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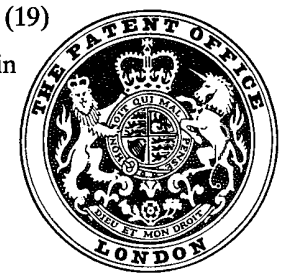

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(54) METHOD AND APPARATUS FOR COATING TUBING

(71) We, WINDMÖLLER & HÖLSCHER, a Kommanditgesellschaft organised and existing under the laws of the Federal Republic of Germany, of 48-52 Münsterstrasse, 454 Lengerich, Westphalia, the Federal Republic of Germany, 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:-

This invention relates to a process of coating woven thermoplastics tubing of fibrillated tape with synthetic thermoplastic material and apparatus for carrying out the process.

Self-supporting valved bags and flat bags are often made from non-oriented single-ply thermoplastic tubing, which is usually extruded in tubular form or is made in that flat extruded sheeting is folded and then welded or adhesively joined to form a tubing. Such single-ply tubing of synthetic thermoplastics has only a relatively low strength and in some cases is unstable when used at very high or very low temperatures. The disadvantages which reside in a low strength and inadequate thermal stability are avoided by the use of woven webs which consist of oriented fibrillated tapes of plastics material and are usually rendered impermeable to moisture and dust by an extruded coating. For reasons of weaving technology it was possible so far only to make a flat woven fabric from fibrillated tape.

That flat woven fabric was coated on one side with a thermoplastic film in the roller frame of an extrusion coating plant and was then welded at its two longitudinal edges to form a tubing. The longitudinal seam of the resulting weld has in no case the strength of the woven fabric of fibrillated tape and can easily be torn, particularly under shock load.

As a result of further developments in weaving technology, it is now possible to produce at a high production rate a woven tubing which consists of fibrillated tape and has no longitudinal seams and exhibits the same strength in all regions. On the other hand, problems arise in the coating of such woven tubing of fibrillated tape with synthetic thermoplastics in order to render the woven tubing impermeable to dust and moisture. At the present time, the tubing is coated in a conventional extrusion coating plant, in which the flattened woven tubing is first coated on one side and in a second pass through the extrusion coating plant is coated on the other side. Because the flattened tubing cannot be coated exactly as far as to its edges, fins of coating material protrude from the edges. In the manufacture of boxlike bags or large bags having an approximately square bottom from length sections of the coated woven tubing, these protruding fins render the formation of tight ends more difficult because it is hardly possible to avoid the formation of passages through which moisture can enter or solids filled into the bags can trickle out.

According to the invention, there is provided a process of coating woven thermoplastics tubing of fibrillated tape wherein flattened tubing is advanced, is opened out and supported from the inside, a plastics tube is extruded around the opened out and supported tubing, the diameter of the extruded tube being greater than that of the tubing, and the extruded tube is subsequently pressed onto the peripheral surface of the tubing while in a soft condition, the wall thickness of the extruded tube being reduced before being pressed on to the tubing.

German Utility Model Specification 1,928,736 discloses a plant for manufacturing internally reinforced thermoplastics tubing in that a first inner tubing is extruded and is then provided with a braided covering of reinforced threads by rotary braiders and is subsequently coated on the outside with a

tubular film, which is directly applied to the braided reinforcing covering from a die orifice which has an exit diameter that corresponds to the diameter of the tubing to be coated. A tubular film cannot be applied to a synthetic thermoplastic woven tubing of fibrillated tape in the known manner because the extruder head temperature and melt temperature are so high that the tubular film would destroy the woven tubing of fibrillated tape.

Printed German Application 2,137,059 disclosed apparatus for manufacturing plastics material tubing which comprises a woven tubular reinforcing insert. In the known apparatus an internal mandrel is held by a retaining roller system in the woven reinforcing tubing, which is surrounded by an extruder head, in which the thermoplastic material for forming the coating is extruded onto the inside and outside of the woven tubing so that the extruded material entirely penetrates the reinforcing woven tubing. That known apparatus also cannot be used to coat thermoplastic woven tubing of fibrillated tape because the latter would be melted during the coating operation.

