

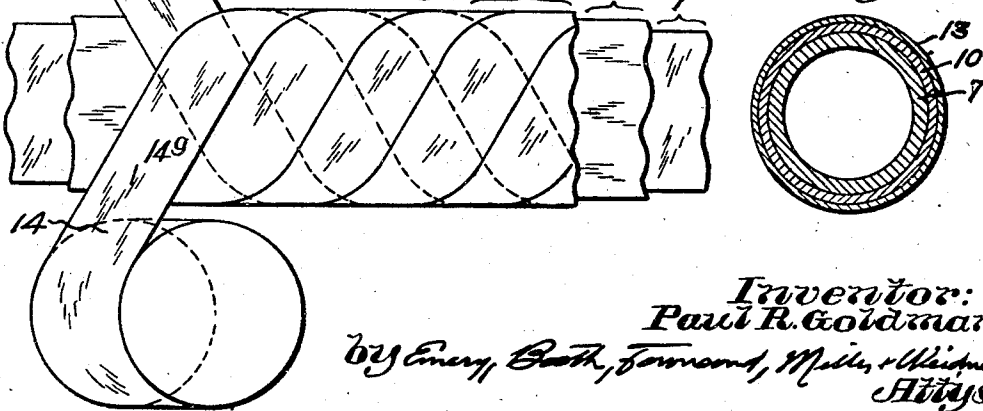
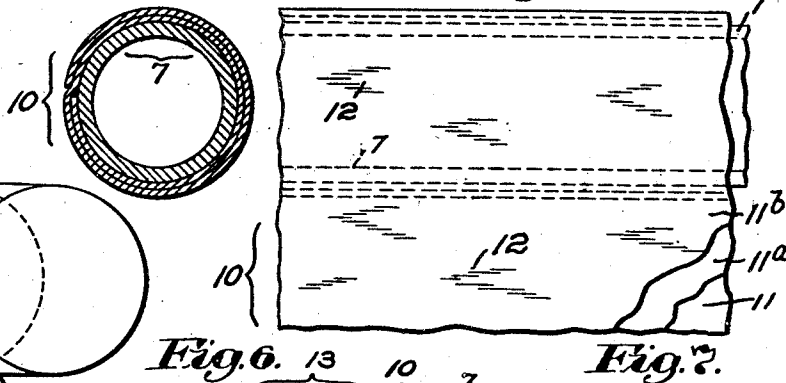
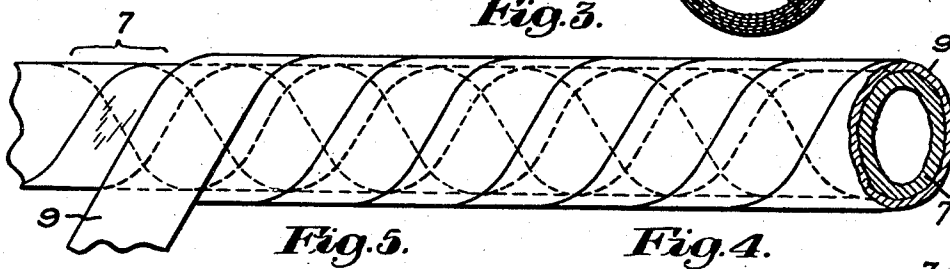
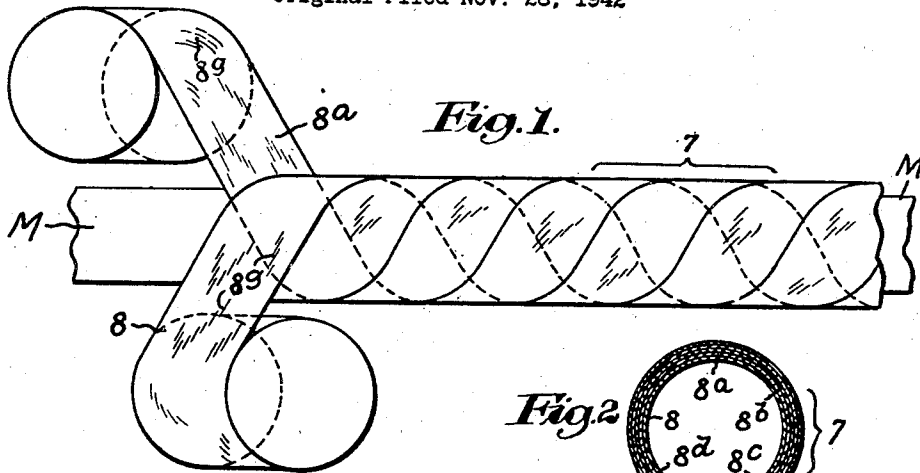
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2,402,040

