

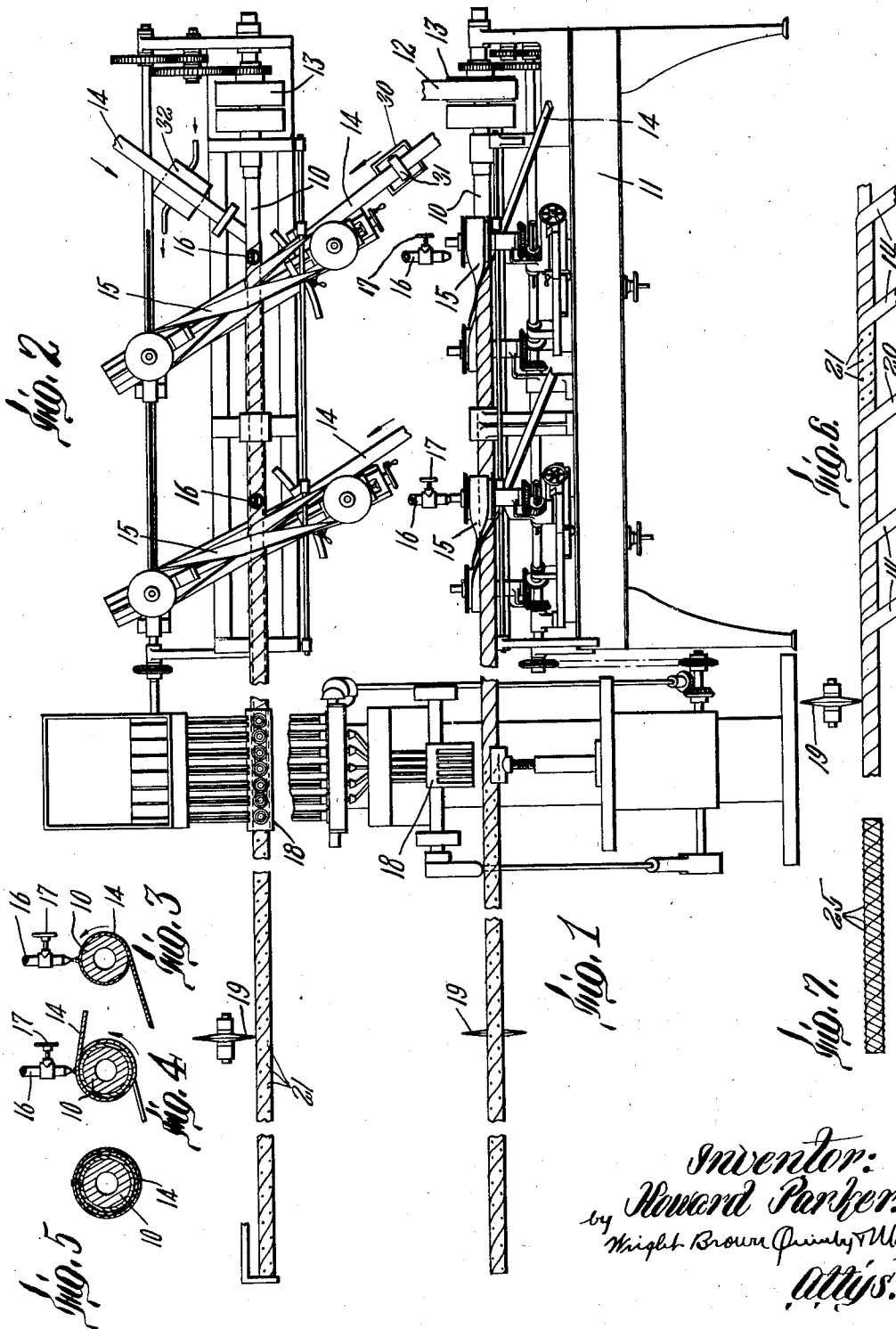
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WATERPROOF FIBROUS TUBING AND METHOD OF MAKING THE SAME

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WATERPROOF FIBROUS TUBING AND
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This invention relates to waterproof fibrous tubing and a method for making the same. Heretofore fibrous tubes for various purposes have been made by winding in helical form successive strips of paper, that is, cellulosic sheet material which is sufficiently dry to be self-sustaining, the edges of the successive turns of each strip abutting to form a tubular layer, which, with other layers, form the wall of the tube. In constructing a tube in this manner, adhesives are customarily employed to cement the layers or plies together so as to produce a coherent structure. The winding of such tubes is usually a continuous operation, the tube sliding along a stationary mandrel as formed. A movable saw is customarily provided to cut off suitable sections from the end of the tube, these sections being of any desired length.

Paper tubes can also be made by rolling up a rectangular sheet of paper upon itself with adhesive between successive convolutions to prevent unrolling of the sheet.