Also according to the invention, there is provided apparatus for carrying out the method of the invention, said apparatus comprising means for advancing flattened woven thermoplastics tubing of fibrillated tape, means for opening out and internally supporting the tubing, extrustion means for producing a tube of plastics material around the supported tubing at a diameter greater than that of the tubing, and means downstream of the extrusion means for pressing the tube onto the peripheral wall of the tubing while the tube is still soft and after the wall thickness of the tube has become reduced.

One preferred form of the apparatus comprises a tubular die that is supplied with synthetic thermoplastic material from an extruder and surrounds a mandrel for opening the woven tubing, and means for feeding the woven tubing and for withdrawing the coated tubing and wherein the orifice of the tubular die is larger in diameter than the opened woven tubing, the tubular die is succeeded by a superatmospheric pressure chamber, which has a wall that surrounds the extruded tubing adjacent to the mandrel and is sealed by a sealing lip against the coated tubing which leaves the chamber, the superatmospheric pressure chamber contains cooling air supply rings, which have outlet slots that are directed to the extruded tube, and that the superatmospheric pressure chamber is provided with an inlet pipe and with a cooling air outlet pipe, which contains a hinged throttle valve. In the apparatus the woven tubing of fibrillated tape is re-opened into tubular form on the mandrel. A completely formed tubular coating film emerges from the extrusion die, which surrounds the woven tubing of fibrillated tape and which has an orifice that is much larger in diameter than the woven tubing. Only after a travel over a certain distance is the coating film tube forced in a still soft state against the woven tubing of fibrillated tape by the pressure in the superatmospheric pressure chamber which is controllable. Because the thickness of the coating film as it emerges from the die orifice greatly exceeds the thickness of the subsequently formed coating, the thick-walled portion of the extruded tubing resists the pressure in the superatmospheric pressure chamber. As the extruded tubing is attenuated to the thickness of the final coating, its resistance decreases to such an extent that when the extruded tubing has been attenuated to the thickness of the coating the extruded tubing is forced in a still softened state against the woven tubing of fibrillated tape.

The superatmospheric pressure in the chamber can be controlled within a wide range by a control of the flow of cooling air out of the chamber.

An illustrative embodiment of the invention will be explained more fully hereinafter with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic longitudinal sectional view showing a coating apparatus,

Fig. 2 shows partly in longitudinal section an apparatus as shown in Fig. 1, which includes a mandrel composed of rings, and

Fig. 3 shows how the flattened woven tubing can be stored in a zig-zag configuration in containers.

In the apparatus shown in Fig. 1, a flattened woven tubing 2 of woven fibrillated tape is unwound from a supply roll 1, which is mounted in an unwinder in a manner which is not shown. The woven tubing 2 is then trained around a deflecting roller 3 and fed to an opening mandrel 7, which is held on the illustrated level relative to the coating die and the superatmospheric pressure chamber by a retaining roller system 4, 5 and a holding beam 6. The rollers 5 mounted on the beam 6 bear on the outer rollers 4, which are mounted in a frame at fixed positions. In the embodiment shown by way of example in Fig. 1, the opening mandrel 7 consists substantially of a cylindrical member.

The woven tubing of fibrillated tape which is expanded into the form of a tube by the opening mandrel 7 is surrounded by a tube extrustion die 8, which defines a diagrammatically indicated annular distributing chamber 10 for receiving coating material from an extruder 9 and for feeding the coating material through a die orifice 11 so that the coating material forms a film 12. When this film has travelled over a certain distance

and has been cooled but is still soft, the film is contacted with the woven tubing of fibrillated tape by superatmospheric pressure. Heat insulation 13 provided in the die 8 prevents an excessive heating of the woven tubing of fibrillated tape. The wall of a superatmospheric pressure chamber 14 is air-tightly secured to the top of the die 8 and is provided with removable covers 14' over access openings and with resilient lips 15 for sealing the superatmospheric pressure chamber against the coated woven tubing. Cooling air is delivered by a cooling air blower 16 and is directed in the superatmospheric pressure chamber 14 onto the coating by cooling rings 17. The distance from the first air cooling ring 17 downstream of the die 8 to said die is suitably adjustable so that the coating film can be cooled almost to its solidification point before its initial contact with the woven tubing of fibrillated tape, when this is desired. By means of a hinged throttle valve 19 in an outlet pipe 18, the superatmospheric pressure in the chamber 14 is controlled in dependence on the rate at which cooling air is delivered by the blower 16 so that the cooling action and the pressure under which the coating is applied can be varied within wide limits.

