

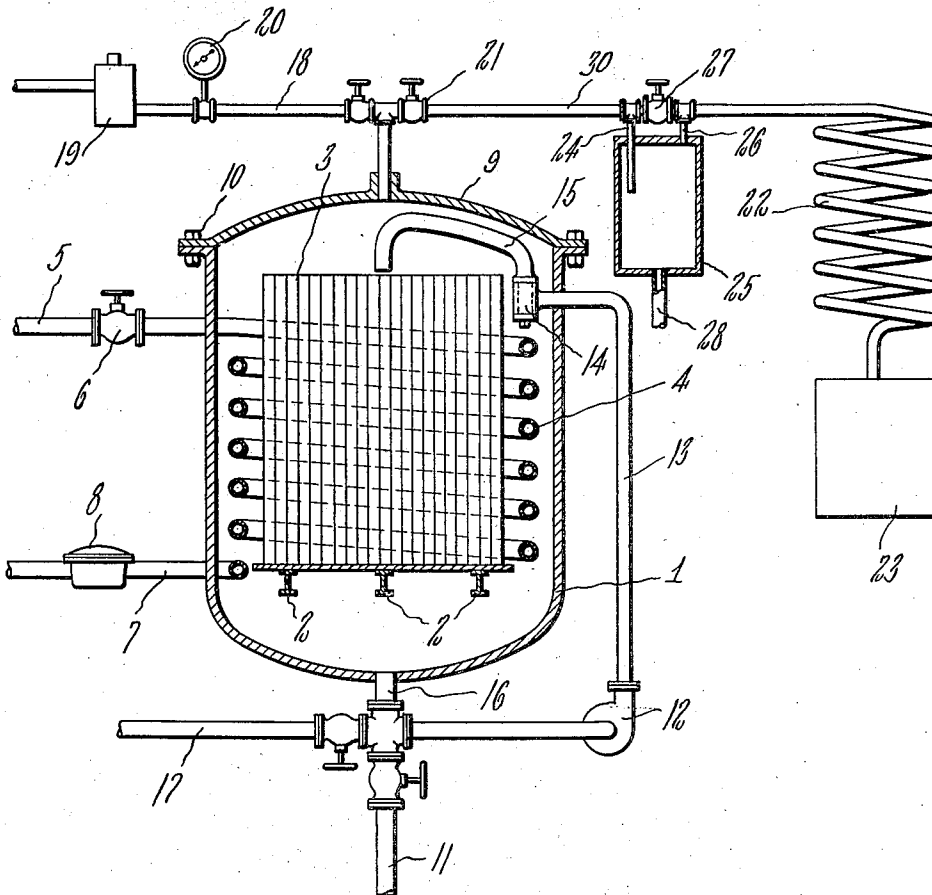
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MANUFACTURE OF IMPREGNATED ARTICLES

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UNITED STATES PATENT OFFICE

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MANUFACTURE OF IMPREGNATED ARTICLES

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This invention relates to the manufacture of impregnated articles, being more particularly concerned with the impregnation under heat of porous articles, such as those made of cellulose fiber, with waterproofing agents of a thermoplastic character. An article falling into this class is so called conduit or tubing which is made by winding a wet web of interfelted cellulose fiber on a mandrel to the desired wall thickness. The web may be formed on suitable papermaking machinery, such as a so-called wet or cylinder machine; and the web may be delivered from the carrier feed of the machine to the mandrel, under sufficient pressure to produce an interlocking or matting together of the successive convolutions into a substantially homogeneous wall structure. The tubes thus formed are removed from the mandrels and are subjected to a drying operation, whereupon the dried tubes are then impregnated under heat and pressure in a bath of suitable waterproofing material, such as pitch, which also serves to strengthen the tubes and to impart dielectric properties thereto.

In carrying out large scale production of impregnated fiber tubes such as described, it has been found necessary to carry out a slow drying operation in long dryers operated on countercurrent principles, in order to avoid injury to the tubes through warping, blistering, or splitting. Experience has shown that if the dryers are forced, that is, if the tubes are passed thereto at too great a rate of speed, there will be sufficient residual moisture in the tubes so that when they are immersed in the hot bath of pitch, they will undergo blistering. Accordingly, the practice has heretofore been to pass the tubes through the dryers at a rate and under such conditions of humidity and temperature to ensure a practically complete drying without causing injury thereto. Inasmuch as moisture is removed from the tubes with increasing difficulty as drying proceeds, a considerable section of the dryer has heretofore been devoted to the removal of the last, say 25% of the moisture content of the tubes.

