

**SEAMLESS TUBE USEFUL FOR MAKING ROOFING BATTENS**

Roofing battens are used widely in securing flexible membranes to underlying materials. Mechanical fasteners, such as roofing screws, are passed through the battens, which may be pre-punched with holes to accommodate such fasteners. Typically, roofing battens comprise metal, wooden, or polymeric strips.

A polymeric material having particular utility in making a roofing batten is disclosed in Kish et al, U.S. Patent No. 4,963,430. As disclosed therein, the polymeric material comprises a major amount of polyethylene-terephthalate and a minor amount of at least one polyolefin, such as polypropylene. As disclosed therein, such material can be substantially mono-axially oriented so as to have a tensile strength of at least about 25,000 psi (172 MPa) in the oriented direction.

Other roofing battens made from polymeric materials are disclosed in Russell et al. U.S. Patent No. 4,718,211 and in Schauffele U.S. Patent No. 4,445,306. One possible arrangement of roofing battens on a roof is disclosed in Kelly U.S. Patent No. 4,736,562.

It is disclosed in our co-pending European Patent Application EP-A-0,377,514 that, as compared to a roofing batten having a single ply, a roofing batten having two plies with a combined thickness equal to the thickness of the single ply provides increased pull-through resistance when used with mechanical fasteners.

Heretofore, it has been preferred to make a roofing batten with two plies, in one piece, from a wide strip by folding such strip longitudinally and using an adhesive to bond half portions of such strip to each other. It would be highly desirable to eliminate such strip-folding and adhesive-bonding steps.

A need has been created, to which this invention is addressed, for a better method of manufacturing a roofing batten with two plies.



According to a first aspect of this invention a seamless tube useful in making a roofing batten is extruded from a polymeric material, flattened so as to define two plies and a substantially collapsed lumen, and oriented
5 longitudinally.

According to a second aspect of this invention a method of making a seamless tube comprises the steps of extruding a seamless tube so as to define two plies and a substantially collapsed lumen, and orienting the polymeric
10 material forming the tube longitudinally.

So as to enhance the utility of the tube for making a roofing batten, the plies may have holes therethrough at spaced intervals along the tube so as to accommodate mechanical fasteners, such as roofing screws.

According to a third aspect of this invention a method of manufacturing a roofing batten comprises the steps of extruding a seamless tube, flattening the tube so as to define two plies and a substantially collapsed lumen, milling and drawing the tube so as to orient the polymeric
15 material of the tube longitudinally, and punching holes through the plies at spaced intervals along the tube.

Preferably, the polymeric material is similar to the polymeric material disclosed in Kish et al. U.S. Patent No. 4,963,430 and contains a major amount of polyethylene
25 terephthalate and a minor amount of at least one polyolefin. Preferably, moreover, the tube is oriented so as to have a tensile strength of at least about 25,000 psi (172 MPa) in a longitudinal direction.

Other polymeric materials that may be alternatively used include polyethylene terephthalate and polyolefins, such as polypropylene. Polyamides (nylons) may be
30 alternatively used. For making a roofing batten, the polymeric material disclosed in the Kish et al. patent noted above is preferred because of its superior characteristics of split resistance and pull-through
35 resistance when used with mechanical fasteners, such as roofing screws.



In a preferred mode for carrying out the method, the tube is extruded with a substantially open lumen, whereupon the tube is flattened substantially by being sized in a vacuum sizer, which is arranged to flatten the tube and to provide the tube with a substantially elongate lumen. Thereupon, in the preferred mode, the tube is oriented by milling and drawing the tube. Finally, in the preferred mode, holes are provided through the tube at spaced intervals along the tube after the tube has been oriented.

Although a seamless tube according to the first and second aspects of this invention has particular utility when used to make roofing battens, it is contemplated that such a tube may have other similar and dissimilar uses.

A preferred embodiment of this invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a fragmentary, perspective, partly exploded, vertical cross sectional view of a roofing construction comprising a roofing deck, a slab of fibrous roofing insulation, two overlapped membranes, and plural roofing battens made from a seamless tube according to this invention, along with roofing screws co-acting with such roofing battens;

Figure 2 is a fragmentary, perspective view of one end portion of a seamless tube according to this invention;

Figure 3 is a cross sectional view of the same tube, as extruded;

Figure 4 is a cross sectional view of the same tube, as flattened;

Figure 5 is a cross sectional view of the same tube, as milled and drawn; and,

Figure 6 is a diagrammatic representation of a processing line useful in manufacturing a seamless tube according to this invention.

As shown in Figure 1, a roofing structure incorporating this invention comprises a roofing deck made of corrugated metal, a slab of fibrous roofing



insulation overlying the deck 12, one or possibly two roofing membranes made of a flexible, waterproof material, namely a lower membrane 16 covering the slab 14 and an upper membrane 18 covering the lower membrane 16, and plural roofing battens 20 overlying the upper membrane 18 at spaced intervals. Roofing screws 22 having threaded shanks 24 and enlarged heads 26 co-act with the battens 20 to secure the membranes 16, 18, and the slab 14 to the deck 12. Thus, the battens 20 stabilise the membranes 16, 18, against ballooning excessively under wind loads. According to this invention, each batten 20 is made from a seamless tube 30, which is extruded from a polymeric material. The tube 30 is flattened, so as to have a substantially elongate lumen 32 and so as to define two plies 34, 36, and is oriented longitudinally. The plies 34, 36, are punched so as to have a series of holes 38 through the plies 34, 36, at spaced intervals along such tube 30. The holes 38 are dimensioned to permit the screw shanks 24 to pass through the holes 30 but not to permit the screw heads 26 to pass therethrough. The plies 34, 36, exhibit excellent pull-through resistance when used with mechanical fasteners, such as the screws 22.

Preferably, the tube 30 is extruded from the polymeric material disclosed in Kish et al, U.S. Patent No. 4,963,430, the disclosure of which is incorporated herein by reference. Such material, when extruded and oriented, exhibits superior characteristics of split resistance and pull-through resistance when used with mechanical fasteners, such as the screws 22. As disclosed therein, the polymeric material contains a major amount (e.g. from about 80% to about 97% by weight) of polyethylene terephthalate and a minor amount (e.g. from about 3% to about 20% by weight) of at least one polyolefin, preferably polypropylene. As disclosed therein the polyolefin may be a blend of polypropylene, maleic anhydride grafted polypropylene, rubber. A preferred composition for the polymeric material is, by weight, approximately 92%



polyethylene terephthalate, 6% polypropylene, 0.8% maleic anhydride grafted polypropylene, and 1.2% ethylene-propylene rubber.

