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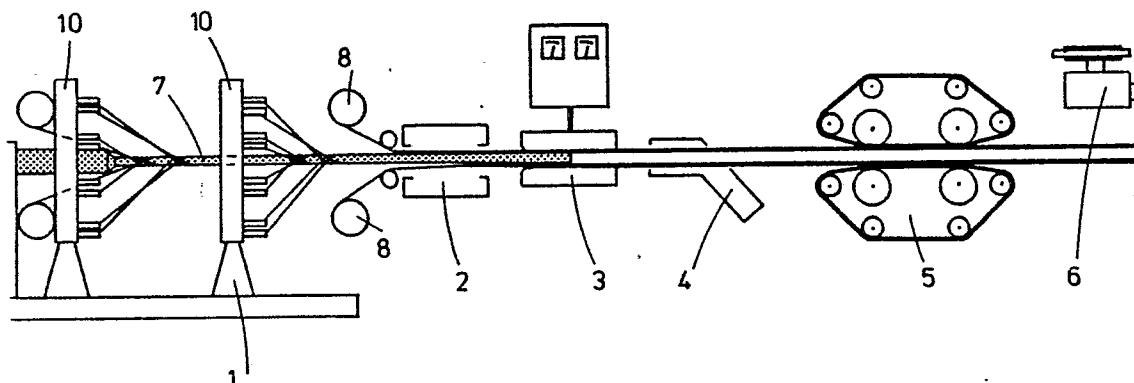
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(54) Process for producing a cylindrical unit.

(57) The invention relates to a process for producing and treating a cylindrical unit, in which process a hose is made from flexible threads around a tube, upon which the hose is subjected to thermal treatment and is molded to form a cylinder around the tube, wherein the hose is made from threads containing fibrous material and a thermoplastic or thermosetting polymer which are braided or knitted together.

A cylindrical unit according to this invention can be used for replacing cylindrical units made of other materials, and especially in those cases in which a low weight and a high torsional and flexural resistance are deemed to be important.

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PROCESS FOR PRODUCING A CYLINDRICAL UNIT

The invention relates to a process for producing and treating a cylindrical unit, in which process a hose is made from flexible threads around a tube, upon which the hose is subjected to thermal treatment and is molded to form a cylinder around the tube.

Such a process is known from US-A-4202718. In this process a cylindrical unit is formed by winding threads spirally around a mandrel into a cylindrical reinforcing layer, after which the layer is incorporated in a tubular product by impregnating it with a resinous material and thermoforming it. It is described that a second set of threads can be wound spirally in the other direction to bind the first threads. Further longitudinal strands are added. In a modification of the process tapes of resinous material can be wound around the reinforcing layer before thermoforming it.

The disadvantage of this product is that the wounded reinforcing layers have no coherent structure of themselves. In case of disrapture of the cylindrical unit, the reinforcing layers will delaminate.

The object of the invention is to provide a process of the above-mentioned kind, in which process a product is formed which does not have said disadvantage.

This object is achieved according to the invention in that the hose is made from threads which are braided or knitted together.

A process for producing a braided or knitted hose for impregnating use is known from NL-A-8502880.

In this known process the hose is produced by means of a so-called circular braiding machine, in which process the hose is formed on a prolonged support or support tube and is subsequently rolled on a reel. After that this hose is drawn over another support tube and impregnated.

The disadvantage of this process is that in all treatments which the hose is subjected to it must be supported in the process on the inside by a support tube. So as not to let the support tube move along with the hose, this tube must, according to the state of the art, be supported and fixed by rolls, which also take care of the movement of the hose, which press against the tube right through the hose material. This may cause inhomogeneity of the hose material and interfere with the movement of the hose.

Another disadvantage of the process according to NL-A-8502880 is that the process is not continuous. When a reel is empty, the process is stopped and a next one is connected. This makes the process quite laborious.

In the process according to the invention, the support tube need no longer be fixed with rolls pressing through the hose material, but this is effected via the piece of tube passing through the heart of the circular braiding machine, round which the hose is produced. When the bobbins of braiding thread of one machine are empty, the next circular braiding machine may be connected in a continuous process, so that in principle an endlessly long hose can be obtained.

It is possible to vary the pitch of the braiding hanks and by doing so to determine the angle at which they cross each other.

It is also possible to apply various layers of braided fabric with or without difference in pitch and of different materials one on top of the other, and it is possible to apply additional lengthwise fibres, knitted fabrics, woven fabrics and/or flat braids either continuously or not.

It is possible to produce a hose filled with a core of, for instance, foamed material by allowing this endlessly or not endlessly long core in the treatment of the hose to move along with the hose through, in this case, a hollow tube, in which process the supporting function of the tube is taken over, after the end of said tube, by the core material.

Thanks to this on-line arrangement of one or more circular braiding machines and further processing equipment, the product can be adjusted, locally if so desired, to highly specific requirements in a continuous process.

