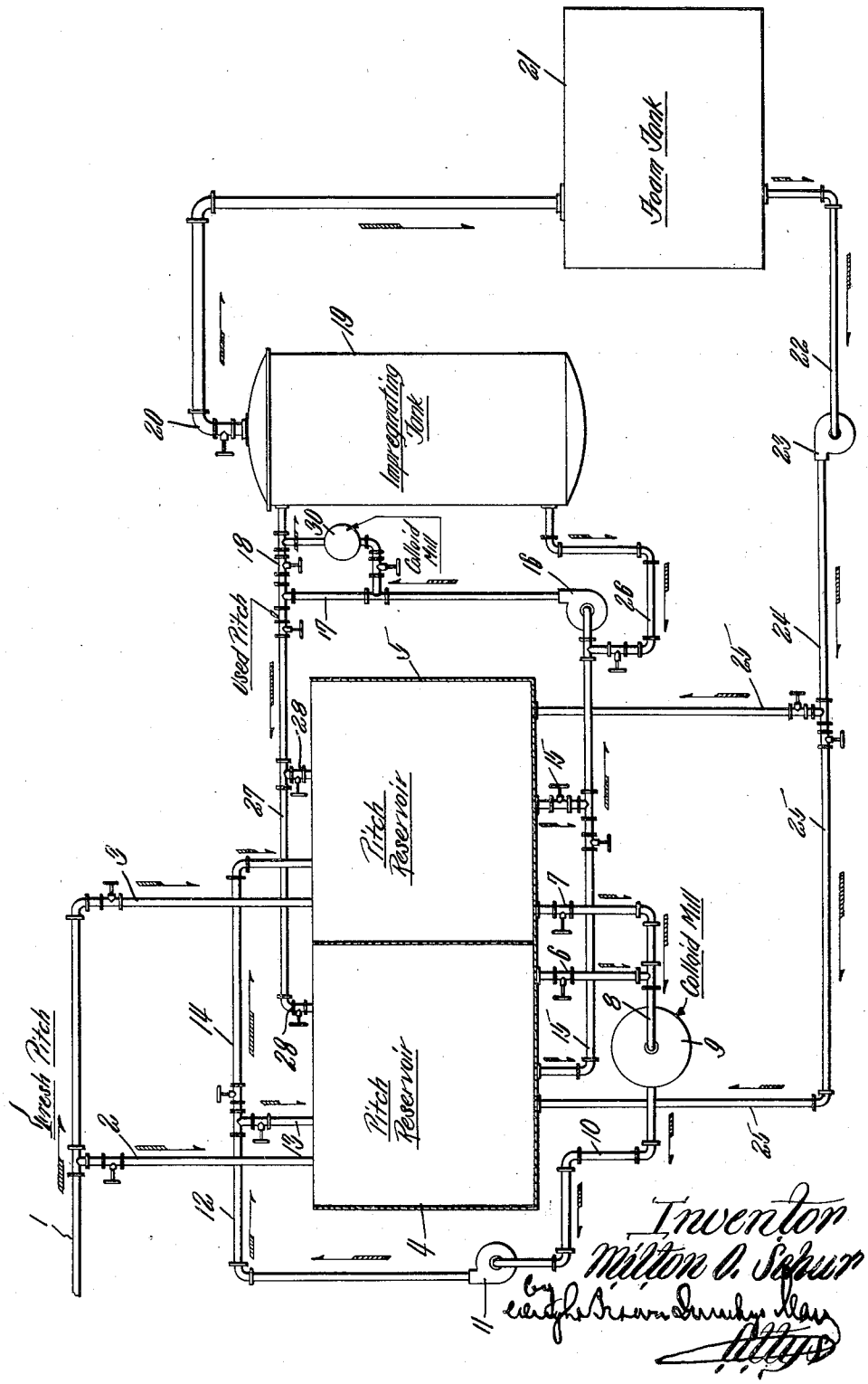
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METHOD OF IMPREGNATING FIBROUS ARTICLES AND MATERIAL THEREFOR