Preferably, the tube 30 is oriented longitudinally so as to have a tensile strength of at least about 25,000 psi (172 MPa) in a longitudinal direction. It is disclosed in the Kish et al patent noted above that a strip extruded from the polymeric material disclosed therein can be mono-axially oriented so as to have such a tensile strength. The tube 30 is extruded in an indeterminate length. Preferably, after the tube 30 has been flattened but before it is oriented, the tube 30 has a width of approximately 1.7 inches (33 mm) and a combined thickness of approximately 150 to 180 mils (3.8 to 4.5 mm) for the plies 34, 36, as shown in Figure 4. Preferably, after the tube 30 has been oriented, the tube 30 has a width of approximately 1 inch (25 mm) and a combined thickness of approximately 50 mils (1.25 mm) for the plies 34, 36, as shown in Figure 5.

As shown in Figure 6, the roofing batten 10 can be efficiently manufactured in a processing line comprising known apparatus. The processing line is described below.

The respective constituents of a suitable composition, such as the preferred composition noted above, are fed into an extruder 100. In the extruder 100, such composition is blended, heated to a suitable temperature (e.g. a temperature in a range from approximately 520°F to approximately 550°F or 271°C to 288°C) so that such composition becomes plastic, and extruded through a suitable die 110 including a mandrel (not shown) so as to form a seamless tube 30. Preferably, the tube 30 is extruded so as to have a substantially circular lumen 32, as shown in Figure 3. The tube 30 may be alternatively extruded so as to have a differently shaped lumen (not shown) such as a substantially rectangular lumen.

While the tube 30 remains plastic, the tube 30 is fed through a vacuum sizer 120, in which the tube 30 is



flattened so as to define two plies 34, 36, and in which the tube 30 is sized so as to have a substantially elongate lumen 32, as shown in Figure 4. The tube 30 solidifies in the vacuum sizer 120, which prevents the plies 34, 36, from welding to each other before the tube 30 solidifies. Moreover, as discussed below, the plies 34, 36, do not weld to each other after the tube 30 solidifies. The tube 30 is pulled from the vacuum sizer 120 by a pair of endless belts 130.

10 Via the endless belts 130, the tube 30 is fed through a pair of milling rolls 140, which compresses the tube 30 and causes the lumen 32 to be substantially collapsed. From the milling rolls 140, the tube is drawn over a set of first rollers 150 defining a first bridle. The first
15 rollers 150 are rotated at surface speeds relative to the surface speeds of the milling rolls 140 so as to provide a draw ratio in a range from approximately 1.0 to approximately 1.2. Because of elastic recovery of the polymeric material leaving the milling rolls 140, a draw ratio of
20 approximately 1.0 corresponds to an elongation of approximately 25%. Thus, as compressed by the milling rolls 140 and drawn by the first rollers 150, the tube 30 is oriented longitudinally.

From the first rollers 150, the tube 30 is fed through
25 an annealing unit 170, in which the tube 30 is annealed at a suitable temperature (e.g. approximately 250°F or 121°C) so as to set the elongation of the tube 30. The tube 30 is then drawn over a set of second rollers 160 defining a second bridle. The second rollers 160 are rotated at
30 surface speeds relative to the surface speeds of the first rollers 150 so as to define a draw ratio of approximately 0.95.

The annealed tube 30 is then driven through a water bath 172, which cools the tube 30.

35 From the water bath 172, the tube 30 is fed through a punching unit 180, in which the holes 38 are punched through the plies 34, 36. From the punching unit 180, the



5 tube 30 is fed into a winding unit 190, in which the flattened, oriented, punched tube 30 is wound onto spools. The tube 30 may be then cut into suitable lengths, each to constitute a roofing batten, as exemplified by the roofing battens 20.

As mentioned above, the plies 34, 36, do not weld to each other when the tube 30 is flattened. Unexpectedly, the plies 34, 36, do not weld to each other when the tube 30 is milled, drawn and annealed.

10 An alternative method for making a seamless tube according to this invention is contemplated, in which such milling rolls are not used, and in which the flattened tube is oriented by being drawn over a short gap between two sets of rollers being rotated at different speeds.

15 Having superior characteristics of split resistance and pull-through resistance, a roofing batten made from a seamless tube according to this invention performs as well as the two ply batten disclosed in the co-pending European patent application noted above.

20 As a possible modification of the preferred embodiment described above, the plies of the seamless tube may be adhesively bonded to each other, via an adhesive introduced before the tube is milled.

C L A I M S



1. A seamless tube (30) useful in making a roofing batten, extruded from a polymeric material, flattened so as to define two plies (34, 36) and a substantially collapsed lumen (32), and oriented longitudinally.
2. A seamless tube according to claim 1, wherein the plies (34, 36) are provided with holes (38) therethrough at spaced intervals along the tube (30).
3. A method of manufacturing a seamless tube, which is useful in making a roofing batten, the method comprising the steps of extruding a seamless tube (30) so as to define two plies (34, 16) and a substantially collapsed lumen (32), and orienting the polymeric material forming the tube longitudinally.
4. A method according to claim 3, comprising another step of providing the plies (34, 36) with holes therethrough at spaced intervals along the tube (30) after the tube has been oriented.
5. A method according to claim 3 or 4 wherein the tube (30) is extruded with a substantially circular lumen (32), and wherein the method comprises a further step of flattening the tube (30) substantially in a vacuum sizer, which is arranged to flatten the tube and to provide the tube with a substantially elongate lumen (32).
6. A method according to any one of claims 3 to 6, wherein the polymeric material of the tube (30) is oriented by milling and drawing the tube (30).
7. A method of manufacturing a roofing batten (20), the method comprising the steps of extruding a seamless tube (30), flattening the tube (30) so as to define two plies (34, 36) and a substantially collapsed lumen (32), milling and drawing the tube (30) so as to orient the polymeric material of the tube (30) longitudinally, and punching holes (38) through the plies (34, 36) at spaced intervals along the tube (30).





