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METHOD AND APPARATUS FOR MAKING FIBROUS SHAPES

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Fig. 3.

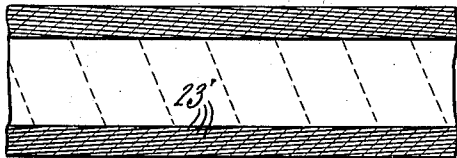


Fig. 1.

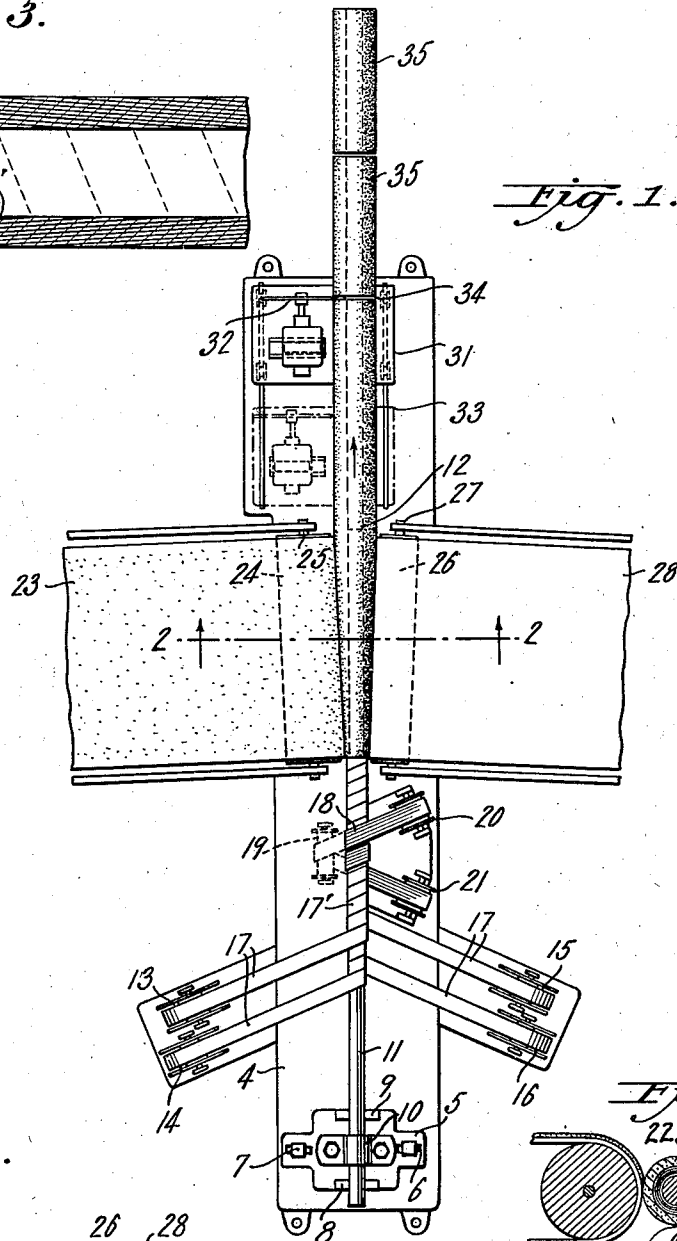


Fig. 2.

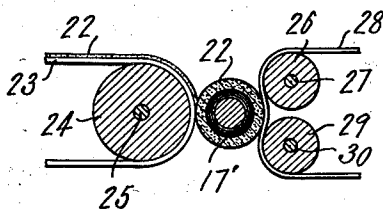
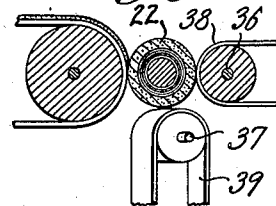


Fig. 4.



