June 10, 1930. W. G. DUDLESTON 1,762,329

METHOD OF AND APPARATUS FOR SATURATING SHEET MATERIAL BY CALENDERS

Filed June 11, 1926

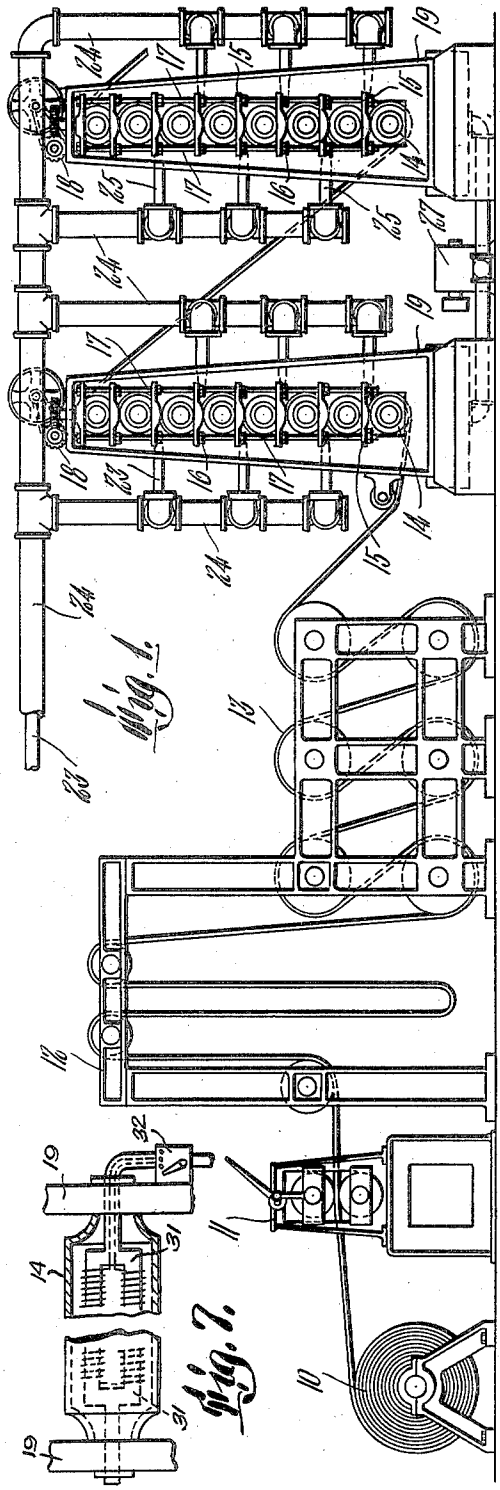


Fig. 1.

Fig. 7.

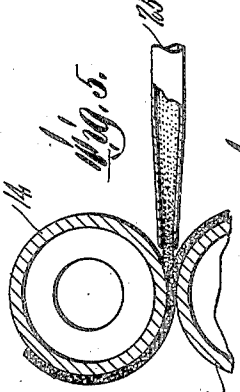


Fig. 5.

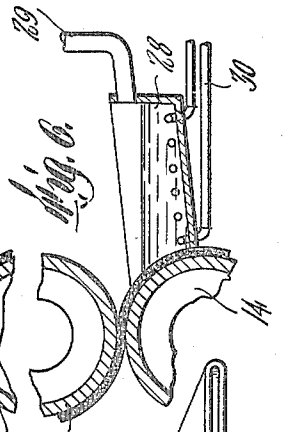


Fig. 6.

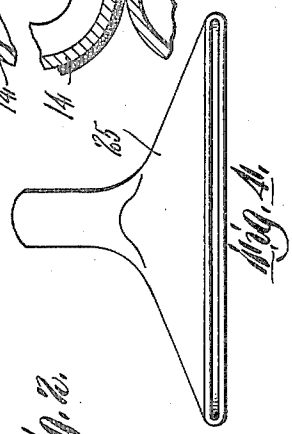


Fig. 4.

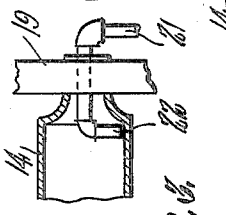


Fig. 3.

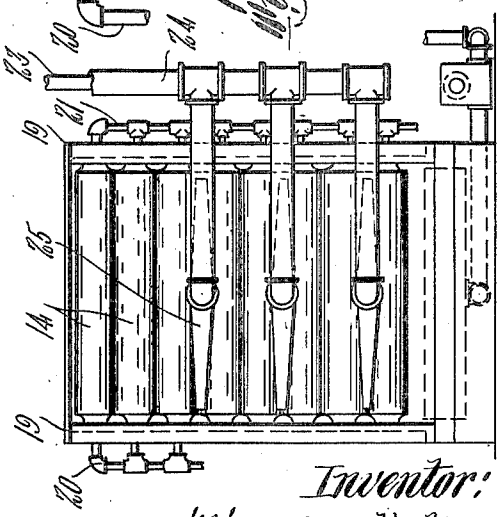


Fig. 2.