8. A seamless tube according to claim 1 or 2, or a method according to any one of claims 3 to 7, wherein the polymeric material is oriented so as to have a tensile strength of at least substantially 25,000 psi (172 MPa) in a longitudinal direction.

9. A seamless tube according to any one of claims 1, 2 or 8, or a method according to any one of claims 3 to 8, wherein the polymeric material comprises a major amount of polyethylene terephthalate and a minor amount of at least one polyolefin.





A B S T R A C T

SEAMLESS TUBE USEFUL FOR MAKING ROOFING BATTENS

5 A seamless tube (30) useful in making a roofing batten
 (20) is extruded from a polymeric material consisting
 essentially of a major amount of polyethylene terephthalate
 and a minor amount of at least one polyolefin, flattened
10 in a vacuum sizer (120) so as to define two plies (34, 36),
 and milled and drawn so as to orient the polymeric material
 of the tube (30) longitudinally. As milled and drawn, the
 tube is oriented so as to have a tensile strength of at
 least substantially 25,000 psi (172 MPa) in a longitudinal
15 direction. The plies (34, 36) are punched so as to have
 holes (38) therethrough at spaced intervals along the tube
 (30). When used to make a roofing batten to co-act with
 conventional fasteners, such as roofing screws, the tube
 exhibits superior characteristics of split resistance and
 pull-through resistance.

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[Figures 2 and 4]



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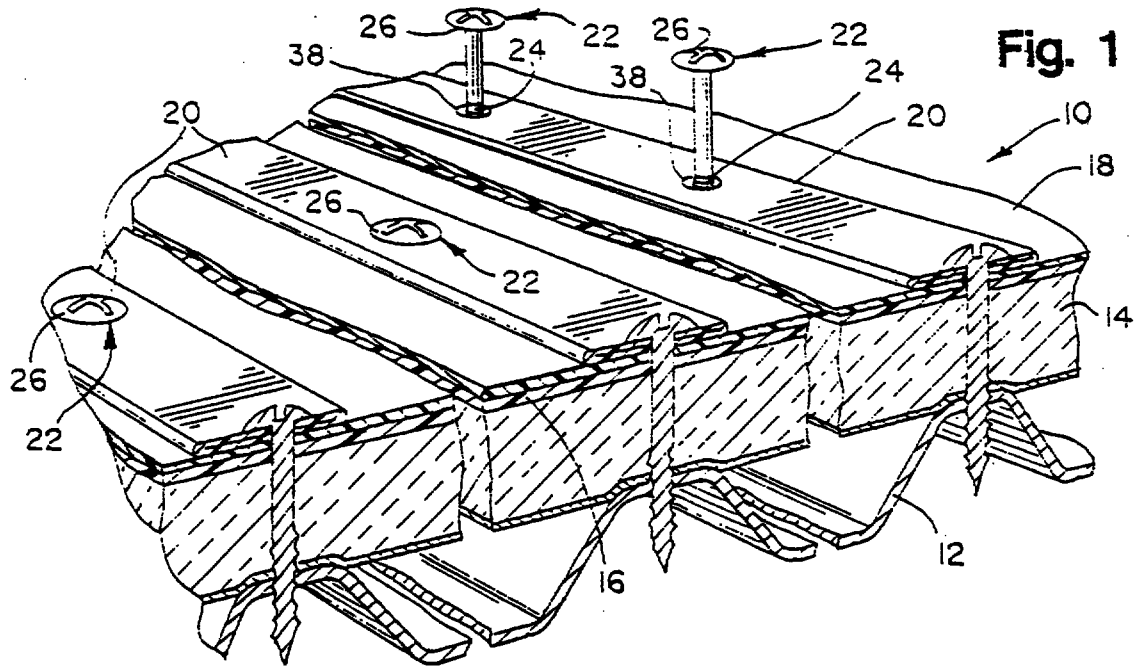