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METHOD AND APPARATUS FOR MAKING
FIBROUS SHAPES

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21 Claims. (Cl. 92-66)

This invention relates to the manufacture of hollow, fiber tubing designed for various uses. Such tubing may include fiber cores used in paper mills for winding up paper, fiber conduit for underground cables, and fiber pipe. Such tubing may be impregnated with pitch or other substances to strengthen it and/or render it resistant to chemically active fluids, such, for instance, as those that attack the ordinary types of iron or steel pipe and conduit which is laid under or adjacent the ground.

In the preparation of the ordinary fiber tubing, it has heretofore been the practice to utilize individual mandrels upon which fibrous pulp is deposited, as by the blanket of a wet machine. This procedure has necessitated the use of a number of mandrels, the size of which must be varied in accordance with the length and diameter of the tubes to be constructed, and has required costly equipment and complicated mechanisms in order to feed the mandrels to the laminating apparatus and to remove them therefrom. Tubing formed in lengths greater than six or eight feet, requiring mandrels of the same or approximately the same length, have been made by this method, but this size is close to the practical limit in which fibrous tubing can be made, as larger sizes require such large and cumbersome mandrels that it is difficult to handle them.

In order to overcome these difficulties and to simplify the manufacture of fibrous tubing generally, it has been proposed to form continuously a tube from fiber stock by extruding the same through an annular die under pressure. This procedure, however, is not practicable as the pressure applied to the stock merely expresses the water or other vehicle from the pulp and leaves a solid, compacted mass of fibers which no practical amount of pressure can force through the die.

The present invention enables the continuous production of fibrous tubing in a manner not subject to the difficulties inherent in an extrusion process and in a manner which is commercially superior to the present modes of individual construction upon a mandrel.

The invention, therefore, will be seen to be extremely advantageous in the art of making tubing of fibrous material, as it eliminates the necessity of using costly and cumbersome equipment and places the production of such material on the basis of a continuous process with its concomitant advantages of speed, economy and volume of production.

The invention makes use of several well known

instrumentalities at present in use in paper mills but by the several changes, variations and adaptations hitherto unknown in the art, effects a new and heretofore unknown result, to wit, a continuous process for making fiber tubing and, as a product, a tubing of practically no limit of length other than such as the demands of the market may dictate.

A well known machine in the paper working art is designed to make paper tubing consisting of multiple paper wrappings formed on a mandrel and glued together. Such tubings are frequently used as containers of matter to be sent through the mails; or as cores on which paper or fabrics of various sorts may be rolled or wound. The machine on which such paper tubing is constructed may be of various types, all of which, however, comprise a mandrel of more or less limited length; means for spirally winding as many plies of paper strip as may be desired; means for applying a coat of an adhesive substance at least to one surface of the inner and to the outer paper wrappings; and cutting means to cut the paper tubing to the desired length.

Another well known machine, used in the art of the manufacture of fiber articles, is the so-called "wet machine". An important element of this machine consists of a felt blanket or belt adapted to carry a thin film of fibrous material. Rotating metallic mandrels suitably arranged to contact with the moving felt take up an increasing number of laminations of fibrous material until the desired total thickness is obtained. In this manner a fiber pipe or conduit is formed, which on being dried shrinks away from the mandrel and may be easily removed therefrom. The mandrels customarily used in this machine consist of metal rods or brass pipes. Owing to the large number of different sizes of mandrels required, and also to the large number of the same size required for commercial production of pipe or conduit, the mandrels alone necessitate a very large investment.

Furthermore, there are several well known types of cutting machines at present in use in factories where paper tubing or cores are made, the purpose of these machines being to trim or cut the tube or core to the desired size.

It is an object of the present invention to provide a machine which combines certain of the elements of these three types of machines and discards certain that have heretofore been considered necessary.

It is a further object to provide a machine upon

which continuous tubing can be made, upon which, indeed, as long as the raw materials are provided to the machine, a piece of tubing can be constructed, regardless of length. According to the invention, a cutting device may be included for the purpose of separating this continuous tubing into such lengths as commercial demand requires.