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METHOD OF IMPREGNATING FIBROUS ARTICLES AND MATERIAL THEREFOR

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This invention relates broadly to the impregnation with thermoplastic agents, of porous or bibulous substances to impart thereto waterproofing or other desired properties flowing from the use of such agents, and while this invention relates more particularly to the impregnation of fibrous articles, such as tubes, formed from cellulose pulp with thermoplastic agents which impart water resistance and strength thereto, and my invention is hereinafter explained in detail in connection with the treatment of fibrous tubes with pitch, I desire to have it understood that there is no intention on my part to limit the invention to any particular form of fibrous substance, or to any specific bituminous or other thermoplastic agent. The thermoplastic material employed is preferably one which does not tend to ooze from the impregnated product or render it sticky even under extreme solar heat and at the same time is convertible by heat into a liquid of sufficiently low viscosity below the charring temperature of the articles to impregnate them thoroughly in a reasonable period. Pitch has been found suitable for this purpose, but difficulty is sometimes experienced in obtaining thorough impregnation even with this material. This is a serious matter, for unless articles such as tubes are thoroughly impregnated, they may absorb while in use an excessive amount of moisture from their surroundings, and as a result become soft and weak. In the mill, samples when taken at random from a batch of freshly impregnated tubes and cut are sometimes found to have white or unimpregnated areas, and in such cases the whole batch must be returned to the baths of pitch and impregnation continued. When this difficulty results from faulty beating practice, that is, when the pulp has been gelatinized to such a degree that too dense a tube wall results, it may be readily detected and obviated, but it frequently arises even when the tubes are made from properly beaten pulp.

I have observed that the difficulty of securing complete impregnation of the tubes in a reasonable period is usually caused by the accumulation in the pitch of gummy and solid components originally present therein, and to fibrous material coming into the pitch from the tubes and perhaps in partially charred condition as a result of long contact with the pitch. The fact is, that whereas new pitch employed as the impregnating material may have a softening point of 170° F., a free carbon content of 7% to 8%, and an Engler viscosity of 12 to 16 at 300° F., the same batch of pitch when old, that is, after repeated use in the impregnating tank, may have a softening point of 180° to 184° F., a free carbon content of 20%, and an Engler viscosity at 300° F. of 26 to 28. It is found that fresh pitch usually penetrates through the tube wall in, say, six to eight hours, at a temperature of 300° F. and under a pressure of about 75 pounds per square inch, but as the age of the batch of pitch increases, the time required for complete impregnation gradually increases, even though fresh pitch is continuously being added to compensate for that removed by the tubes and for losses, and at the end of five or six weeks the time necessary to effect complete impregnation may be twelve hours, or even longer. Because of the changes which occur in the pitch, it is difficult to maintain a uniform production schedule in the mill. Labor, steam, and power are also consumed in the further treatment of tubes which routine tests show to be imperfectly impregnated. In order to maintain production as high as possible and to avoid the danger of producing incompletely impregnated tubes, it has heretofore been the custom to bleed off a certain amount of pitch from time to time, and at longer intervals to drain the impregnating system entirely and refill with new pitch. The old pitch has either been burned as fuel, or dumped, and has represented a considerable loss. It has been found that the addition of flux such as wax tailings to old pitch increases its useful life to a certain extent, as it serves to decrease viscosity, but the addition of only a comparatively small quantity of flux is permissible, since otherwise too great a lowering of the softening point is effected. Moreover, fluxes such as wax tailings are much more expensive than pitch, and while they increase the useful life of the pitch, they

do not affect the solid and gummy components, the continued accumulation of which may more than offset in a comparatively short time the advantages gained through their use.