Inventor:
William G. Dudleston,
by Wright, Brown, Quinby & Macy
Attys.

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UNITED STATES PATENT OFFICE

WILLIAM G. DUDLESTON, OF CHICAGO HEIGHTS, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE PATENT AND LICENSING CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

METHOD OF AND APPARATUS FOR SATURATING SHEET MATERIAL BY CALENDERS

Application filed June 11, 1926. Serial No. 115,289.

This invention relates to a method of and apparatus for saturating sheet material, and is more particularly designed for the continuous progressive saturation of a web of indeterminate length, being also especially suitable for webs of comparatively slight tensile strength.

Apparatus embodying my invention finds a field of utility in the manufactured roofing art. A large amount of the manufactured roofing of today is made of sheets of felted fibrous material which are saturated and coated with asphaltic compounds, and further treated in various ways. The material commonly used as a base for such roofing is made from a pulp of rag or asbestos fibers, or the like, which is formed into continuous sheets in a paper-making machine, the fibers being loosely felted together as the sheet is formed. Sheet material of this kind, known as "roofing felt", is ordinarily of a relatively loose, porous texture, capable of absorbing a considerable quantity of saturant. It has, however, relatively low tensile strength so that the problem of feeding such material without subjecting it to more than moderate tensile stresses is one which demands consideration in the construction of a machine to handle and operate upon it. This is particularly true of the step of saturating with a liquefied asphaltic compound. The liquid asphalt is of an oily consistency, and has a tendency to lubricate the interfelted fibers, thus reducing further the tensile strength of the sheet. In order to fill up the pores and voids between the fibers in the sheet by immersing the sheet in a pool of saturant, the saturant must have a relatively high degree of fluidity, preferably combined with alternating changes of pressure to allow the air or gases caught in the pores to escape and to force the saturant thereinto. Where commonly used asphaltic compounds are employed as saturants, the fluidity is usually obtained by heat while the pressure changes may be effected by leading the sheet down and up a number of times in a deep body of saturant, the head of the liquid producing the increased pressure.

In order to obtain sufficient fluidity of the saturant without raising it to a prohibitive temperature which would tend to scorch or injure the fibrous sheet, it is necessary to use a relatively low melting-point asphalt which is not as desirable for roofing elements as a relatively high melting-point asphalt since it is liable to be liquefied on the roof by mid-summer heat. It is not practicable, however, to use the high melting-point asphalt as a saturant by the methods now commonly employed since the sheet cannot be subjected to the temperatures necessary to melt such asphalt for a period sufficient to insure thorough saturation without injury to the fibers by scorching or charring. According to common present practice, the sheet is led through a pool of low melting-point asphalt of considerable size in order to provide sufficiently extensive immersion for thorough saturation. The Immersion step may be carried out by leading the web beneath the surface of the saturant at one end of a container of considerable length, extending it through the saturant for substantially the entire length of the container, and leading it out at the further end. Or series of upper and lower rolls may be provided in a container of considerable depth, the web being passed over the upper and lower rolls alternately. In either case, a considerable length of web is drawn through the body of the saturant against the skin friction of the saturant on the rough fibrous faces of the web. This dragging action combined with the weakening effect of the saturant upon the fibrous structure of the web renders the latter liable to breakage, particularly if for any reason the viscosity of the saturant happens to increase. As a result, it is necessary to keep a relatively large body of saturant at a given temperature and it is also necessary to devote a considerable amount of floor space in a plant for the saturating pool. The tops of these pools are frequently flush or nearly flush with the floor level, a source of danger to the workmen attending the apparatus.