It is a still further object to provide a machine for the purpose indicated which in a continuous operation first forms its own mandrel of the size and shape desired and without limit as to length, and then builds the tubing on the mandrel so formed,—the mandrel itself being made of pre-formed fibrous material so that, on removal of the tubing therefrom, the mandrel may be utilized, after being processed, as additional fibrous material to be fed to the machine. The large investment in metallic mandrels and handling equipment is thus eliminated.

With the above factors in mind, the present invention may be seen to consist, briefly, in building upon an advancing core or mandrel a continuous fiber tubing by a process in which the core is first formed and then fed through the instrumentalities by which the fibrous tubing is built thereon. There is, therefore, no limit to the length of tubing which may be made in accordance with this invention,—that is, the tubing may be made in an indefinite length or cut during the process to any desired length.

Proceeding now to a more detailed description of the invention, reference may be had to the drawing in which Figure 1 is a diagrammatic plan view of the machine of this invention by which the process of the invention may be accomplished; Figure 2 is an enlarged section along the line 2—2 of Figure 1; Figure 3 is an enlarged longitudinal section of a portion of fibrous tubing made in accordance with the present invention; and Figure 4 is a modification of the laminating apparatus of Figure 2.

Reference character 5 represents the adjustable base of a spiral wound paper core machine, which consists in an outstanding shaft 11 supported in cradles 8, 9, and clamped in place by clamp 10. The base 5 is preferably provided with slots 6 through which bolts 7 may be extended in order to adjustably secure the base to the foundation plate 4 of the machine. The shaft 11 is arranged so that a plurality of strips of paper 17, such as ordinary wrapping paper, may be wound thereupon to form a paper core 17'. The shaft may be arranged to terminate at 12 adjacent the edge of the felt or blanket 23 of an ordinary wet machine in which fibrous pulp is laminated upon a form. On either side of the shaft 11 are disposed reels 13, 14, 15, 16, upon which suitable paper strips are wound. The reels are disposed at an angle to the shaft 11 so that they will deliver the strips in such a manner that they may be readily wound on the shaft 11 and formed into a core as shown in Figure 1. This may be accomplished by rotating the formed core around the shaft 11, as by a belt 18, said belt being lapped around the core one or more times and disposed at an angle to the shaft in order to urge the core along it. The belt 18 may be supported by rollers 19, 20 and 21, and driven from a suitable source of power (not shown). The gripping pressure of the belt on the core 17' should, of course, be adjusted so there will be sufficient friction to cause movement in the desired direction. It should be understood that the means illustrated is only one way in which the core may be advanced

along the shaft 11, and that other or additional means to effect this movement may be employed without departing from the principles herein set forth. If desired, an abrasive device may be arranged to smooth the outer surface of the core 17' preparatory to its passage across the felt or blanket of the wet machine, which will now be described.

The felt 23 of the wet machine is disposed as shown in Figure 1 at an angle to the axis of the shaft 11, and is led around a suitable roller 24 whose shaft 25 is journaled in suitable bearings in the frame of the machine. Oppositely-disposed to the felt 23 may be provided a pressure belt 28, led around suitable rollers 26 and 29 disposed on shafts 27 and 30 which are likewise journaled in suitable bearings in the frame of the machine. The bearings which carry shafts 27 and 30 are preferably mounted adjustably in the frame so that the assembly may be moved toward and away from the felt 23 in order to accommodate smaller and larger mandrels and cores. By reference to Figures 1 and 2 it will be seen that as the completed paper core 17' advances through the apparatus a pellicle or layer of pulp or fibrous material 22 is applied thereto by felt 23, and this pellicle or layer is convolved upon itself and above the core and pressed tightly against the core by means of pressure belt 28.