Fig. 1

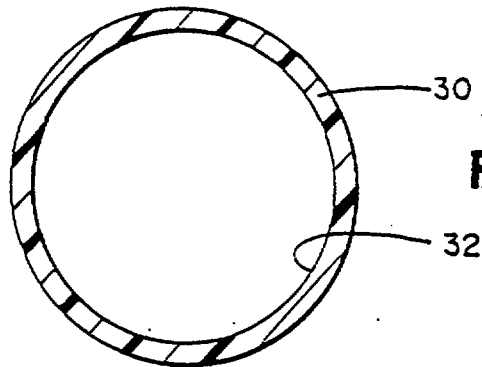


Fig. 3

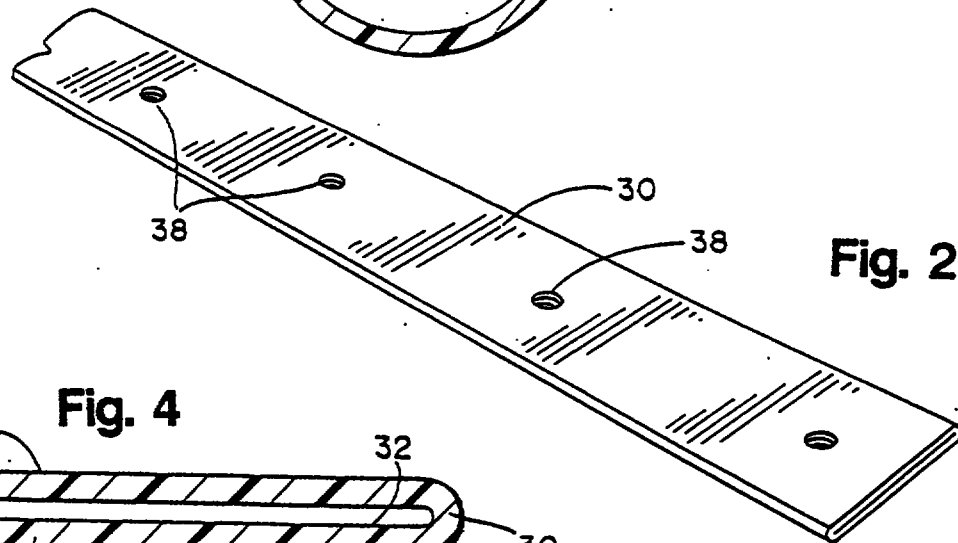


Fig. 2

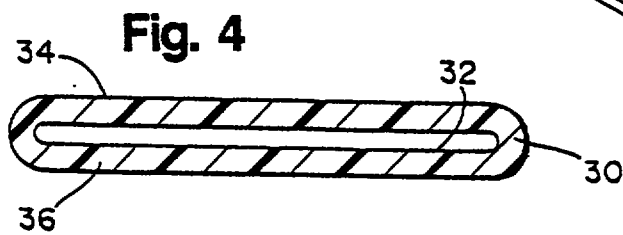


Fig. 4

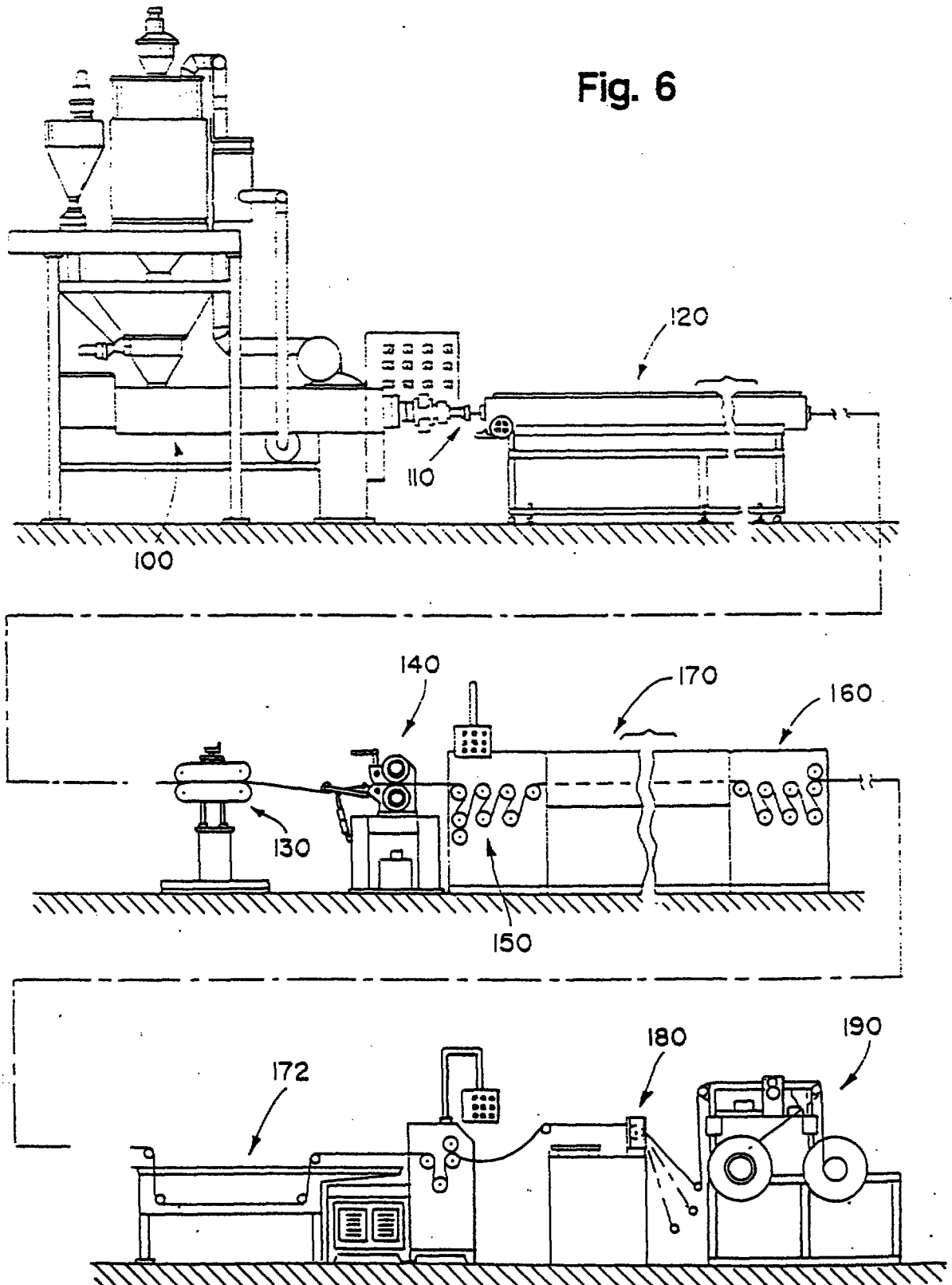


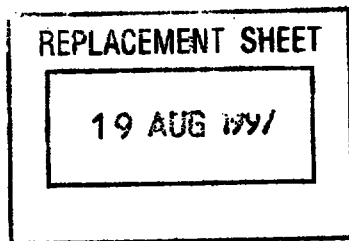
Fig. 5



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Fig. 6





SEAMLESS TUBE USEFUL FOR MAKING ROOFING BATTENS

Description

Roofing battens are used widely in securing flexible membranes to underlying materials. Mechanical fasteners, such as roofing screws, are passed through the battens, which may be pre-punched with holes to accommodate such fasteners. Typically, roofing battens comprise metal, wooden, or polymeric strips.

A polymeric material having particular utility in making a roofing batten is disclosed in Kish et al, U.S. Patent No.4,963,430. As disclosed therein, the polymeric material comprises a major amount of polyethylene-terephthalate and a minor amount of at least one polyolefin, such as polypropylene. As disclosed therein, such material can be substantially mono-axially oriented so as to have a tensile strength of at least about 25,000 psi (172 MPa) in the oriented direction.

Other roofing battens made from polymeric materials are disclosed in Russell et al. U.S. Patent No.4,718,211 and in Schauffele U.S. Patent No.4,445,306. One possible arrangement of roofing battens on a roof is disclosed in Kelly U.S. Patent No.4,736,562.

It is disclosed in our European Patent Application EP-A-0,377,514 that, as compared to a roofing batten having a single ply, a roofing batten having two plies with a combined thickness equal to the thickness of the single ply provides increased pull-through resistance when used with mechanical fasteners.

Heretofore, it has been preferred to make a roofing batten with two plies, in one piece, from a wide strip by folding such strip longitudinally and using an adhesive to

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bond half portions of such strip to each other. It would be highly desirable to eliminate such strip-folding and adhesive-bonding steps.

