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(54) IMPROVEMENTS IN OR RELATING TO FLEXIBLE
THERMOPLASTIC HOSE

(71) We, BTR INDUSTRIES LIMITED, a British Company, of Silvertown House, Vincent Square, London SW1P 2PL, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to reinforced flexible pressure hose of thermoplastic material.

According to the invention there is provided a method of manufacturing reinforced flexible thermoplastic hose comprising the steps of extruding a thermoplastic tube, applying a positive, predetermined pressure difference between the inside and outside of the tube, and applying to the tube reinforcing elements under tension, in which the reinforcing elements are heated prior to application to the tube to such a temperature that the reinforcing elements soften the exterior of the tube and the tension applied to the elements in combination with the pressure difference across the tube causes the elements to penetrate the tube, the pressure difference being maintained while the reinforced assembly is allowed to cool whereby the reinforcing elements are secured to the thermoplastic tube.

The pressure difference is preferably removed after cooling below the hardening temperature of the tube.

The positive pressure difference between the inside and the outside of the tube may be created by sealing one end of the tube and filling the tube with fluid (for example water) under pressure.

The fluid may be removed from the tube by applying compressed air to the tube.

An outer cover of thermoplastic material may be applied to the completed tube.

Alternatively, the initial external diameter of the hose may be greater than the desired final external diameter of the reinforcement, such that when the heated reinforcing elements are applied, the outer diameter of the hose is greater than the external diameter of the reinforcement, the reinforced hose being passed through heated smoothing means to smooth the exterior surface of the tube, and the

pressure difference between the inside and the outside of the hose removed, whereby an integrated cover and final hose is formed.

The invention further provides a reinforced hose manufactured by the method as described above.

By way of example, a specific method of manufacturing reinforced thermoplastic hose and a modification thereto will now be described with reference to and as shown in the accompanying drawings, in which:—

Figure 1 is a diagrammatic view to illustrate a method of manufacturing thermoplastic hose, and

Figure 2 is a diagrammatic view to illustrate a modified method of manufacturing thermoplastic hose.

The first step of the preferred embodiment of the method according to the invention is to extrude a thermoplastic tube, and such an extruded thermoplastic tube 10 is shown extending from a coil 19 in Figure 1. The tube is then filled with fluid, for example water, and the leading end of the tube is sealed, the other end of the tube being connected to a pressure source and gauge, shown generally at 11.

The interior of the tube is pressurised to a predetermined pressure, the pressure being determined by the exact dimension of the inside diameter of the tube and the outside diameter required for the reinforcement, and the calculation of the pressure is also dependent on the tensions in the reinforcement which are to be applied to the outside of the tube. The pressure can be regulated during the reinforcement process so that precise diametral control of bore and reinforcement outer diameter is permitted.

The reinforcement machine is shown generally at 12. The reinforcement may be braided or spirally wound, and is heated externally of the tube 10 in a gas flame, although it will be appreciated that other forms of heating could be used. The heated reinforcement is then applied to the exterior surface of the tube such that the exterior surface of the tube is softened while the interior surface of the tube remains solid due

to the presence of the cool pressurising fluid. The application of the reinforcement forces the reinforcement into the soft exterior of the tube, thus effectively filling the underside of interstices of the reinforcement and creating a homogenous matrix.

After the reinforcement has been applied, the fluid is removed from the tube by blowing out with compressed air, although other methods of removal could be used. The tube is now secured to the reinforcement, and the final step is to cover the tube with a thermoplastic covering, thereby completely enclosing the reinforcement. An outer cover can also be applied using conventional polymers and microwave techniques.

In Figure 2, a modified method of manufacturing reinforced thermoplastic tubes is shown. In the modified method, the tube 10 is extruded thicker than in the method described with reference to Figure 1, with the result that when the reinforcement is applied the outer diameter of the tube extends beyond the outer diameter of the reinforcement, the heated reinforcement being effectively submerged in the tube.

The tube with reinforcement applied passes over a haul-off conveyor 13, through a heating station 14 and through a heated sizing die 15 which smooths the outer surface of the tube to form an integrated cover and final hose. The hose then passes over a second haul-off conveyor 16, through a line marking station 17 and is finally wound onto a drum 18.

One advantage of this embodiment of a method of manufacturing reinforced hose, and the modification thereto, is that it permits manufacture of a hose using a thin walled thermoplastic tube whereby accurate braid and bore tolerances can be achieved. A homogenous tube/reinforcement matrix is produced which is advantageous since rosetting of the reinforcement is reduced, as is distortion of reinforcement helix angle during fitting of the hose to a coupling.

The use of a fluid as the cooling medium for the interior of the tube protects the innermost portion of the tube from distortion upon application of the heated reinforcement, thereby maintaining a smooth interior surface.

WHAT WE CLAIM IS:—

1. A method of manufacturing reinforced flexible thermoplastic hose comprising the steps of extruding a thermoplastic tube, applying a positive, predetermined pressure difference between the inside and outside of the tube, and applying to the tube reinforcing elements under tension, in which the reinforcing elements are heated prior to application to the tube to such a temperature that

the reinforcing elements soften the exterior of the tube and the tension applied to the elements in combination with the pressure difference across the tube causes the elements to penetrate the tube, the pressure difference being maintained while the reinforced assembly is allowed to cool whereby the reinforcing elements are secured to the thermoplastic tube.

2. A method of manufacturing reinforced flexible thermoplastic hose as claimed in claim 1 wherein the pressure difference is removed after cooling below the hardening temperature of the tube.

3. A method of manufacturing reinforced flexible thermoplastic hose as claimed in claim 1 or claim 2 wherein the positive pressure difference between the inside and the outside of the tube is created by sealing one end of the tube and filling the tube with fluid under pressure.

4. A method of manufacturing reinforced flexible thermoplastic hose as claimed in claim 3 wherein the fluid may be removed from the tube by applying compressed air to the tube.

5. A method of manufacturing reinforced flexible thermoplastic hose as claimed in any preceding claim comprising the further step of applying an outer cover of thermoplastic material to the completed tube.

6. A method of manufacturing reinforced flexible thermoplastic hose as claimed in any of claims 1 to 4 wherein the initial external diameter of the hose is greater than the desired final external diameter of the reinforcement, such that when the heated reinforcing elements are applied the outer diameter of the hose is greater than the external diameter of the reinforcement, the reinforced hose being passed through heated smoothing means to smooth the exterior surface of the tube, and the pressure difference between the inside and the outside of the hose being removed after smoothing whereby an integrated cover and final hose is formed.

7. A method of manufacturing reinforced flexible thermoplastic hose substantially as hereinbefore described with reference to Figure 1 or modified as hereinbefore described with reference to Figure 2 of the accompanying drawings.

8. A reinforced hose manufactured by a method as claimed in any preceding claim.

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FIG. 1.

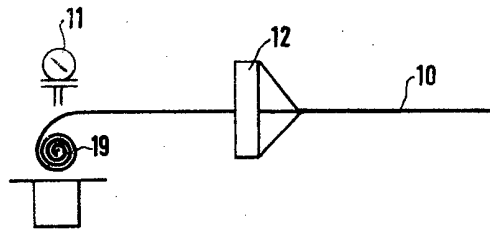


FIG. 2.