When the coating 12 adheres to the woven tubing 2 of fibrillated tape, the latter tubing is flattened by means of flattening plates 20, withdrawn by a pair of stripper rolls 21 and then fed to a winder, which is not shown.

Fig. 2 shows another embodiment of an opening mandrel 7, which consists of several backing rings 7', which are mounted on a holder 6' and axially spaced suitable distances apart.

To enable an adaptation to variations in width of the woven tubing of fibrillated tape without a formation of wrinkles, the opening mandrel 7 or the backing rings 7' are suitably resiliently yieldable in the radial direction to a certain extent. The resulting clearance at the periphery of the opening mandrel does not disturb the backing of the woven tubing of fibrilated tape.

To apply a controlled tension to the woven tubing which consists of fibrillated tape and is to be coated, it is desirable to provide the retaining rollers 4 with a snubber and to provide the peripheral surface of said rollers with a high-friction rubber covering.

Because it is fairly complicated to thread the woven tubing of fibrillated tape through the coating die and the superatmospheric pressure chamber when said tubing is to be coated, the supply roll 1 may be replaced by containers 1', 2', in which the flattened woven tubing 2', 2" of fibrillated tape which is to be coated is laid in a zigzag configuration. When the woven tubing of fibrillated tape is held ready in this manner, successive lengths 2', 2", etc. of the woven tubing of fibrillated tape can be joined without difficulty by adhesive bonds 2 at the periphery of the tubing so that these peripheral bonds can pass through the coating apparatus without difficulty.

As soon as the first container has been emptied, the next following filled container is pushed into the same position and the woven tubing stored in a further container is adhesively joined to the preceding length of tubing.

WHAT WE CLAIM IS:-

1. A process of coating woven thermoplastics tubing of fibrillated tape wherein flattened tubing is advanced, is opened out and supported from the inside, a plastics tube is extruded around the opened out and supported tubing, the diameter of the extruded tube being greater than that of the tubing, and the extruded tube is subsequently pressed onto the peripheral surface of the tubing while in a soft condition, the wall thickness of the extruded tube being reduced before being pressed on to the tubing.

2. A process according to claim 1, wherein the tube is forced in a soft state against the woven tubing by the action of compressed air.

3. Apparatus for carrying out a process according to claim 1 comprising means for advancing flattened woven thermoplastics tubing of fibrillated tape, means for opening out and internally supporting the tubing, extrusion means for producing a tube of plastics material around the supported tubing at a diameter greater than that of the tubing, and means downstream of the extrusion means for pressing the tube onto the peripheral wall of the tubing while the tube is still soft and after the wall thickness of the tube has become reduced.

4. Apparatus according to claim 3, wherein the extrusion means is a die connected to an extruder having a circular orifice of a diameter greater than the tubing, and the means for opening out and internally supporting the tubing is a mandrel, and wherein the tube is pressed on the tubing by a superatmospheric pressure chamber downstream of the die and surrounding the tubing and the tube, the chamber containing cooling air supply rings connected to an air inlet pipe and having outlet slots directed towards the tube around the tubing, the chamber also having a sealing lip which engages the coated tubing as it leaves the chamber and an air outlet pipe containing a throttle valve.

5. Apparatus according to claim 4, wherein the cooling air rings are axially displaceable in the chamber and adapted to be fixed in position.

6. Apparatus according to claim 4 or 5, wherein an outer wall of the chamber has transparent closure plates.

7. Apparatus according to any of claims

4 to 6, wherein the mandrel is held by a beam and retaining rollers within the woven tubing.

8. Apparatus according to any of claims 4 to 7, wherein the mandrel has a continuous cylindrical peripheral surface.

9. Apparatus according to any of claims 4 to 7, wherein the mandrel consists of axially spaced apart backing rings, which are secured to the beam.