The aggregate amount of pulp applied to the core 17' will depend upon the speed of rotation and advance of the fibrous core and this in turn is dependent upon the width of the strip which is applied to the shaft 11. For instance, if the strip 17 be of a width of one inch, the speed of advance should be adjusted so that each revolution of the core about the shaft 11 will advance the core approximately one inch. If the felt 23 of the wet machine is eight feet (or 96 inches) wide, then it will require ninety-six revolutions of the core in order to advance it the entire width of the felt, and during this advance there will be applied to the core approximately ninety-six layers of pulp which are built up in overlapping relation one upon the other on each revolution of the core. If the width of the strip 17 be two inches instead of one inch, it will be seen that the core 17' can be formed twice as fast and can be advanced through the apparatus at approximately twice the speed which is obtained with the one inch strips. The aggregate thickness of the tubing or piping will, therefore, be only that imparted by forty-eight layers, as the core will have passed through the machine in only half the time and will have revolved only forty-eight times instead of ninety-six.

After passing through the laminating device, the built-up tube may be passed through a cutting device 31 and cut into lengths 35 of the desired size. The cutting machine may comprise a longitudinally movable standard on which a laterally traveling rotating saw or knife 32 may be mounted, arrangement being made so that the cut may be made during the advance of the tubing 35. For instance, the blade 32 will commence to cut at the position indicated at 33 and the complete severance of the tube will take place during the time when the tubing passes from 33 to 34. Any known quick return mechanism may be arranged to bring the blade back to the initial cutting position.

The cut tubes may be then placed in suitable racks and led into or through dryers of the usual type. During the drying operation, the fibrous tubes shrink away from the fibrous cores 17',

which latter are easily removed and may be economically utilized in the process by returning them to the beaters for the formation of new stock. If desired, the tube may be dried continuously upon leaving the forming apparatus and subsequently cut into the desired lengths.

After the tubes are formed and dried, they may be impregnated in any desired way as with rosin, pitch, silicates or sulphur compounds for imparting strength and resistance to corrosion and erosion. In order to obtain better impregnation, the impregnating material may be reduced to finely divided form and sprinkled on the fibrous film on the felt 23 during the construction of the tube, thus ensuring its intimate incorporation throughout the body of the tube upon subsequently subjecting the finished tube to heat and/or pressure. If the tubes are to be used as electrical conduits or piping, the ends may be machined or threaded to form interfitted joints so that a continuous conduit system may be constructed. In short, they may be processed in the same manner as tubing and piping produced by the processes of the prior art.

It should be noted that a fibrous tube constructed in accordance with the principles of my invention, which is preferably formed of a mixture of 50% sulphite screenings and 50% ground wood pulp, is distinctly different in structure from the types of fibrous tubing heretofore known or used, and is greatly superior thereto. Instead of being composed of concentric cylindrical layers of fibers deposited from the pulp, it is constructed of longitudinally overlapping convolutions whose widths extend from the inner surface of the pipe to the outside thereof. Referring to Figure 3, which is greatly enlarged in order to illustrate the laminated structure, it will be seen that the layers 23' while interfelted and compacted into a substantially homogeneous mass, overlap longitudinally so that each layer extends from the inner surface of the tube diagonally to the outside. The construction not only enhances the strength of the tube but also prevents an inner layer or layers from working loose under the softening and disintegrating action of the chemically active fluids to which the tubing may be subjected in usage, and also minimizes the tendency of the tubes to shrink lengthwise during drying. In other words, the body of tubing made in accordance with general practice comprises a substantially homogeneous mass of fibers constructed in substantially concentric layers, and when separation occurs it follows the line of contact between the laminations, and results in an entire layer being freed from the body of the tube. On the other hand, applicant's construction entails a progressive overlapping of the component layers of the tube with the line of contact between the layers running from the inside of the tube to the outside so that separation of one layer is prevented by the binding action of the subsequent layers.

In Figure 4 is illustrated a modification of a device adapted to exert pressure on the tube during formation. Instead of the blanket or belt arrangement indicated in Figure 2, which presents a relatively large belt surface in contact with the laminated tube, there may be provided one or more belts 38 and 39 led around rollers 36 and 37 so as to present a smaller surface for contact against the laminated tube 22. If desired, the pressure device may be tilted, as indicated by the roller 37 of Figure 4 so that the area of contact on the fibrous tube may be still further decreased

and a component of force in the direction of the travel of the core may be imparted thereto.