WOOD TUBING AND THE LIKE

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WOOD TUBING AND THE LIKE

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Original application November 28, 1942, Serial
No. 467,243, now Patent No. 2,352,533, dated
June 27, 1944. Divided and this application
March 14, 1944, Serial No. 526,462

5 Claims. (Cl. 138—79)

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My present invention relates to tubes, pipes and other hollow cylindrical structures having thin wood strips and sheets as a component material. It aims to provide for such structures novel constructions, arrangements and combinations of component means and elements presenting in the resulting articles and products distinctive strength and rigidity, both axially and radially, for a given mass and weight of the wood material, and wherein the relation as between flexure resistance as characterized by axial strength and rigidity, on the one hand, and crushing resistance as characterized by radial strength and rigidity, on the other hand, may be predeterminedly selected and calculated as appropriate to different use conditions and requirements.

This application is a division of my copending application Serial No. 467,243, filed November 28, 1942, now Patent 2,352,533, dated June 27, 1944, containing claims directed to certain novel processes and methods whereby tubular wood veneer products such as here concerned may be manufactured.

In the accompanying drawing, representing somewhat diagrammatically a typical embodiment of the invention:

Fig. 1 shows an initial stage of the process, wherein a tubing core is formed;

Fig. 2 illustrates in cross-section a typical resulting core element;

Fig. 3, also relating to the core-forming stage, illustrates an example of a pressure treatment of the core;

Figs. 4 and 5 represent an intermediate phase, being respectively an elevation of a short length of the tubing under construction and a cross-section of the resultant intermediate structure;

Fig. 6 illustrates a step in a further or third phase of development of the product; and

Fig. 7 is a cross-sectional view of the finished tubing product.

Referring first more particularly to Figs. 1 and 2, the initial phase or operation in accordance with the invention comprises the formation of an inner element or core 7. For this purpose a removable mandrel M is employed, of a diameter the same as the inside diameter desired for the core and for the resulting tube or pipe as a whole. On this mandrel there is wrapped spirally one or a successive plurality of layers or laminae of thin wood stripping or veneer 8, 8a, etc. Each such layer is individually wound spirally with a selected pitch such that the leading and trailing edges of succeeding turns are abutted. Further,

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where a plurality of spiral wraps are provided, each succeeding wrap is wound oppositely to the one preceding, so that the resulting plural layer core element 7, such as that of Fig. 2, has its layers or plies individually alternated as to the direction of wind.

Thus the side-edge juncture line in any given layer crosses such line of any next adjacent layer, whether inside or outside it. Desirably also the plies having the same direction of wind, such for example as 8, 8b, 8d, etc., are slightly advanced or set back relative to each other, with resultant staggering or offsetting of their spiral joint lines. The number of windings, plies or layers for such core element 7 may be varied within a considerable range, from a single layer upward, depending on the wall thickness desired or permissible in any particular instance. In the majority of cases about three to seven plies are employed, with four or five representing an average construction, it being understood that the veneer strips such as 8 and 8a of Fig. 1 are representative and usually are followed by others such as 8b, 8c, 8d, Fig. 2, these being similarly applied under alternated spiraling starting at either end of the plural ply core 7. Desirably the individual wood strips or tapes 8, 8a, etc., which may themselves be plural ply in some instances, have the grain or predominant fibre direction disposed lengthwise of the strips, as indicated at 8g, Fig. 1, so that in the formed core 7 they extend angularly and out of parallel to the core axis.

Each such thin wood layer or wound strip 8, 8a, etc., as spirally laid on the mandrel is coated, either before or in conjunction with the wrapping, with a bonding or plastic agent, such as certain glues, cements or like adhesive or uniting agents, preferably one of the polymerizable or plastic type either of the cold setting or the heat setting varieties, depending on the particular field of use for the tubing product in the given instance.