By my invention, I provide apparatus

which occupies relatively little floor space, which enables felted sheet material to be fed through the saturating process with very little tension on the sheet and hence practically no danger of breakage of the sheet, which eliminates the necessity for a large pool of saturant, incidentally eliminating also the source of danger which is often occasioned by the location of such a pool and which accomplishes the thorough saturation of a sheet of material, such as roofing felt, with an asphalt of considerably higher melting point than is possible with the ordinary saturating means now in common use. By my invention, the saturation of a sheet is accomplished by first passing the sheet through a stack of calender rolls which press the sheet firmly therebetween, liquid saturant being flowed upon a face of the sheet immediately prior to its passage between each pair of the rolls, so that the saturant is rolled together with the web and is pressed thereinto and therethrough. This step of squeezing and pressing the felt sheet and the saturant is effective only to the extent of thoroughly coating or "wetting" the individual fibers in the sheet. Further squeezing of the sheet prevents the further absorption of saturant; in fact, once the fibers are wetted, squeezing the sheet tends to press saturant out of the sheet, after the manner of a wringer pressing from a wet towel water that has been taken up and held in the voids between the fibers. In order to complete the saturation of the sheet therefore, it is necessary to follow the squeezing process by further treatment to fill up the voids or pores in the sheet. This may be accomplished by pressing saturant against a face of the sheet without squeezing the sheet. This may be done by passing the sheet through a stack of rolls which are supported with sufficient clearance to permit the passage of the sheet and a layer of saturant. By flowing the saturant on the sheet as it comes into contact with each roll, the liquid is caught between the sheet and roll and is pressed into the pores of the felt without any squeezing of the sheet itself. The saturating action of the rolls can be made more effective by suitable temperature control. If the temperature of the sheet, after being thoroughly "wetted" with saturant, is progressively reduced in the presence of excess saturant, the contraction of the saturant and residual air in the sheet occasioned by the cooling, draws more of the saturant into the sheet. This feature of temperature control may be carried out by regulating the steam admitted to successive rolls in a stack so that each successive roll in the stack is cooler than the one before it. Thus for example a sheet of roofing felt is passed through a calender stack and squeezed between the nips with asphalt at a temperature of about 450° F., wetting all the fibers thoroughly. Next, the sheet is passed through another calender stack with spaced rolls to obviate squeezing the felt. Excess saturant is supplied to both faces as required during the passage of the sheet through the stack and the cooling of the sheet by the successively lower temperatures of the rolls contracts the asphalt and air within the pores and sucks more saturant in. This sucking action in conjunction with the pressing of the rolls against the sheet effects a high degree of saturation.

Further details of structure and advantageous features will be set forth in the description which follows and are disclosed on the drawing, of which:

Figure 1 is a side elevation of the apparatus including an embodiment of my invention, part of the apparatus being diagrammatically shown.

Figure is an end elevation of a set of calenders.

Figure 3 is a fragmentary showing partly in section of a calender, showing the method of supporting and heating the same.

Figure 4 is a view of a spout for supplying liquid saturant to the sheet.

Figure 5 is a sectional view showing the manner of application of saturant through a spout to the traveling sheet.

Figure 6 shows an alternative means of applying the saturant to the sheet.

Figure 7 shows an alternative heating means for a calender roll.

Referring to the drawing in detail, 10 represents a supply roll of sheet material, such for example as "roofing felt." In order to maintain a continuous length of sheet to pass through the machine, a splicing device generally indicated at 11 may be supplied to join the ends of successive rolls together, a looping device indicated at 12 being supplied to provide a reserve supply of sheet to feed through the apparatus during the splicing of ends in the splicer 11. The sheet of felt is preferably preheated as by a series of heated rolls 13 of which there may be any desired number, and which may be heated in any desired way, as for example by steam pipes connected as shown in Figure 3. The preheated sheet may then be led through a calendering mechanism comprising a plurality of calender rolls 14 which for economy of floor space and utilization of gravity pressure may be arranged in superposed relation. The rolls 14 are each supported on a cross bar 15 at each end of the roll, these cross bars 15 resting on nuts 16 which are adjustably mounted on screw-threaded vertical rods 17 which pass loosely through perforations in the cross bars 15. The nuts 16 are so arranged on the rod 17 that when the latter are raised by a motor-driven mechanism

indicated at 18, the nuts thereon will successively separate the calendering rolls, thus permitting the rolls to be threaded with facility. The rolls with the associated mechanism may be supported as by a suitable standard or framework 19. The construction of the stack of calender rolls per se is well known in the art, a stack of this type being described in Patent No. 762,211. It is preferred that the rolls 14 be heated to maintain the saturant in fluid condition and to prevent sticking of the sheet to the rolls. This may be done by any desired means suitable for the required temperatures, the temperature used being determined by the characteristics of the saturant employed. In the embodiment shown in the drawing means for heating the rolls by steam have been indicated in Figures 2 and 3, the piping being omitted from Figure 1 to avoid undue complication of detail. As shown in Figure 3, steam may be introduced through a supply pipe 20, the pipe entering the hollow roll by a suitable packed joint such as is well known in the steam-fitting art. The exhaust pipe 21 may be led in through the opposite end of the roll, the end 22 being preferably turned down in order to exhaust from the bottom of the roll any condensed liquid which may be formed there. Valves may be employed on the branches of the pipes 20 and 21 to regulate the steam supply to the several rolls. Instead of steam for heating the rolls, I may use electricity, burning or heated gases, heated oil, or any other heating agency suitable for the purpose, together with means for regulating the temperatures of the individual rolls.