A need has been created, to which this invention is addressed, for a better method of manufacturing a roofing batten with two plies.

FR-A-2,025,179 discloses a method of making a seamless polymeric tube comprising the steps of extruding a seamless tube so as to define two plies and a substantially collapsed lumen, and orienting the polymeric material forming the tube longitudinally.

According to a first aspect of this invention a seamless polymeric tube useful in making a roofing batten is characterised in that the plies are provided with transverse holes there-through at spaced intervals along the tube.

According to a second aspect of this invention a method of making a seamless polymeric tube is characterised in that it comprises the further step of providing the plies with transverse holes there-through at spaced intervals along the tube after the tube has been oriented.

According to a third aspect of this invention a method of manufacturing a roofing batten comprises the steps of extruding a seamless tube, flattening the tube so as to define two plies and a substantially collapsed lumen, milling and drawing the tube so as to orient the polymeric material of the tube longitudinally, and punching transverse holes through the plies at spaced intervals along the tube.

Preferably, the polymeric material is similar to the polymeric material disclosed in Kish et al, U.S. Patent No.4,963,430 and contains a major amount of polyethylene

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terephthalate and a minor amount of at least one polyolefin. Preferably, moreover, the tube is oriented so as to have a tensile strength of at least about 25,000 psi (172 MPa) in a longitudinal direction.

Other polymeric materials that may be alternatively used include polyethylene terephthalate and polyolefins, such as polypropylene. Polyamides (nylons) may be alternatively used. For making a roofing batten, the polymeric material disclosed in the Kish et al. patent noted above is preferred because of its superior characteristics of split resistance and pull-through resistance when used with mechanical fasteners, such as roofing screws.

In a preferred mode for carrying out the method, the tube is extruded with a substantially open lumen, whereupon the tube is flattened substantially by being sized in a vacuum sizer, which is arranged to flatten the tube and to provide the tube with a substantially elongate lumen. Thereupon, in the preferred mode, the tube is oriented by milling and drawing the tube.

Although a seamless tube according to the first and second aspects of this invention has particular utility when used to make roofing battens, it is contemplated that such a tube may have other similar and dissimilar uses.

A preferred embodiment of this invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a fragmentary, perspective, partly exploded, vertical cross sectional view of a roofing construction comprising a roofing deck, a slab of fibrous roofing insulation, two overlapped membranes, and plural roofing battens made from a seamless tube



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according to this invention, along with roofing screws co-action with such roofing battens;

Figure 2 is a fragmentary, perspective view of one end portion of a seamless tube according to this invention;

Figure 3 is a cross sectional view of the same tube, as extruded;

Figure 4 is a cross sectional view of the same tube, as flattened;

Figure 5 is a cross sectional view of the same tube, as milled and drawn; and

Figure 6 is a diagrammatic representation of a processing line useful in manufacturing a seamless tube according to this invention.

As shown in Figure 1, a roofing structure 10 incorporating this invention comprises a roofing deck 12 made of corrugated metal, a slab 14 of fibrous roofing insulation overlying the deck 12, one or possibly two roofing membranes made of a flexible, waterproof material, namely a lower membrane 16 covering the slab 14 and an upper membrane 18 covering the lower membrane 16, and plural roofing battens 20 overlying the upper membrane 18 at spaced intervals. Roofing screws 22 having threaded shanks 24 and enlarged heads 26 co-act with the battens 20 to secure the membranes 16, 18, and the slab 14 to the deck 12. Thus, the battens 20 stabilise the membranes 16, 18 against ballooning excessively under wind loads. According to this invention, each batten 20 is made from a seamless tube 30, which is extruded from a polymeric material. The tube 30 is flattened, so as to have a substantially elongate lumen 32 and so as to define two plies 34, 36, and is oriented longitudinally. The plies 34, 36, are punched

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so as to have a series of holes 38 through the plies 34, 36, at spaced intervals along such tube 30. The holes 38 are dimensioned to permit the screw shanks 24 to pass through the holes 30 but not to permit the screw heads 26 to pass therethrough. The plies 34, 36, exhibit excellent pull-through resistance when used with mechanical fasteners, such as the screws 22.

Preferably, the tube 30 is extruded from the polymeric material disclosed in Kish et al, U.S. Patent No.4,963,430, the disclosure of which is incorporated herein by reference. Such material, when extruded and oriented, exhibits superior characteristics of split resistance and pull-through resistance when used with mechanical fasteners, such as the screws 22. As disclosed therein, the polymeric material contains a major amount (e.g. from about 80% to about 97% by weight) of polyethylene terephthalate and a minor amount (e.g. from about 3% to about 20% by weight) of at least one polyolefin, preferably polypropylene. As disclosed therein the polyolefin may be blend of polypropylene, maleic anhydride grafted polypropylene, rubber. A preferred composition for the polymeric material is, by weight, approximately 92% polyethylene terephthalate, 6% polypropylene, 0.8% maleic anhydride grafted polypropylene, and 1.2% ethylene-propylene rubber.

Preferably, the tube 30 is oriented longitudinally so as to have a tensile strength of at least about 25,000 psi (172 MPa) in a longitudinal direction. It is disclosed in the Kish et al patent noted above that a strip extruded from the polymeric material disclosed therein can be mono-axially oriented so as to have such a tensile strength. The tube 30 is extruded in an indeterminate length. Preferably, after the tube 30 has been flattened but before it is oriented, the tube 30 has a width of approximately

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1.7 inches (33 mm) and a combined thickness of approximately 150 to 180 mils (3.8 to 4.5 mm) for the plies 34, 36, as shown in Figure 4. Preferably, after the tube 30 has been oriented, the tube 30 has a width of approximately 1 inch (25 mm) and a combined thickness of approximately 50 mils (1.25 mm) for the plies 34, 36, as shown in Figure 5.

As shown in Figure 6, the roofing batten 10 can be efficiently manufactured in a processing line comprising known apparatus. The processing line is described below.