While tubes made as described are suitable for certain purposes, they are subject to softening and deterioration by moisture so that they cannot be put to any use which involves the presence of moisture. Attempts to saturate such tubes with asphalt or pitch or other waterproofing compounds have heretofore been unsuccessful owing to the difficulty of causing the saturant to penetrate past the films of adhesive matter between the successive plies or layers in the tube wall. The present invention relates to a method of saturating tubes of this kind completely with waterproofing material so that a thoroughly waterproofed product is obtained which is mechanically stronger than the untreated tube of the same fibrous material.

For a more complete understanding of the invention reference is had to the description thereof which follows and to the drawing, of which,—

Figure 1 is a side elevation of a conventional tube forming mechanism to which has been added apparatus for practicing the invention.

Figure 2 is a plan view of the same, with an added feature.

Figures 3, 4 and 5 are sectional views of the mandrel on which the tube is formed showing the tube in various successive stages of development.

Figure 6 represents a tube of modified construction in process of formation.

Figure 7 shows a section of tube made as indi-

cated in Figure 6 and provided with a retaining clamp for immersion in a saturant.

Referring to the drawing in detail, a stationary mandrel 10 is mounted on a suitable frame 11. On this mandrel are wound successively a number of paper strips 14 which may be supplied from suitable rolls (not shown) and which are wrapped helically about the mandrel 10 as by belts 15, these belts being driven through suitable mechanical connections, well known in the art, by a power belt 12 on a pulley 13. The presser belts, being arranged angularly with respect to the mandrel, exert an axial thrust on the tube being formed, so that the tube slides continuously along the mandrel. According to the invention the usual means for applying adhesive such as paste, etc. are omitted and may be replaced by means for applying molten pitch, asphalt or other thermoplastic waterproofing compound. To this end a number of supply pipes 16 may be suitably mounted over the mandrel 10 so as to run small streams of molten asphalt onto the paper strips as they are wound on the mandrel. The rate of supply of the thermoplastic substance may be controlled by suitable hand valves 17. This thermoplastic material is highly adhesive and quickly cools when brought into contact with the paper strip, so that it acts as an efficient adhesive to hold the tube together as it leaves the mandrel 10.

Instead of, or in addition to, applying molten waterproofing material between the strips of paper to hold them together, one or more of the strips may be previously coated or saturated with such material. Previously saturated strips may be wound cold with hot adhesive between the plies, or may be passed over a heated member such as a steam box 32 or heated roll to render the waterproofing material therein sticky, unless this material is such as to be sticky at atmospheric temperatures. In such case, a heating unit may conveniently be located against the supply roll to facilitate the unrolling of the sticky strip therefrom.

An application of pitch or the like may be made to one or more of the paper strips, immediately prior to winding, by passing the strip or strips through a bath of molten saturant as the strip approaches the point of winding on the mandrel. The bath may be conveniently contained in a suitable box or boxes 30, a guide roller 31 being provided to ensure immersion of the strip in the bath. By regulation of the temperature, and hence of the viscosity, of the pitch, the

strips may be made to take up a quantity of pitch sufficient for the complete impregnation of the whole tube.

If greater mechanical strength is required in the finished tube, one or more strips of textile fabric, rubber, etc. may be wound up with the paper strips.

The tube thus formed travels under a stapling head 18 by which fasteners 21 or the like are clinched through the wall of the tube at suitable spaced intervals. This adds to the strength of the tube as a whole and also provides a positive fastening means for the plies of the tube wall to hold the tube together independently of the adhesion of the thermoplastic material between the plies. The stapling head 18 may be adapted to insert and fasten several staples in one operation so as to permit rapid operation of the tube forming mechanism. As shown the stapling head may be reciprocated by suitable means, conventionally indicated in Figure 1, this means being driven from the belt 12 so as to be synchronized with the tube forming mechanism.

Conduit for special purposes may be made with layers of special materials. Thus, for example, where it is desired to lay telephone conduits in the same trench with conduits for cables carrying heavy alternating currents, it may be desirable to provide a metallic shield for the telephone wires. This may be done by winding a layer of metal foil 20 on the tube structure hereinbefore described. Additional paper layers 14 may be wound outside of the foil layer for its protection from mechanical injury and also from possible corrosion.

A saw or equivalent cutter 19 may be provided to cut off successive lengths from the advancing tube in a manner well known in the art. These sections of tubing are thereupon transferred to a suitable saturating bath of molten thermoplastic waterproofing material, or are otherwise treated to cause such material to permeate the walls of the tubing. The molten material soaks into the walls and melts the adhesive layers of thermoplastic material which are already therein. At this time the tube is held together by the metal fasteners or by any other means which does not interfere with access of saturant to the tube. Since the adhesive films between the plies are liquefied, the waterproofing substance has ready access to the entire thickness of the tube wall, with the result that the tubes are thoroughly saturated with waterproofing compound. If the tubes have been wound with strips already containing sufficient saturant for the finished tube, the bath need be only of sufficient duration to heat the tube to effect the coalescence of the pitch in the several strips or layers constituting the tube wall. In the case of tubes having inner layers of paper fastened by through fasteners and surrounded by outer unfastened layers of paper or the like with or without an intermediate layer of foil, means must be employed for preventing the loosening of the outer layers. This may be done by the use of an exterior clamp which touches the tube only at spaced points so as to permit free access of the saturant to the tube. Such a clamp may be in the form of a helical coil 25 of spring wire with spaced turns, as shown in Figure 7. The coil prevents disintegration of the exterior layers of the tube during saturation, and is removed after the saturating treatment. When removed from the saturating bath, the thermoplastic compound in the walls of the tubes solidifies, thus rendering the tubes

waterproof and adding materially to their mechanical strength. Since the tubes of this kind may readily be formed of paper strips which are relatively loose in texture and hence absorbent, a high degree of saturation is obtainable through the use of the thermoplastic adhesive and the metal fasteners to hold the tube plies together during the period of saturation.