On completion of the winding of the core element 7, pressure is applied uniformly to the entire core, either before or after it is removed from the mandrel M. Such pressure application may be variously accomplished. One effective and convenient procedure is that of temporarily wrapping the core 7 with a strip or web of resilient material 9, Fig. 3, such as a rubber or rubber-like composition, wound onto the core under tension proportioned to the degree of pressure desired, removably held at its ends as by suitable ties or clamps, not shown.

The cores, such as the element 7, with the pres-

sure-applying means such as 9 in position upon them are then subjected to a drying and setting or polymerizing treatment. In the case of cold-setting binding agents this may be accomplished by hanging or otherwise placing the tubing cores so as to subject them to ordinary room temperatures for a period of usually 24 to 48 hours, more or less. With heat-setting bonding agents the cores with the pressure-applying means upon them may be suspended in or passed through a drying compartment or oven at controlled temperatures generally of the range of about 180° to 240° depending on the particular agent and on the time available. In general also the polymerization, curing, drying or setting of the cores where relatively cool- or cold-setting agents are employed may be considerably accelerated by a heat treatment such as referred to.

Following the drying and setting operation, wherein the compressive pressure such as afforded by the resilient means 9 is maintained, with or without the application of heat, such means is removed from the core element 7, leaving the core in individually finished condition as a compact and substantially homogeneous unit in readiness for the surrounding outer elements to be described.

It is particularly noted that by reason of the wholly spiral disposition of any component veneer strips 8, 8a, etc., of the inner base or core elements 7, maximum advantage is taken of the compression resisting capacity of such spirally formed structure. Resultantly these bases or cores 7 are of high rigidity and strength in the radial direction, that is, against stresses acting radially and tending to crush or deform them. It is a demonstratable fact that for a given total wall thickness the radial strength factor of a cylindrical structure varies with the diameter, being relatively high for the smaller diameters, and decreasing proportionately with any increase in diameter. Hence by utilizing the inherently radially rigid spiral formation for the innermost or base element 7, the one having the least internal diameter, the total resulting radial rigidity for the final tubing product of given overall or external diameter, is proportionately increased. Otherwise stated, due to its innermost location and consequent relatively small diameter, adequate radial rigidity is obtained with a less wall thickness and weight of component material. The result is a core or base 7 which is highly resistant to radial stresses but which is of relatively less rigidity in the axial direction, against forces tending to bend or deflect it or cause it to sag out of straight alignment, such as a weight or pressure intermediately applied to the element while it is supported only at or near its ends.

Turning now to Figs. 4 and 5, these represent diagrammatically a further and intermediate phase in the manufacture of the product, under the process of my said application Serial No. 467,243. A finished base tube or core 7 is itself manipulated in the manner of a mandrel to receive upon it a longitudinally rigidifying element represented as a whole by the numeral 10. The resultant intermediate structure comprising the base 7 and the surrounding element 10 will be referred to as the tubing body.

As shown in Fig. 4 by way of example, this core-surrounding element 10 comprises one or more wrappings or layers of wood veneer in sheet form wound straight onto the core 7, that is, with the side edges of the veneer sheets perpen-

dicular to the core axis. The veneer for this core-surrounding element 10 may be of single thickness, or it may comprise a plurality of plies, two or more, three of which plies 11, 11a and 11b are shown in Fig. 4 by way of example, such veneer plies being bonded together either before or in association with their application to the core. Further, the wood material for these sheets is selected and arranged so as to have the grain or fibre extend predominately crosswise of the sheet, as indicated at 12 in Fig. 4, that is, in or approximately in parallelism with the axis of the core as the veneer is wound onto the latter.