10. Apparatus according to any of claims 7 to 9, wherein the mandrel is resiliently yieldable in a radial direction.

11. Apparatus according to any of claims 4 to 10, wherein the die is provided with a heat-insulated through bore for the mandrel and tubing.

12. Apparatus according to any of claims 4 to 11, wherein the flattened woven tubing of fibrillated tap is withdrawn from a container in which it has been laid in a zigzag configuration.

13. A method of coating woven tubing substantially as hereinbefore described with reference to the accompanying drawings.

14. Apparatus for coating woven tubing constructed and arranged substantially as hereinbefore described and shown in the accompanying drawings.

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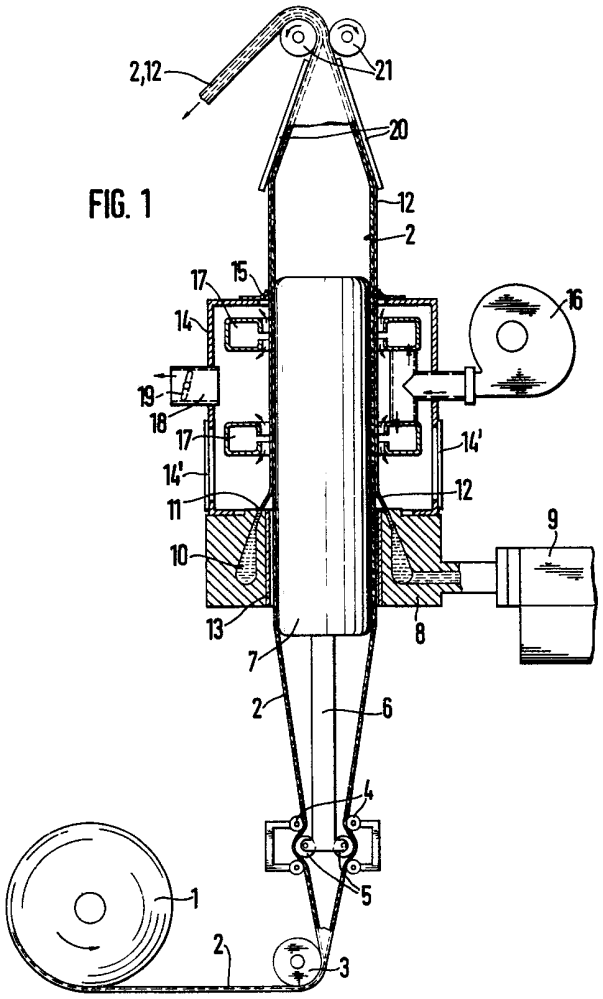
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1



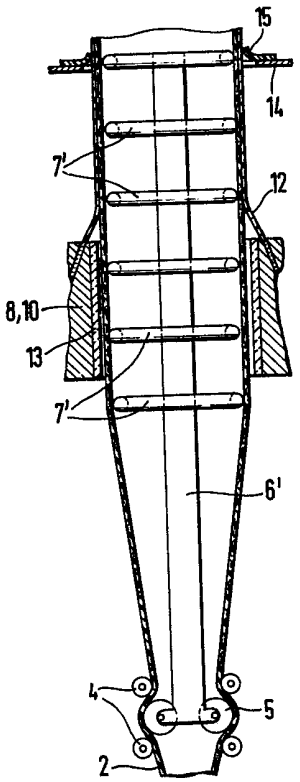


FIG. 2

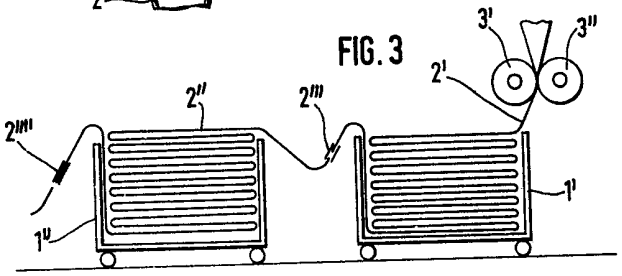


FIG. 3