The respective constituents of a suitable composition, such as the preferred composition noted above, are fed into an extruder 100. In the extruder 100, such composition is blended, heated to a suitable temperature (e.g. a temperature in a range from approximately 520°F to approximately 550°F or 271°C to 288°C) so that such composition becomes plastic, and extruded through a suitable die 110 including a mandrel (not shown) so as to form a seamless tube 30. Preferably, the tube 30 is extruded so as to have a substantially circular lumen 32, as shown in Figure 3. The tube 30 may be alternatively extruded so as to have a differently shaped lumen (not shown) such as a substantially rectangular lumen.

While the tube 30 remains plastic, the tube 30 is fed through a vacuum sizer 120, in which the tube 30 is flattened so as to define two plies 34, 36, and in which the tube 30 is sized so as to have a substantially elongate lumen 32, as shown in Figure 4. The tube 30 solidifies in the vacuum sizer 120, which prevents the plies 34, 36, from welding to each other before the tube 30 solidifies. Moreover, as discussed below, the plies 34, 36, do not weld to each other after the tube 30 solidifies. The tube 30 is pulled from the vacuum sizer 120 by a pair of endless belts 130.

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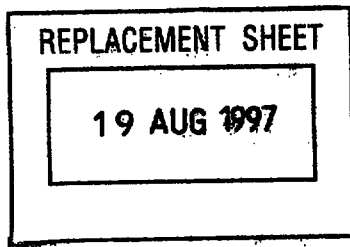
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Via the endless belts 130, the tube 30 is fed through a pair of milling rolls 140, which compresses the tube 30 and causes the lumen 32 to be substantially collapsed. From the milling rolls 140, the tube is drawn over a set of first rollers 150 defining a first bridle. The first rollers 150 are rotated at surface speeds relative to the surface speeds of the milling rolls 140 so as to provide a draw ratio in a range from approximately 1.0 to approximately 1.2. Because of elastic recovery of the polymeric material leaving the milling rolls 140, a draw ratio of approximately 1.0 corresponds to an elongation of approximately 25%. Thus, as compressed by the milling rolls 140 and drawn by the first rollers 150, the tube 30 is oriented longitudinally.

From the first rollers 150, the tube 30 is fed through an annealing unit 170, in which the tube 30 is annealed at a suitable temperature (e.g. approximately 250°F or 121°C) so as to set the elongation of the tube 30. The tube 30 is then drawn over a set of second rollers 160 defining a second bridle. The second rollers 160 are rotated at surface speeds relative to the surface speeds of the first rollers 150 so as to define a draw ratio of approximately 0.95.

The annealed tube 30 is then driven through a water bath 172, which cools the tube 30.

From the water bath 172, the tube 30 is led through a punching unit 180, in which the holes 38 are punched through the plies 34, 36. From the punching unit 180, the tube 30 is fed into a winding unit 190, in which the flattened, oriented, punched tube 30 is wound onto spools. The tube 30 may be then cut into suitable lengths, each to constitute a roofing batten, as exemplified by the roofing battens 20.



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As mentioned above, the plies 34, 36 do not weld to each other when the tube 30 is flattened. Unexpectedly, the plies 34, 36, do not weld to each other when the tube 30 is milled, drawn and annealed.

An alternative method for making a seamless tube according to this invention is contemplated, in which such milling rolls are not used, and in which the flattened tube is oriented by being drawn over a short gap between two sets of rollers being rotated at different speeds.

Having superior characteristics of split resistance and pull-through resistance, a roofing batten made from a seamless tube according to this invention performs as well as the two ply batten disclosed in EP-A-0 377 514.

As a possible modification of the preferred embodiment described above, the plies of the seamless tube may be adhesively bonded to each other via an adhesive introduced before the tube is milled.

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Claims

- 1 A seamless tube (30) useful in making a roofing batten, extruded from a polymeric material, flattened so as to define two plies (34, 36) and a substantially collapsed lumen (32), and oriented longitudinally, characterised in that the plies (34, 36) are provided with transverse holes (38) therethrough at spaced intervals along the tube (30).
- 2 A method of manufacturing a seamless polymeric tube, which is useful in making a roofing batten the method comprising the steps of extruding a seamless tube (30) so as to define two plies (34, 16) and a substantially collapsed lumen (32), and orienting the polymeric material forming the tube longitudinally, characterised in that the method further comprises the step of providing the plies (34, 36) with transverse holes there-through at spaced intervals along the tube (30) after the tube has been oriented.
- 3 A method according to claim 2, wherein the tube (30) is extruded with a substantially circular lumen (32), and wherein the method comprises a further step of flattening the tube (30) substantially in a vacuum sizer, which is arranged to flatten the tube and to provide the tube with a substantially elongate lumen (32).
- 4 A method according to claim 2 or 3, wherein the polymeric material of the tube (30) is oriented by milling and drawing the tube (30).



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- 5 A method of manufacturing a roofing batten (20), the method comprising the steps of extruding a seamless tube (30), flattening the tube (30) so as to define two plies (34, 36) and a substantially collapsed lumen (32), milling and drawing the tube (30) so as to orient the polymeric material of the tube (30) longitudinally, and punching transverse holes (38) through the plies (34, 36) at spaced intervals along the tube (30).
- 6 A seamless tube according to claim 1, or a method according to any one of claims 2 to 5, wherein the polymeric materials is oriented so as to have a tensile strength of at least substantially 25,000 psi (172 MPa) in a longitudinally direction.
- 7 A seamless tube according to claim 1 or 6, or a method according to any one of claims 2 to 5, wherein the polymeric material comprises a major amount of polyethylene terephthalate and a minor amount of at least one polyolefin.