What I claim is:

1. The process of making fibrous tubing comprising continuously advancing a dry fibrous core while applying thereto successive films of wet fibrous material.

2. The process of making fibrous tubing comprising continuously advancing a fibrous core while applying thereto successive films of wet fibrous material, cutting the tubing so formed into predetermined lengths and drying the same.

3. The process of making fibrous tubing comprising continuously forming a paper core and advancing the same while laminating thereon a plurality of thicknesses of fibrous pulp, and then forming completed tubing of predetermined length.

4. In an apparatus for forming fibrous tubing, in combination, means for continuously advancing a dry fiber core and means for applying thereto a plurality of layers of fibrous pulp.

5. In an apparatus for forming fibrous tubing, in combination, means for continuously advancing a dry fiber core and means for applying thereto a plurality of overlapping layers of fibrous pulp.

6. In an apparatus for making fibrous tubing, in combination, means for forming and advancing a dry paper core over a mandrel, means for applying to said core a thickness of fibrous material, and means for cutting the tube so formed into predetermined lengths.

7. In an apparatus for forming fibrous tubing, in combination, means for forming a continuous fibrous mandrel, means for advancing said fibrous mandrel, means for applying thereto a thickness of fibrous material thereby forming a fibrous tube upon said fibrous mandrel and means for cutting the tube so formed into predetermined lengths.

8. The process of making fibrous tubing comprising continuously forming and advancing a dry fibrous core, applying a film of wet fibrous material thereto while rotating the same, cutting and drying said assembly and then removing said core.

9. The process of making fibrous tubing comprising forming a dry fibrous core, rotating the same and advancing it longitudinally of its axis and while so moving it applying thereto a wet fibrous sheet.

10. An apparatus for forming fibrous tubing, in combination, means for forming a dry fibrous core and for rotating said core while advancing it lengthwise, and means for applying a film of wet fibrous material to said core during said advance.

11. A fibrous tube constructed of a continuous layer of feltable fibrous material convolved upon itself longitudinally to overlap preceding layers, the fibrous convolutions being interfelted and compacted with one another.

12. A fibrous tube constructed of a continuous layer of feltable fibrous material convolved upon itself longitudinally to overlap preceding layers, the fibrous convolutions being interfelted and compacted with one another into a substantially homogeneous mass.

13. A fibrous tube constructed of a continuous layer of feltable fibrous material convolved upon itself longitudinally to overlap preceding layers, the fibrous convolutions being interfelted and compacted with one another, the edges of said

layer disposed respectively at the inner and outer surfaces of said tube.

14. A fibrous tube constructed of a continuous layer of feltable fibrous material convolved upon itself longitudinally to overlap preceding layers, the fibrous convolutions being interfelted and compacted with one another, the edges of said layer disposed respectively at the inner and outer surfaces of said tube, said tube being impregnated with a strengthening and corrosion-resisting agent.

15. A continuous layer of feltable fibrous material spirally convolved upon itself under pressure in the form of a self-sustaining tube.

16. A continuous layer of feltable fibrous material spirally convolved and compacted upon itself in the form of a self-sustaining tube, the inner and outer surfaces of said tube being defined by the respective edge portions of said layer.

17. A continuous layer of feltable fibrous material spirally convolved and compacted upon it-

self in the form of a self-sustaining tube, the inner and outer surfaces of said tube being defined by the respective edge portions of said layer, said tube being impregnated with a bituminous substance.

18. A process of making fibrous tubing comprising convolving a single fibrous layer upon a core advancing in the direction of its axis.

19. Process of making fibrous tubing comprising convolving a single fibrous layer continuous for any desired length upon a core advancing continuously in the direction of its length.

20. A fibrous tube constructed of a single band of wet pulp spirally wound upon itself and compacted into the form of a series of continuously overlapping convolutions.

21. A fibrous tube constructed of a single band of feltable fibrous material spirally wound upon itself and compacted into the form of a series of continuously overlapping convolutions.

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