The tubing base or core 7 has one or more full turns or wraps of the veneer sheeting 10 applied to it straightwise, that is, with a straight-on wind as above explained. As indicated diagrammatically and in an exaggerated manner at the left in Fig. 5, wherein two turns or layers of the veneer 10 are illustrated by way of example, the leading and the terminal longitudinal edges of this veneer are disposed in close radial proximity to each other, so that the entire resulting core-surrounding element 10 is of uniform thickness, with no excess overlap or part turns. The individual plies such as 11, 11a, 11b, Fig. 4, as also the spirally applied veneer strips 8, 8a, etc., of the tubing base, generally have a thickness of the order of about $\frac{1}{64}$ to $\frac{1}{100}$ of an inch in the smaller sizes of tubing; that is, tubing of internal diameters of from say $\frac{1}{4}$ inch up to 3 or 4 inches. Hence the outward deflection or shouldering of the material of the straight-wound veneer 10 where it passes from one convolution to the next, as at the left in Fig. 5, is but a similar small fraction of an inch in radial dimension. But by using a length of the veneer 10 precalculated to afford exactly the desired number of winds, or by cutting it off directly opposite the position of its leading longitudinal edge as applied upon the core, the terminal longitudinal edge is abutted against and merged with the adjacent shallow shoulder in smooth non-thickening juncture with it. After the following pressure and setting operations the resulting joint is scarcely discernible.

Prior to or during the operation of winding the core-surrounding element 10, it is coated at one or both faces, except at any externally exposed surface of the final wrap, with a similar impregnating and bonding agent as in connection with the formation of the core 7. The resulting composite tubing body composed of both the base 7 and the surrounding element 10 is then subjected to external pressure uniformly over its outer cylindrical surface. This again may be variously accomplished, as by temporarily winding onto it under determined tension a resilient pressure strip or web such as that indicated at 9, Fig. 3, in connection with forming the core. While maintaining this pressure the core-surrounding element 10 of the tubing body is cured, dried or set, with or without the application of heat, also as previously described in connection with Figs. 1 to 3. On completion of the drying and setting the pressure strip or other compressive means is removed, leaving a composite tubing body such as that of Fig. 5 as an intermediate product.

Such composite body 7-10 has a high radial rigidity derived primarily from the base 7. This is effectively augmented by the surrounding element 10. The latter, however, serves mainly to afford an axial rigidity or flexure resistance in the resulting product of maximum efficiency with the given thickness and weight of the component wood material. This is largely due to the de-

terminated fact that for a given character and thickness of the wood material substantially greater longitudinal or axial rigidity is obtained from the straight-on or convolute wound formation as illustrated in Figs. 4 and 5 and wherein the natural graining or fibre direction of the veneer is disposed in general parallelism with the tubing axis. Further, such axial or flexure-resistant strength for a laminate wood cylinder of given wall thickness increases with the diameter of the cylinder; for example, such tube or cylinder of say $1\frac{1}{2}$ in. diameter and having a wall thickness of say $\frac{3}{4}$ in. has a higher longitudinal rigidity, against axial flexure, than a similarly formed tube or cylinder of say $\frac{1}{2}$ in. diameter with the same wall thickness and material.

Hence, in accordance with the invention, by locating the straight-grained straight-wound veneer element 10 in an outer position, outside the core or base 7, and thereby affording it a relatively larger diameter, the inherent high axial rigidity factor of such element 10 is made to contribute to a maximum extent toward a total axial rigidity for the resultant wood tubing product of a given material and given inside and overall diameter, wall thickness and weight. In the resulting tubing body such as 7-10 its two main elements thus cooperatively complement each other to produce a structure of remarkably high rigidity both radially and axially, and in which each such factor is present to a greater extent than in either of the elements alone. By relatively varying the thickness of the respective elements 7 and 10 the radial and the axial rigidity factors may be proportionately adjusted as any particular use circumstances may require. If desired, one or more further elements corresponding either to the core 7 or the intermediate element 10 may be applied.

With a straight-on application of straight-grained veneer as illustrated and described in connection with Figs. 4 and 5 there is in some instances a tendency at its outer surface for it to check or crack lengthwise of the tubing. To overcome this I complete the tubing by applying to any external straight-laid element such as 10 of the drawing an outer covering or protective and finishing jacket such as indicated as a whole by the numeral 13 in Figs. 6 and 7. This may be composed of one or more spiral wraps of thin wood stripping, two of which are here indicated at 14, 14a. The procedure for the application of these spirally disposed cover strips, in which the grain 14g preferably but not necessarily extends mainly lengthwise the strips, may be substantially the same as already fully described in connection with the first operative phase, Figs. 1 to 3, generally including the operations of spiral winding, with reversal of direction in succeeding layers or any plurality thereof, application of the bonding agent, temporary installation of the compressive pressure material such as the resilient material 9 of Fig. 3, and the drying and setting, with or without the application of heat. The end product on removal of such pressure means is a finished substantially homogeneous tubing unit having hard, wear-resistant surfaces and a high total radial and axial rigidity as above explained.