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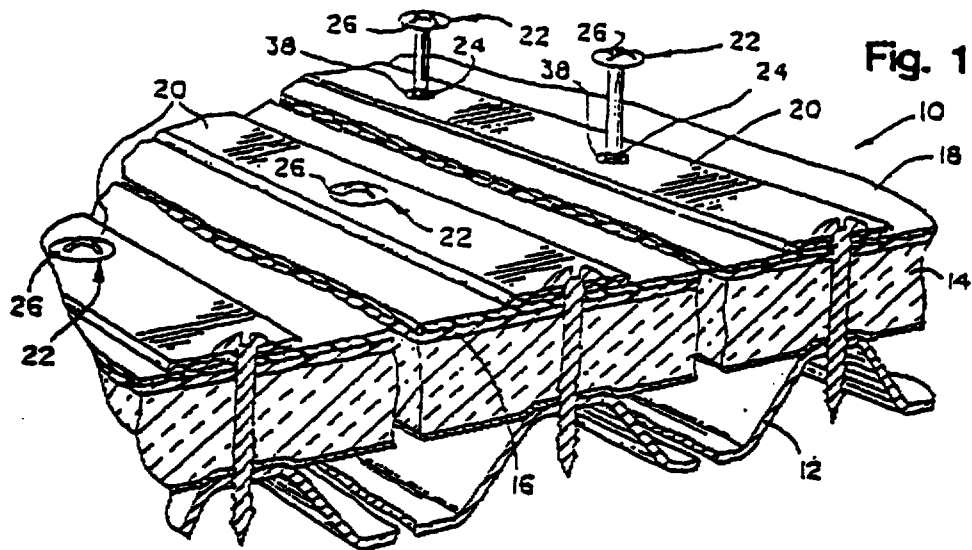


Fig. 1

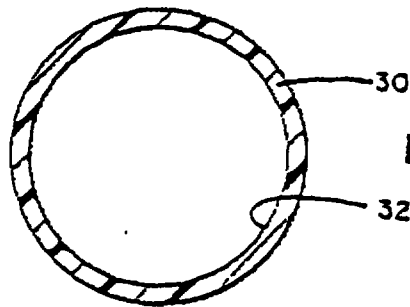


Fig. 3

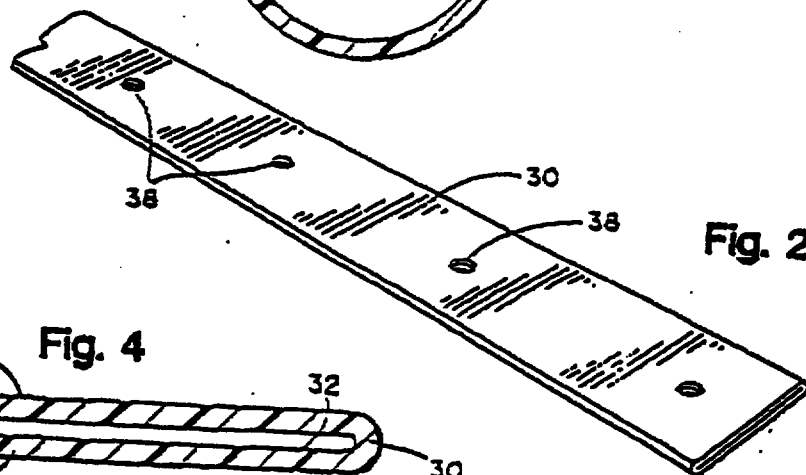


Fig. 2

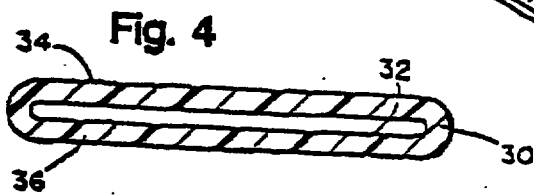
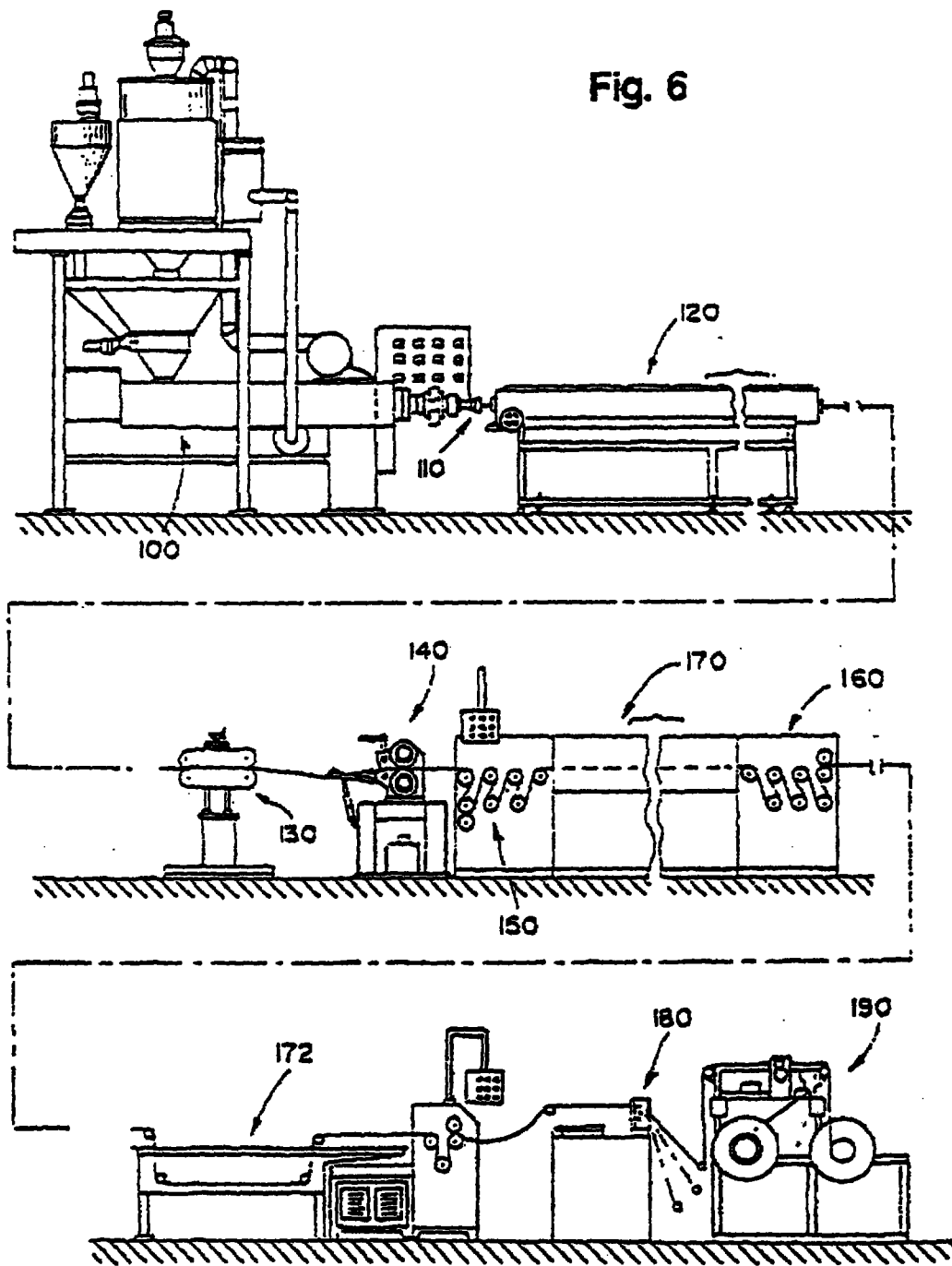