As indicated in Figure 1, the saturant is preferably flowed on to a surface of the sheet immediately before it enters the nip of a pair of successive rolls. As the sheet is threaded back and forth between the successive rolls, saturant is flowed alternately on the two sides of the sheet and from opposite sides of the stack of rolls. The hot asphalt may be supplied through pipes 23 which are preferably steam jacketed by surrounding pipes 24 in order to maintain the asphalt passing therethrough at the desired temperature, and to prevent premature cooling thereof which would quickly clog the supply pipes 23. At the delivery end of the supply pipes 23, suitable nozzles 25 are preferably attached, these nozzles being elongated horizontally as indicated in Figure 4 to supply a liquid sheet of saturant to the entire width of the traveling felt sheet. In order to insure thorough saturation, it is preferred to supply an excess of saturant beyond what the sheet can absorb, the excess being caught as by pans 26 and returned by suitable pumping means 27 to the heated reservoir from which the asphalt is supplied to the pipes 23.

Instead of supplying the saturant in streams from nozzles 25, I may substitute for the nozzles, pans or containers 28 which are supplied with liquid saturant as by pipes 29 and may be maintained at the proper temperature as by steam pipes 30 or other equivalent heating means. The pans 28 are constructed with an open end, the sides adjacent that end being of curved shape to permit the pans to be positioned adjacent to the rolls with a very slight clearance between the pan and the surface of the felt sheet. In this form of construction, the sheet in passing comes in contact with the body of saturant contained in the pan 28 and picks up a coating of saturant which is carried therewith to the nip of the rolls. The layer of saturant deposited upon the sheet either by a nozzle 25 or by a pan 28 is worked into the felt as it passes between a pair of rolls, the pressure of the rolls serving to squeeze the sheet and to press the portion of the saturant into the pores and voids thereof, so that all the individual fibers of the sheet are thoroughly wetted with the saturant. If desired, the extent or completeness of saturation may be controlled to some extent with apparatus of this kind by regulating the number of rolls between which the sheet is passed and the pressure between successive rolls. The saturant may also be supplied on one side only of the stack, it thus being applied successively to one side only of the sheet and forced through to the other side. In the drawing two stacks of calenders are illustrated, but as many more may be employed as desired. For thorough saturation of the sheet it is preferred to separate the rolls of the second stack so that the sheet will not be squeezed when passing between them. This is easily done by adjusting the supports for the several rolls. The temperatures of the individual rolls may also be regulated by adjusting the steam valves if steam is used to heat the rolls, or regulating the current if electricity is used. Other heating means may be used, if preferred. It is obvious that each pair of rolls, besides pressing the saturant into the felt, will serve as feed rolls to advance the sheet, hence there is no considerable length of the sheet being drawn through a viscous liquid as in the case of the ordinary saturating tanks, and the liability of damage to the sheet from breaking or tearing is reduced to a minimum. Since a machine of this kind can be run at a relatively high speed, the sheet passes through quickly and is in contact with the heated elements and bodies of saturating fluid for only a relatively short time. Hence it is possible with this machine to use as a saturant asphaltic compounds of relatively high melting-point

which by reason of their physical properties as well as their high melting points, are a more desirable constituent of roofing elements than the lower melting-point asphalts.

Having thus described an embodiment of my invention, it should be evident to those skilled in the art that many changes and modifications may be made therein without departing from its spirit or scope as defined by the appended claims.

I claim:

1. The method of saturating a web of fibrous material, which comprises applying liquid saturant to the faces of the web, squeezing the web and saturant together, flowing a film of saturant on each face of the web, and successively pressing said films into the web without squeezing the web.

2. The method of saturating a web of fibrous material with a heat-liquefied saturant, which comprises applying liquefied saturant to the web, squeezing the web and saturant together, flowing additional saturant onto the faces of the web, and reducing the temperature of the web and the saturant carried therewith.

3. The method of saturating a web of fibrous material with a heat-liquefied saturant, which comprises flowing saturant onto the faces of the web, squeezing the web and saturant together, flowing more saturant onto the faces of the web, pressing alternately against opposite faces of the web without squeezing the web, and progressively reducing the temperature of the web during said pressing operations.

4. An apparatus of the class described, comprising a series of rolls each of the intermediate rolls of the series forming a nip with each of two other rolls and the end rolls forming nips with their respective adjacent intermediate rolls through which nips a web of fibrous material may be fed in zigzag formation, and means for directing streams of saturant toward said nips to coat the web as it passes thereto.

5. An apparatus of the class described, comprising means for flowing liquid saturant onto the faces of a sheet of fibrous material, means for squeezing the sheet and the saturant together, said squeezing means comprising a plurality of rolls between which the sheet is adapted to be passed, a series of spaced rolls having sufficient clearance to permit the passage of the sheet therebetween without squeezing, and means for flowing films of saturant onto the faces of the sheet immediately before contacting the spaced rolls.

In testimony whereof I have affixed my signature.

WILLIAM G. DUDLESTON.