In a first embodiment the hose is impregnated, after braiding, with a thermosetting or thermoplastic resin and subsequently dried and/or cooled, so that a resin-impregnated hose is obtained.

In another embodiment the hose is coated, after the braiding, with a material suited for the impregnation, and subsequently subjected to thermal treatment so that the fibre is impregnated.

In another possible embodiment the hose is built up at least in part of fibres which already contain a material suitable for impregnation, so that the fibre itself provides part of the material suitable for the impregnation.

Other characteristics and advantages will be clear from the description following hereinafter, in which description reference will be made to the attached drawing.

In it a diagrammatic representation is given of a device for carrying out the process according to the invention.

As shown in the figure, a hose is formed by means of circular braiding machines 10, two such machines being shown in the figure, but it is clear

that such a hose can be realized also with one or with more than two circular braiding machines. The circular braiding machine 10 forms the hose round a tube 7, which is secured on the one side by a frame on which also the circular braiding machines 10 have been mounted, and which, on the other side, projects through the central openings in the circular braiding machines 10, all of it as customary in this art. For more information about the winding round a tube reference may be made, for instance, to the German Offenlegungsschrift 3245705. It is clear that within the scope of the invention other types can be used without problem. An important element is always that a hose will be formed by the machine on a tube. The braiding or knitting according to the invention has major advantages over DE-3.245.705. When the product of the winding process is twisted, there will be a risk of delamination. In the process according to the invention all threads bind in turns, so that a better distribution is obtained, with the product having strong resistance against torsion without delamination. Moreover, the process of DE-3.245.705 is only possible with a rubbery hose-pipe as the mandrel.

For the purpose of this invention it is further necessary that this tube should extend through the arrangement in so far as the hose must be supported on the inside.

After the formed hose over tube 7 has left the last circular braiding machine, it may optionally be provided with a layer of material suited for the impregnation. This material may be unrolled, for instance, from rolls 8 placed on either side of the tube in the embodiment shown, but it is clear that more than two rolls may be present also and optionally only one roll may be present, too. It is possible also for the hose to be passed via the tube through an impregnating bath with a liquid thermosetting or thermoplastic resin. This is not essentially different from applying material suited for impregnation via rolls 8. If impregnation has been effected with a liquid resin, the resin can be dried and/or cooled so that a semi-finished article is obtained that can preferably yet be moulded to some degree.

In another embodiment the hose, while still moving over tube 7, can be fed to an oven 2. If the material suited for impregnation is a thermoplastic resin, the hose is heated to a temperature at which the material suited for impregnation becomes soft. The chosen temperature, of course, depends on the composition of the material suited for impregnation. After having left oven 2 the hose can be fed to a mould or shaping device 3. The hose then still moves over the tube and is thus, on the inside, kept in the shape of it. The outer shape of the tube can be chosen in such a form as is required for the cylindrical unit which is to be produced. At the

same time the outside is brought into the correct shape. In shaping device 3 the hose is cooled to a temperature below the softening temperature, in which process a cylinder is obtained. The shape of this cylinder may be round, but may also be oblong, or the cylinder may be of any other shape. In mould or shaping section 3 the cylinder leaves tube 7 and is subsequently subjected to further treatment in a cooling tunnel 4, where the cylinder is cooled further. If impregnation is effected with a thermosetting resin, the shaping can take place in the oven during the curing.

Finally, the cylinder passes through a drawing unit 5 and is moved on to a sawing unit 6, where the cylinder is cut to the correct length to form a cylindrical unit. At this moment the cylinder is a completely solid and hard cylindrical unit. It is clear that the hose or cylinder is moved forward by means of drawing unit 5, so that a process is created called pultrusion. Within the scope of the invention numerous other variants are, of course, possible.

The thermoplast applied can, for instance, be polyethylene, polypropylene, acrylonitril butadiene styrene graft copolymers (ABS), various grades of polyamides, polyesters, etc.

Impregnation can be effected also with caprolactam according to RIM-Nylon (Reaction Injection Moulding) techniques known per se. Then the shaping takes place before and/or during the polymerization.

The thermosetting resin applied can, for instance, be epoxy resin, unsaturated polyester resin, polyurethane resin, acrylate resin, phenolformaldehyde resin, melamineformaldehyde resin, etc.

As reinforcement fibre can, for instance, be used glass fibre, carbon fibre, aramide fibre, nylon fibre, acrylonitrile and other fibres. Preference is given to the use of glass, carbon or aramide fibres. The melting temperature of the fibre must, of course, be significantly higher than the curing or melting temperature of the material suited for impregnation.

A cylindrical unit according to this invention can be used for replacing cylindrical units made of other materials, and especially in those cases in which a low weight and a high torsional and flexural resistance are deemed to be important.

If a thermoplastic polymer is used as matrix material, the cylindrical unit may yet be thermally shaped later on. With a thermosetting matrix material the shaping must take place during the curing.

