 and thence upward over rolls 7 and downward again to the next roll 5. In the particular embodiment illustrated, adjacent each stretch of the web as it leaves a roll 5 and travels toward a roll 7 a spray or jet pipe 9 is arranged for directing a jet or spray or stream of asphalt against the web. It will be noted that the spray or jet pipes 9 all are arranged so that the jet or stream will be directed against the same face of the web 1 as it travels upon rolls 5 and 7. As many rolls and spray pipes are utilized as will secure the application of the asphalt at said first face of the web in sufficient amount and at sufficiently repeated intervals to provide the asphalt which will be absorbed by the web and to drive the air and moisture out at the opposite face of the web 1 and, as well, to form and maintain the barrier layer of asphalt upon said face of the web. If desired, on each downward stretch of the web between the rolls 7 and 5 a scraper 11 may be arranged to remove any surface portion of the asphalt layer carried upon the face of the web which may be congealed as the web passes upward and over and downward from the roll 7. Preferably the scrapers 11 and jets 9 are placed close to the rolls 5 to avoid any substantial contraction before the next application of asphalt by a jet 9.

When the web 1 has absorbed asphalt applied at said first face thereof so that the asphalt appears at the opposite face of the web and preferably colors the whole of said opposite face of the web with a substantial or a complete wetting of the opposite face, the web is delivered to the second or "cold section" of the apparatus where asphalt is applied at both faces of the web as above described. In Fig. 1 the rolls 5 and 7 and the jets 9 are assumed to provide sufficient application of asphalt to produce the wetted condition just described with a given structure of the felted web and a given character of the saturant utilized. Thereafter the web passes downwardly from the last roll 7 to and under a roll 13 and upwardly and over roll 15 and thereafter downwardly and under rolls 13 and upwardly and over rolls 15. In this portion of the apparatus to which the invention particularly relates asphalt is applied at both faces of the web by means of spray pipes 17 which apply and maintain the barrier layers of asphalt on said faces. After passing the last roll 13 the web 1 with its barrier layer of asphalt on both faces thereof may be passed between control or doctor rolls 19 or other device for removal of any asphalt in said barrier layers which is in excess of that which is required just to fill the sheet as it reaches the apparatus for the application of the sealing coating.

A sufficient number of rolls 13 and 15 and of jets 17 is used to secure the application of the saturant of low melting point at both faces of the web 1 at sufficiently close intervals and in sufficient amount to maintain the barrier layer upon each face of the web during the cooling of the web in its passage from the last roll 7 to the apparatus for applying the sealing coating of high melting point asphalt. As has been explained, during this cooling saturant from the barrier layers will be drawn into the structure of the web as the saturant previously absorbed at the higher temperature recedes because of its contraction. The barrier layers are maintained upon the web on both faces thereof in sufficient thickness and uniformity over the faces of the web to insure that entrance of air and moisture into the web following the receding saturant as it cools is prevented.

The temperature of the saturant applied by means of the first spray or sprays 17 may be substantially that of the saturant applied by sprays 9. The temperature may be gradually reduced from that which is applied by the first pair of sprays 17 to that which is applied by the last pair of sprays 17 past which the web 1 moves. As this gradual reduction, however, may involve the use of numerous pumps to deliver the saturant to the sprays or jets 17 in the several steps of reduced temperature, it is preferable to apply the saturant to the web 1 by means of the first sprays or jets 17 at as low a temperature as is practical and saturant of such low temperature, that is, "cold saturant," may be applied by all sprays 17. The low melting point saturant at lower temperature than that in the "hot section" of the apparatus, however, may be applied in two steps or a limited number of steps of temperature to prevent undue immediate congealing of the "hot saturant" which has been absorbed by the web in passage thereof over the rolls 5 and 7 of said first section. In any case it is the aim of the invention to apply the saturant by means of the jets 17 so that the barrier layers carried thereby will be at as low a temperature as is practical just prior to delivery of the web to the apparatus for applying the sealing coating. Such a temperature will be that which will insure that the saturant is fluid enough to be pumped and sprayed and absorbed by the voids left by the receding hot saturant but low enough to produce before it sets substantial cooling and the greatest amount of contraction possible before application of the sealing coating.

This coating apparatus may consist of the roll 21, which receives the completely filled up and cooled web 1 from the rolls 19, and the rolls 23 and 25 under which and between which respectively the web 1 passes to carry it through the bath of coating asphalt 27 contained in the pan 29. Thereafter the coated web may be treated in any of the usual finishing processes commonly used in the roofing industry.