An object of the present invention is to make possible a thorough impregnation of fibrous articles such as tubes in a shorter period, using molten thermoplastic impregnating material, such as pitch existing as a continuous medium or phase and, having solid or gummy components naturally associated therewith and/or picked up from previous impregnating treatment of similar articles. Another object is to make possible an indefinitely repeated use of the same impregnating material with little if any necessity of draining such material from the system. I have found that these objects may be attained if the solid or gummy components present in the impregnating material are reduced to particles of impalpable fineness, as by passing such material through a colloid mill. Tests show that when pitch is colloided, it penetrates into and impregnates fibrous articles such as tubes with remarkable facility. For instance, colloided fresh pitch will completely impregnate tubes in three to four hours, as against six to eight hours for the original pitch, and old pitch such as is usually discarded from the system, will effect complete impregnation in seven to eight hours, as against incomplete impregnation even in fourteen to sixteen hours with the corresponding uncolloided material. In a test run on tubes using fresh, uncolloided pitch, the pitch ratio (i. e., ratio of weight of pitch absorbed to weight of fiber) was 0.36 after a four-hour immersion at 300° F. and under 75 pounds pressure, whereas in another test using similar colloided pitch under similar conditions, the pitch ratio was 1.85. Sections cut from the impregnated tubes of the first test showed white rings of unimpregnated fibrous material about twice the area of the bordering black rings where pitch had penetrated from the outside and inside of the tube wall, while similar sections cut from the impregnated tubes of the second batch indicated complete impregnation. In similar tests using uncolloided old pitch, the pitch ratio was 0.58 in four hours, and this ratio was increased to only 0.61 in eight hours, whereas when using similar colloided pitch under the same conditions, the pitch ratio was 0.93 in four hours, and 1.11 in eight hours. Sections cut from tubes treated for eight hours showed white rings in the case of the uncolloided old pitch, while complete impregnation was evident in the case of the colloided old pitch.

With the foregoing and other objects and features in view, the present invention may best be understood from the following more complete description thereof when taken in conjunction with the accompanying drawing, which illustrates more or less diagrammatically and conventionally an impregnating system such as may be employed in practicing the present invention.

While not limited thereto, the present invention will be described as applied to the saturation of fibrous tubes with pitch. Such tubes may be made by winding a web of cellulose pulp on a mandrel until the desired wall thickness has been produced, whereupon the tube may be removed from the mandrel and dried. The successive convolutions of a tube so made are sufficiently matted together to form a substantially homogeneous wall which when dry is comparatively dense and hard, particularly when the pulp has been more or less gelatinized before web formation.

Referring to the drawing, 1 represents a pipe through which molten pitch at suitable temperature may be passed selectively from a suitable source of supply to valved pipe 2 or 3, respectively discharging into reservoirs 4 and 5, shown arranged side by side, the pitch being heated in the reservoirs to the desired temperature, as by steam coils (not shown). The reservoirs 4 and 5 are respectively provided with valved pipes 6 and 7, through which the pitch may be discharged into a pipe 8 leading to a colloid mill 9 of any suitable type, say, one whose rotor is designed to make 2,000 to 5,000 R. P. M., to have a peripheral speed of 5,000 to 20,000 feet per minute, and to be separated, for instance, about .002 to .004 of an inch from a stator, or from a second rotor turning in the opposite direction. The pitch in passing through this narrow clearance between the relatively moving parts undergoes a shearing or cutting action which disperses, emulsifies, or otherwise homogenizes various components present in the pitch, the solid and gummy components being reduced to particles of impalpable fineness. The colloided pitch passes from the mill 9 into an outlet pipe 10, and is forced by a pump 11 through a pipe 12 from which it may be selectively delivered through valved pipes 13 and 14 into the reservoirs 4 and 5, respectively. A batch of pitch to be colloided may thus be fed into either one of the two reservoirs, or withdrawn from either reservoir and passed through the colloid mill, and discharged into the other reservoir, conditioned for use as an impregnating material. The drawing shows each of the reservoirs provided with a valved pipe 15 communicating with a pump 16 which delivers the pitch through a pipe 17 and thence through a valved pipe 18 into an impregnating tank 19 which may be provided with suitable heating means (not shown). Before being impregnated, the tubes contain air and more or less moisture, even though they have been subjected to apparently complete drying, and this moisture, when the articles are immersed in the hot pitch, is converted into steam,