Claims

1. Process for producing and treating a cylin-

drical unit, in which process a hose is made from flexible threads around a tube, upon which the hose is subjected to thermal treatment and is molded to form a cylinder around the tube, the process being characterized in that the hose is made from threads which are braided or knitted together. 5

2. Process according to claim 1, characterized in that the pitch of the braiding hanks can be varied.

3. Process according to any one of claims 1-2, characterized in that lengthwise threads, knitted fabrics, woven fabrics and/or flat braids are added to the braided fabric. 10

4. Process according to any one of claims 1-3, characterized in that various layers of braided fabric and/or other woven fabric are laid one on top of the other. 15

5. Process according to any one of claims 1-4, characterized in that the hose is impregnated after the braiding with a thermosetting resin. 20

6. Process according to any one of claims 1-4, characterized in that the hose is impregnated after the braiding with a thermoplastic polymer.

7. Process according to any one of claims 1-6, characterized in that the hose is impregnated after the braiding with RIM-Nylon. 25

8. Process according to any one of claims 1-7, characterized in that the hose is at least in part built up from fibres containing a material suited for impregnation. 30

9. Process according to any one of claims 1-8, characterized in that the hose is subjected to thermal treatment and shaped.

10. Process according to any one of claims 1-9, characterized in that the hose is moved through the various stages of treatment by means of pultrusion. 35

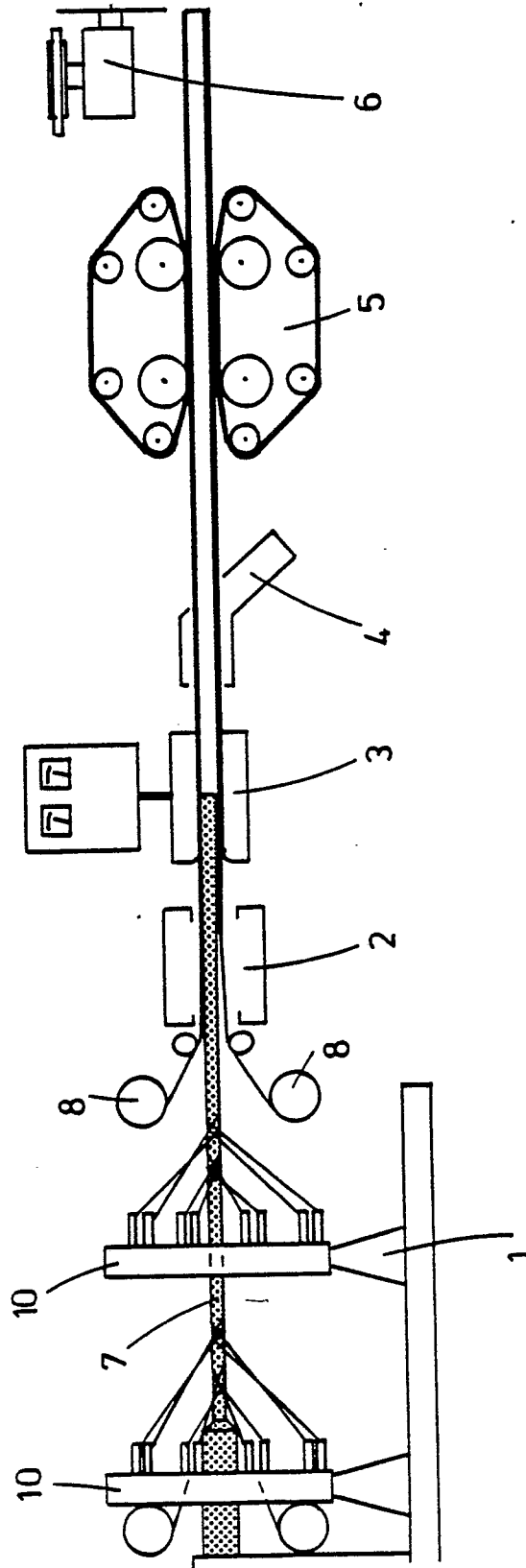
10. Cylindrical unit obtained while applying the process according to any one of claims 1-10. 40

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2373386 (KURARAY PLASTICS CO) * the whole document * ---	1-6, 8-11	D06B3/10
X	FR-A-2319482 (INTRUCO LIMITED GUERNSEY) * the whole document * ---	1-5, 11	
X	FR-A-1092329 (PAIX & COMPAGNIE) * the whole document * ---	1	
A,D	EP-A-223277 (KONINKLIJKE TEXTIELFABRIEKEN NIJVERDAL-TEN CATE) * abstract * ---		
A	EP-A-6601 (HOECHST) * abstract; claims 1-8; figure 1 * -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D06B B29D
Place of search THE HAGUE		Date of completion of the search 09 NOVEMBER 1989	Examiner PETIT J.P.
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