Beneath the sets of rolls 5 and 7 and 13 and 15 is arranged a pan 10 which serves to catch and drain towards one end thereof, the righthand end in the embodiment illustrated in Fig. 1, the excess of asphalt which may drip from the web 1 and the rolls over which it passes. If the saturant which is applied to the web 1 by means of the spray 17 is substantially the same as that which is applied by means of the sprays 9, these excesses may be collected in the common collecting pan 10 as shown and returned to the still for reheating for delivery to jets or sprays 9 or the collected excesses, especially if cooled, may be supplied directly to the jets 17 or may be mixed with saturant of lower temperature which is to be applied by the jets 17. Removal of the excess caught by the pan 10 may be effected through a pipe 12. If desired, however, separate collecting pans may be provided for the "hot" or "cold" sections and the excesses thereby kept separate to be returned to their respective supplies. Saturants of different character but compatible with each other thus may be used in the two sections.

The process of the invention may be practiced by other apparatus which will insure the application of the saturating asphalt at one face of the web until the web is completely filled with asphalt at the high temperature of the hot section and which apparatus also will insure the subsequent application at both faces of the web of saturating asphalt of the same or such com-

patible composition and capillary properties as to be absorbed by the felted structure to complete the impregnation in a manner comparable to and compatible with the asphalt which is used to impregnate the web in the hot section. The web thus becomes completely filled up by the process of the invention with saturant which is of substantially homogeneous character or with saturant of substantially the same effectiveness. The web may then receive its sealing coating of high melting point which will remain, as it is intended, upon the surfaces of the web while suitably gripping the saturated web without being unduly drawn thereinto to follow the receding saturant as is the case with roofing sheets in the present practice.

It should be noted, however, that the preferred method and apparatus which utilizes a set of rolls 13 and 15 and jets 17 for applying the saturant to both faces of the web in jets or sprays makes it possible to pass the web through the air for a long distance while maintaining thereon the barrier and cooling layers. This cooling is more effective than that which can be secured by passing the web through a bath of the saturant at lower temperature because the heat removed from the web may be dissipated more easily in the air. Moreover, the temperature as well as the amount delivered and thickness of the barrier layers to effect the filling up of the web may be controlled so that the proper condition of the web as it is delivered to the coating apparatus 21, 23, 25 is insured.

For the purpose of full understanding of the invention, note is made that the melting points of low melting point asphalts commonly used as saturants for impregnation of roofing materials are generally in the range between 90° and 150° F. The melting points of the high melting point asphalts which are commonly used for sealing coatings applied to the impregnated sheet are generally in the range between 200° F. and 235° F. For the purposes of the invention the melting point of the "cold saturant" asphalt may, however, be as low as about 75° F. particularly for carrying out that phase of the invention described above which utilizes a saturant of lower melting point than the commonly used low melting point asphalts. For the purposes of the invention the melting point of the "hot saturant" may be as high as 175° F.

Having thus described my invention, I now claim:

1. Process of impregnating a felted web with a saturant which comprises applying at one face of the web a thermoplastic saturant heated to a condition of fluidity readily to impregnate said web and in an amount to maintain substantially a continuous fluid layer of the saturant upon said face of the web preventing entrance of air and moisture at said face of the web, continuing said application to said face of the web to drive out air and moisture at the opposite face of the web until the impregnating saturant appears at said opposite face of the web, thereafter before substantial contraction of said impregnating saturant occurs applying a thermoplastic saturant to both faces of said web so as to maintain a substantially continuous fluid layer of said saturant upon both faces of the web preventing entrance of air and moisture at said faces, and gradually cooling said web during the application of said saturant to both faces with concomitant contraction of the impregnating saturant carried thereby, said thermoplastic saturant applied to both faces of the web being in a condition of fluidity and impregnating capacity similar to that applied at said first face so as to flow into and fill up the voids left by the contraction of the impregnating saturant.

2. Process of impregnating a felted web with a saturant which comprises applying at one face of the web a thermoplastic saturant heated to a condition of fluidity to be absorbed by the felted structure of said web and in an amount to maintain substantially a continuous liquid layer of the saturant upon said face of the web as a barrier against entrance of air and moisture at said face, continuing said application to said one face of the web until the air and moisture are driven from said web at the opposite face thereof and the impregnating saturant appears at said opposite face of the web, before substantial contraction of said impregnating saturant occurs applying to both faces of the web a thermoplastic saturant in a similar condition of fluidity and in impregnating capacity so as to form barrier layers of liquid saturant preventing access of air and moisture to said web at said faces, continuing the application of the saturant simultaneously at both said faces of the web to maintain a barrier layer upon each face of the web, gradually cooling said web during the application of saturant to both faces with concomitant absorption of the saturant therefrom, the amount of saturant in said barrier layers being sufficient to supply that absorbed by the impregnated web upon such cooling and as well to maintain said barrier layers throughout the cooling of said web to a temperature suitable for application of a sealing coating, and applying said sealing coating to the cooled web permanently to prevent access of air to the impregnated structure of the web.

MICHELE CROCE.