Other and continuous processes for fabricating products such as those hereof are disclosed and claimed in the copending application of Goldman et al., Ser. No. 488,854, filed May 28, 1943. Other tubing products to the manufacture of which the processes of said Goldman et al. application and

of my previously mentioned copendent Patent 2,352,533 are applicable are disclosed and claimed in my copending application Ser. No. 476,890, filed February 22, 1943.

My invention is not limited to the particular embodiment as herein described or illustrated, its scope being pointed out in the appended claims.

I claim:

1. Lamellar wood veneer tubing comprising a radially rigid core of length-grained tape-like wood veneer strip material spirally wound in edge-abutted relation and bonded into a unitary hollow tubular element, a core-surrounding axially rigid element consisting of straight-on wrapping of veneer having its fibre direction paralleling the tube axis and being compressively bonded with itself and to the core to provide with the latter a composite tubing body, and a spirally wrapped veneer strip covering and compressively bonded to said tubing body.

2. An integrated plywood tubing product comprising in combination a length-grained tape-like wood-veneer strip spirally wound in closed edge-abutted formation both as to wind direction and grain extent presenting a unitary radially rigid hollow tubular core, a concentric core-surrounding axially rigid element consisting of a straight-on wrapping of wood veneer formed and positioned to present its graining predominantly parallel to the core axis and having both longitudinal side edges closely proximate to a given radial plane lengthwise of said element, said core-surrounding element having incorporated with it a synthetic resinous agent interbonding it to said core to provide with the latter a composite tubular body, and a further spirally-wrapped tape-like wood-veneer strip covering and bonded to said body to present therewith the integrated tubing product.

3. Rigid hollow tubing having concentric continuous smooth-walled inner and outer surfaces, said tubing formed of wood veneer stripping and comprising a spirally disposed edge-abutted winding of said stripping defining a core, an intermediate wood veneer layer of circumferentially uniform thickness convolutely surrounding said core with the grain paralleling its axis, and an outer spiralled edge-abutted winding of said veneer stripping covering said intermediate layer, each winding and layer being resin-bonded to that next adjacent and together presenting an integrated substantially homogeneous unitary product of predetermined radial and axial strength and rigidity for the given total wall thickness.

4. A substantially rigid hollow tubing structure comprising a series of tape-like length-grained veneer strips wound spirally one on another alternately in opposite directions each in edge-abutted relation and bearing between winds a polymerized plastic bonding agent consolidating them into a dense-walled radially rigid hollow base unit, a predominantly transversely grained veneer web wound straight onto said base unit convolutely with the graining lengthwise the latter, said web applied to a uniform thickness of wind about the entire circumference of the base unit with its leading and trailing longitudinal side edges edges terminated closely proximate to the same radial plane lengthwise of the unit and being similarly consolidated with the base unit thereby to present a composite tubing body of high rigidity axially as well as radially, and a covering including a plurality of tape-like veneer strips spirally wound oppositely and similarly consolidated with said tubing body.

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5. An integrated plywood tubing product comprising in combination a series of length-grained tape-like wood-veneer strips respectively wound in alternately opposite directions in closed edge-abutted spiral formation both as to wind direction and grain extent and having between successive strips a synthetic resinous agent bonding them into a unitary radially rigid hollow tubular core, a concentric core-surrounding axially rigid element consisting of a straight-on wrapping of wood veneer formed and positioned to present its graining predominantly parallel to the core

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axis and having both longitudinal side edges in close proximity to a given radial plane lengthwise of said element, said core-surrounding element having incorporated with it a like synthetic resinous agent inter-bonding it to itself and to said core to provide with the latter a composite hollow tubular body, and a further spirally-wrapped length-grained tape-like wood-veneer strip covering and similarly bonded to said body to present therewith the integrated hollow tubing product.

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