I have found that the drying of wet ar-

ticles such as tubes practically to completion in order to permit satisfactory subsequent impregnation with a hot impregnating medium may be avoided if a pressure above the vapor pressure of water at the temperature of the impregnating medium is maintained above the bath of the impregnating medium. This pressure may be realized through the use of an inert gas under pressure such as air; and as impregnation proceeds, the pressure may be slowly lowered while maintaining the elevated temperature of the impregnating medium. Such a finding is particularly advantageous when applied to the manufacture of impregnated fiber tubes of the type described, as it makes possible passing wet tubes through the dryers at a much higher rate of speed than was heretofore customary, since it is necessary to dewater the tubes only to a point at which they may be handled without danger of spoilage, for instance, to a water content of 40%, or even higher. It further makes possible the use of much shorter and less expensive dryers, which may be designed to dewater the tubes to a moisture content of, say, 20% to 40%, rather than to complete dryness, as the subsequent impregnating operation simultaneously effects a drying of the tubes to completion.

While not limited thereto, the present invention will now be described as applied to the manufacture of impregnated fiber tubes, in conjunction with the accompanying drawing, which show diagrammatically and conventionally an apparatus in which the impregnating operation may be carried out.

Referring to the drawing, 1 represents a tank in which the impregnation of the wet tubes may be carried out. The tank is shown provided near its bottom with a series of I-beams 2, on which a crate 3 of tubes to undergo impregnation may be supported. The crate is shown surrounded by a steam coil 4, which serves to maintain the bath of pitch in which the tubes are immersed during the impregnating operation at the desired temperature. The steam may be supplied to the coil 4 from a suitable source (not shown) through a pipe 5, valved at 6, 100

and may be exhausted from the coil into a pipe 7 provided with a steam trap 8. After a crate of tubes has been lowered into the tank, a cover 9 is fastened as by bolts 10 to the tank and molten pitch in amount sufficient to cover the tubes is run into the tank. The molten pitch may be drawn from a suitable source of supply (not shown) through a valved pipe 11 by a pump 12, which forces the pitch through a pipe 13 passing into the tank through its upper side wall and terminating as a fitting 14 in which a goose-neck pipe 15 is swivelled. The pipe 15 may be arranged to project the molten pitch against the upper end of the crate of tubes, whereupon, after the impregnating operation has been completed, it may be swung to one side to permit removal of the crate 3 from the tank. Preferably, constant circulation of pitch from the bottom to the top of the tank is effected during the impregnating operation; and, as shown, this is accomplished by withdrawing pitch from the bottom of the tank through a pipe 16 from which it is passed by the pump 12 through the pipes 13 and 15 to the top of the tank. After the impregnating operation has been completed, the pitch may be withdrawn from the tank through the pipe 16 and permitted to flow through a pipe 17 to a suitable reservoir (not shown).

The pressure desired above the bath of pitch in the tank may be realized by supplying a suitable inert gas, such as air, under pressure, through a valved pipe 18 communicating with the gas space of the tank through the cover 9. The pipe 18 is shown provided with a suitable pressure reducer 19 and a gauge 20. During the impregnating operation the steam and air accumulating in the gas space above the bath may be slowly released and the pressure permitted to drop by opening a valve 21 communicating with the pipe 18 and with a pipe 30 discharging into a condenser coil 22, which serves to condense the steam and volatile vapors present in the air. Inasmuch as the gas and volatile vapors may carry with them an appreciable amount of pitch foam from the tank 1, before passing them into the condenser coil 22, they may be led through a pipe 24 into a closed tank 25 in which the foam is caused to separate out. The foam-free gas and vapors accumulating at the top of the tank may be returned to the pipe 30 by a pipe 26 at a location sufficiently spaced from the pipe 24 to permit a valve 27 to be inserted therebetween to regulate the quantity of gas and volatile vapors shunted into the tank 25 before passing into the condenser coil 22. The mixed condensate from the coil may flow into a tank 23 wherein condensate water distilled from the tubes is permitted to separate from condensate oil distilled from the pitch. The pitch settling at the bottom of the tank

25 may be returned to the pitch reservoir for reuse through a pipe 28.