which with the air escapes from the articles and produces more or less foaming. The foam thus produced is allowed to escape by opening a valved pipe 20 shown communicating with the top of the tank 19 and discharging into a tank 21, from which the settling pitch may be withdrawn through an outlet pipe 22 and returned by a pump 23 through a pipe 24 and thence selectively through valved pipes 25 into either one of the reservoirs 4 or 5. The pitch may be delivered into the tank 19 at from 290° to 300° F., as this allows for the cooling effected by the tubes, the pipe 20 to the foam tank being open, so as to permit free foaming of the saturant due to the escape of steam, air, and other gases from the voids and interstices of the tubes.

After a suitable supply of pitch has been delivered into the tank 19, communication with the reservoirs 4 and 5 is cut off and the pump 16 is operated to remove pitch from the bottom of the tank by a valved pipe 26 and to return it through the pipes 17 and 18 to the top of the tank, this circulation being continued and impregnation of the tubes being effected under a pressure of, say, 90 pounds. When impregnation has been completed, the valved pipe 18 may be closed and the pump 16 operated to withdraw the unconsumed pitch from the tank 19 through the pipe 17 and thence through the pipe 27 having a pair of valved outlets 28 for returning the pitch into either one of the reservoirs 4 and 5. Fresh pitch may be added to the returned pitch to make up for that absorbed by the tubes or lost, whereupon it may be passed through the colloid mill, as previously described, before again being used.

While the apparatus as thus described is designed for conditioning pitch before its use, if desired the apparatus may be designed so that a portion of the pitch being circulated from the bottom to the top of the saturating tank may be put through a colloid mill. That is to say, while impregnation of the tubes is being effected in the tank 19, the pump 16 may be operated to deliver a major portion of the pitch through the pipes 17 and 18 to the top of the tank, while the rest of the pitch may be by-passed, as shown, through a colloid mill 30 before being returned to the top of the tank, so that the pitch may be undergoing conditioning while being used. This may be done to advantage even though the pitch has initially been colloided, since it is likely to pick up solids which interfere with impregnation by contact with the tubes, so that both mills for effecting the initial colloiding and for colloiding the by-passed portion have been shown on the drawing at 9 and 30, respectively, though it should be understood that either may be omitted, if desired.

By the process of the present invention, solid or gummy components present in pitch, which usually fill and plug the outer pores and interstices of the tubes and thus retard impregnation, are broken up into ultra fine particles and uniformly dispersed throughout the pitch so that they pass into and through the fine pores and interstices of the tubes.

In such case, it may therefore be of greater advantage than heretofore to add fluxes to the pitch to lower its viscosity, as the useful life of the flux as well as the pitch is greatly increased, and the benefits gained by the use of the flux thus realized for a much longer time. One may also successfully employ pitch of higher carbon content than heretofore suitable, as the carbon is reduced to ultra fine particle size along with the other solid and gummy components of the pitch.

Having thus described certain embodiments of this invention, it should be evident to those skilled in the art that various changes and modifications might be made therein without departing from the spirit or scope of invention as defined by the appended claims.

I claim:

1. A process of impregnating fibrous substances with molten thermoplastic material having solid or gummy components associated therewith, which comprises reducing such components of the molten material to particles of impalpable fineness, and treating the substances with the molten material.

2. A process of impregnating fibrous substances with molten thermoplastic material having solid components owing to previous contact with such substances, which comprises reducing such components of the molten material to particles of impalpable fineness and dispersing it through the material, and treating the substances with the molten material.