I claim:

1. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into tubular form with thermoplastic adhesive material between successive layers, saturating the tube with liquefied waterproofing material, and holding the tube in shape during said saturating treatment.

2. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into tubular form with thermoplastic adhesive material between successive layers, immersing said tube in a bath of molten waterproofing compound, and holding the tube in shape during said immersion.

3. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying sufficient liquefied waterproofing material between successive layers during winding to hold the wound tube in shape, fastening the layers together by through fasteners extending through the entire thickness of the tube wall, and then saturating the tube with liquefied waterproofing material.

4. A method of making waterproof fiber tubing, which comprises winding paper into tubular form, applying a molten adhesive waterproofing compound between the layers during the winding operation in sufficient quantity to stick the layers together, securing the layers by fasteners passing through the entire thickness of the wall, and saturating the tube with molten waterproofing compound of the same type as that used as an adhesive between the layers.

5. A method of making waterproof fiber tubes, which comprises winding paper into tubular form, applying a thermoplastic adhesive between the plies during said winding to stick the plies together, fastening the plies of the tube together by through fasteners, and then immersing the tube in a bath of molten thermoplastic waterproofing material, said fasteners being of a material infusible at the temperature of said bath.

6. A method of making waterproof fiber tubes, which comprises winding paper into tubular form, applying molten pitch during said winding between successive layers of paper to stick said layers together, fastening the layers together with through fasteners extending through the entire thickness of the tube wall, and then saturating the tube with molten pitch.

7. A method of making waterproof fiber tubing, which comprises winding a plurality of paper strips helically into the form of a laminated tube, applying between the layers during winding sufficient thermoplastic adhesive to stick the layers together, fastening the layers together with metal fasteners passing through the entire thickness of the wall, and then saturating the tube with liquefied waterproofing compound.

8. A method of making waterproofed fibrous tube which comprises winding strips of paper helically into the form of a laminated tube, applying molten waterproofing material between the plies during the winding to stick the plies together, fastening metal fasteners or the like

through the tube walls at spaced points, and immersing the tube thus formed in a bath of molten waterproofing compound.

9. A method of making a waterproof fibrous tube, which comprises winding a plurality of strips of paper helically into the form of laminated tubing, applying molten waterproofing material between the plies during such winding so as to stick the plies together, driving through the walls of said tube successive through fasteners, cutting off successive sections of the tube thus formed, immersing said sections in a bath of molten waterproofing material, removing said sections after an interval for saturation and permitting said sections to cool.

10. A method of making waterproof conduit, which comprises winding a plurality of strips of bitumen-impregnated paper into laminated tubular form, sticking together the layers of tube wall with bitumen, securing the layers together by through fasteners, and heating the tube to coalesce the bitumen in the several layers.

11. A method of making waterproof conduit, which comprises winding a plurality of strips of bitumen-impregnated paper into laminated tubular form, applying additional bitumen between the layers during winding as an adhesive, securing the layers together with through fasteners, and heating the tube to coalesce the bitumen in and between said layers.

12. A waterproof fibrous tube comprising a laminated tube of spirally wound layers of paper strip, fasteners passing through the wall of said tube at spaced points, and a thermoplastic waterproofing material permeating the entire thickness of the wall of said tube.

13. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying liquefied thermoplastic waterproofing material between successive layers during winding to hold

the wound tube in shape, and stapling the layers of tube together with through fasteners.

14. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying liquefied thermoplastic waterproofing adhesive material between successive layers during the winding to hold the wound tube in shape, and driving separate fastening elements into the tube wall so that said elements penetrate and secure together a plurality of the outermost layers of said tube.

15. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying liquefied waterproofing adhesive material between successive layers during the winding to hold the wound tube in shape, driving separate fastening elements into the tube wall so that said elements penetrate and secure together a plurality of the outermost layers of the tube, said elements being of a material infusible at the melting point of said adhesive material, and heating said tube to a temperature above said melting point.

16. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying molten asphaltic material between successive layers during the winding to hold the wound tube in shape, and driving metallic fasteners through a plurality of the outermost layers of said tube.

17. A method of making waterproof fiber tubing, which comprises winding fibrous sheet material into laminated tubular form, applying molten asphaltic material between successive layers during the winding to hold the wound tube in shape, driving metallic fasteners through a plurality of the outermost layers of said tube, and heating the tube to a temperature above the melting point of said asphaltic material.

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