While various examples of procedure falling within the purview of the present invention are possible, I shall cite one which has been found to give eminently satisfactory results in actual practice. Tubes which were dewatered to a moisture content of about 40% were crated and lowered into the impregnating tank 1. After the cover 9 was clamped in place, compressed air was admitted through the pipe 18 into the tank, until an air pressure of 53 pounds (gauge) per square inch was built up, whereupon molten pitch at a temperature of about 300° F. was pumped into the tank in amount sufficient to cover the tubes. This pressure is just above the vapor pressure of water at 300° F., which is 52 pounds (gauge). The pressure was allowed to drop slowly to 43 pounds per square inch by opening the relief valve 21 while the temperature was maintained at 300° F. At the end of five hours, with the pressure at 43 pounds per square inch, the pressure was slowly entirely relieved and the pitch was permitted to drain from the tank. Upon removal of the tubes from the tank, they were found to be sound, firm, and thoroughly impregnated. The vapors leaving the tank during the impregnating operation and condensed in the coil 22 were found to yield a condensate which separated into water and oil layers in the tank 23. The oils thus distilled from the pitch may be returned to the pitch system as needed to keep the softening point of pitch at the desired value. This is an important feature, because if the pitch is too soft, the tubes may become deformed in storage or in use too easily, particularly in warm weather, and its plies may be forced apart more easily, perhaps through osmotic pressure, when the tubes are laid under ground. If, on the other hand, the pitch is too hard, the viscosity at the temperature of impregnation may be too high to permit complete impregnation in a reasonable period of time. Heretofore, the softening point was maintained at the desired value by the blending of hard and soft pitches, thus requiring large pitch inventories. In accordance with the process of the present invention, where the oils distilled during the impregnating operation may be returned for adjusting the softening point of the pitch, the difficulties heretofore experienced may be obviated.

In some cases it has been found possible to treat the moist tubes without first applying air-pressure from an outside source as above described, if the air-pressure is built up through the compression of the air initially in the tank by the action of the incoming pitch. If the pitch supply lines are of ample size and if the pitch-pressure in the supply lines is sufficiently high, the atmospheric air

within the tank can be compressed to the desired point through the entering pitch before the tubes have been heated to any serious extent.

5 The impregnation of wet tubes in accordance with the process of the present invention requires no more time than that consumed in the impregnation of thoroughly dried tubes. The pitch-fiber ratio of tubes
10 impregnated as herein described is as high, if not higher, than the pitch-fiber ratio of tubes impregnated in a completely dried condition. Evidently the removal of moisture from the tubes during the impregnating
15 operation is accompanied by the sweeping of air from the pores of the tube walls, so that at the end of the impregnating operation air originally present in the pores has been entirely eliminated and displaced by pitch.

20 Another important application of the present invention lies in the impregnation and drying of bends which are formed by bending straight tubes while in wet, plastic condition to the desired curvature. Heretofore,
25 the bends were completely dried before the impregnating operation; but in accordance with the process of the present invention, drying and impregnation may be effected in a single operation. A significant saving in
30 time and handling is thus made possible in the making of bends.

I claim:

1. In the manufacture of impregnated articles in a wet condition prior to impregnation with a hot impregnating medium, those
35 steps which comprise subjecting the wet articles to a bath of the hot impregnating medium under a pressure higher than the vapor pressure of water at the temperature of the
40 impregnating medium, and slowly lowering the pressure while maintaining the impregnating medium at the elevated temperature.

2. A process which comprises forming articles of the desired shape from wet pulp, subjecting the wet articles to a bath of hot
45 impregnating medium while maintaining a pressure above the bath higher than the vapor pressure of water at the temperature of the impregnating medium, slowly lowering
50 the pressure above the bath while maintaining the impregnating medium at the elevated temperature, and removing the articles from the bath after impregnation and drying have
55 been completed.

3. In the manufacture of impregnated fiber tubes, those steps which comprise forming the tubes from wet pulp, only partially
60 drying the tubes, subjecting the partially dried tubes to a bath of hot impregnating medium while maintaining a pressure above the bath higher than the vapor pressure of water at the temperature of the impregnating medium, and slowly lowering the pressure
65 above the bath while maintaining the im-

pregnating medium at the elevated temperature.

4. In the manufacture of impregnated fiber tubes, those steps which comprise winding a wet web of interfelted cellulose fibers
70 into tubular form, drying the tubes only to a moisture content at which they may be handled without distortion, subjecting the tubes so dried to a bath of molten pitch while
75 maintaining air pressure above the bath higher than the vapor pressure of water at the temperature of the pitch, and slowly lowering the pressure above the bath while
80 maintaining the pitch at the elevated temperature.

5. A method which comprises immersing wet articles in a bath of molten pitch confined under a gas pressure space, releasing gas from the space to effect a distillation of water vapor from the articles and oil vapors
85 from the pitch, condensing the water and oil vapors, and separating the water condensate from the oil condensate.

6. A method which comprises immersing wet, porous articles in a bath of molten pitch
90 confined under a gas pressure space, releasing gas from the space to effect a distillation of water vapor from the articles and oil vapors from the pitch, condensing the water and oil vapors, separating the water condensate from the oil condensate, removing
95 the articles from the pitch after they have been impregnated, and blending the separated oils with the remaining pitch to adjust its softening point.

In testimony whereof I have affixed my signature.

MILTON O. SCHUR.