3. A process of impregnating fibrous substances with molten pitch, which comprises colloiding such molten pitch to reduce the solid and gummy components associated therewith to particles of impalpable fineness, and treating the substances with the molten pitch.

4. A process of impregnating fibrous articles with molten pitch associated with solids picked up from previous contact with similar articles, which comprises colloiding such molten pitch to reduce its solids content to fine particle size, and treating the articles with the molten pitch.

5. A process of impregnating fibrous articles with molten pitch associated with solid and gummy components which tend to plug the pores of such articles, which comprises reducing such components of the molten pitch to fine particles capable of passing through the pores without plugging them, and immersing the articles in the molten pitch.

6. A process of impregnating fibrous ar-

ticles with molten pitch associated with solid and gummy components, which comprises colloiding such molten pitch, adding a flux, and treating the articles with the mixture.

7. A process of impregnating fibrous articles with molten thermoplastic material associated with solid or gummy components, which comprises colloiding such molten material, and immersing the articles in a bath of such molten material under pressure.

8. A process of impregnating fibrous substances with molten thermoplastic material, which comprises immersing the substances in a bath of such molten material, removing molten material from the bath, colloiding such removed material, and returning it to the bath.

9. A process of impregnating fibrous articles with molten thermoplastic material having solid or gummy components associated therewith, which comprises colloiding such molten material, immersing the articles in a bath of such molten material, removing molten material from the bath, colloiding such removed material, and returning it to the bath.

10. A process of conditioning thermoplastic material associated when molten with solid or gummy components for the impregnation of articles, which comprises melting such material and reducing such components of the molten material to particles of impalpable fineness while keeping the molten material as a continuous phase.

11. A process of conditioning pitch for the impregnation of articles, which comprises melting the pitch and colloiding the molten pitch to reduce its solids content to fine particle size while keeping the pitch as a continuous phase.

12. A process of conditioning pitch having more than its original carbon content as a result of previous contact when molten with fibrous articles for the impregnation of such articles, which comprises reducing said content of the molten pitch to particles capable of passing through the pores of the articles without plugging them while keeping the pitch as a continuous phase.

13. A thermoplastic impregnating material existing as a continuous medium and having solid or gummy components associated therewith when molten, said components being in the form of particles of impalpable fineness uniformly dispersed therethrough.

14. A thermoplastic impregnating material existing as a continuous medium and having solid components associated therewith when molten, owing to previous contact with fibrous articles, said components being in the form of fine particles capable of passing through the pores of such articles without plugging them.

15. A pitch existing as a continuous medium, the solid and gummy components of which when molten exist in the form of particles of impalpable fineness.

16. A pitch existing as a continuous medium and having solid and gummy components when molten and containing a flux, the solid and gummy components being in the form of particles capable of passing through the pores of fibrous articles without plugging them.

17. A pitch existing as a continuous medium and having a carbon content greater than that originally present therein owing to previous contact when molten with fibrous articles, said content being in the form of particles capable of passing through the pores of fibrous articles without plugging them.

18. The method of conditioning for reuse as an impregnating material pitch contaminated by solid and gummy impurities from previous use, which comprises reducing such impurities in the molten pitch to particles of impalpable size and dispersing them in the pitch while keeping the pitch as a continuous phase.

19. In a process of impregnating successive batches of fibrous articles with the same molten thermoplastic material, that step between successive impregnating treatments which comprises reducing the accumulated solid and gummy impurities in the molten material to particles of impalpable size and dispersing them in the molten material.

20. In a process of impregnating successive batches of fibrous articles in baths of the same molten thermoplastic material, those steps which comprise colloiding the molten material between successive impregnating treatments, removing molten material from the baths during the treatments, colloiding such removed material, and returning it to the baths.

21. A process of impregnating fibrous articles with molten pitch containing a flux and associated with solid and gummy components, which comprises colloiding the molten mixture and treating the articles with the colloided mixture.

In testimony whereof I have affixed my signature.

MILTON O. SCHUR.