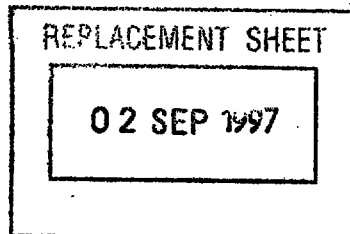
Fig. 4



Fig. 5

Fig. 6





bond half portions of such strip to each other. It would be highly desirable to eliminate such strip-folding and adhesive-bonding steps.

A need has been created, to which this invention is addressed, for a better method of manufacturing a roofing batten with two plies.

FR-A-2,025,179 discloses a method of making a seamless polymeric tube comprising the steps of extruding a seamless tube so as to define two plies and a substantially collapsed lumen, and orienting the polymeric material forming the tube longitudinally.

According to a first aspect of this invention a seamless polymeric tube useful in making a roofing batten is characterised in that the plies are provided with transverse holes there-through at spaced intervals along the tube.

According to a second aspect of this invention a method of making a seamless polymeric tube is characterised in that it comprises the further step of providing the plies with transverse holes there-through at spaced intervals along the tube after the tube has been oriented.

According to a third aspect of this invention a method of manufacturing a roofing batten comprises the steps of extruding a seamless tube, flattening the tube so as to define two plies and a substantially collapsed lumen, milling and drawing the tube so as to orient the polymeric material of the tube longitudinally, and punching transverse holes through the plies at spaced intervals along the tube.

Preferably, the polymeric material is similar to the polymeric material disclosed in Kish et al. U.S. Patent No.4,963,430 and contains a major amount of polyethylene

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according to this invention, along with roofing screws co-action with such roofing battens;

Figure 2 is a fragmentary, perspective view of one end portion of a seamless tube according to this invention;

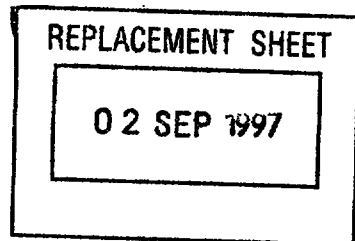
Figure 3 is a cross sectional view of the same tube, as extruded;

Figure 4 is a cross sectional view of the same tube, as flattened;

Figure 5 is a cross sectional view of the same tube, as milled and drawn; and

Figure 6 is a diagrammatic representation of a processing line useful in manufacturing a seamless tube according to this invention.

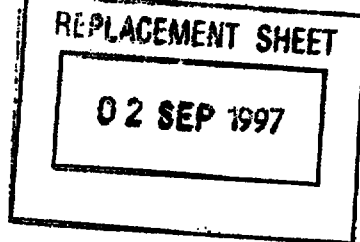
As shown in Figure 1, a roofing structure 10 incorporating this invention comprises a roofing deck 12 made of corrugated metal, a slab 14 of fibrous roofing insulation overlying the deck 12, one or possibly two roofing membranes made of a flexible, waterproof material, namely a lower membrane 16 covering the slab 14 and an upper membrane 18 covering the lower membrane 16, and plural roofing battens 20 overlying the upper membrane 18 at spaced intervals. Roofing screws 22 having threaded shanks 24 and enlarged heads 26 co-act with the battens 20 to secure the membranes 16, 18, and the slab 14 to the deck 12. Thus, the battens 20 stabilise the membranes 16, 18, against ballooning excessively under wind loads. According to this invention, each batten 20 is made from a seamless tube 30, which is extruded from a polymeric material. The tube 30 is flattened, so as to have a substantially elongate lumen 32 and so as to define two plies 34, 36, and is oriented longitudinally. The plies 34, 36, are punched



so as to have a series of holes 38 through the plies 34, 36, at spaced intervals along such tube 30. The holes 38 are dimensioned to permit the screw shanks 24 to pass through the holes 30 but not to permit the screw heads 26 to pass therethrough. The plies 34, 36, exhibit excellent pull-through resistance when used with mechanical fasteners, such as the screws 22.

Preferably, the tube 30 is extruded from the polymeric material disclosed in Kish et al, U.S. Patent No.4,963,430, the disclosure of which is incorporated herein by reference. Such material, when extruded and oriented, exhibits superior characteristics of split resistance and pull-through resistance when used with mechanical fasteners, such as the screws 22. As disclosed therein, the polymeric material contains a major amount (e.g. from about 80% to about 97% by weight) of polyethylene terephthalate and a minor amount (e.g. from about 3% to about 20% by weight) of at least one polyolefin, preferably polypropylene. As disclosed therein the polyolefin may be a blend of polypropylene, maleic anhydride grafted polypropylene, rubber. A preferred composition for the polymeric material is, by weight, approximately 92% polyethylene terephthalate, 6% polypropylene, 0.8% maleic anhydride grafted polypropylene, and 1.2% ethylene-propylene rubber.

Preferably, the tube 30 is oriented longitudinally so as to have a tensile strength of at least about 25,000 psi (172 MPa) in a longitudinal direction. It is disclosed in the Kish et al patent noted above that a strip extruded from the polymeric material disclosed therein can be mono-axially oriented so as to have such a tensile strength. The tube 30 is extruded in an indeterminate length. Preferably, after the tube 30 has been flattened but before it is oriented, the tube 30 has a width of approximately

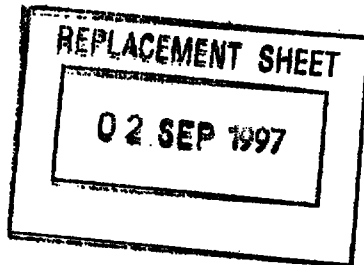


Via the endless belts 130, the tube 30 is fed through a pair of milling rolls 140, which compresses the tube 30 and causes the lumen 32 to be substantially collapsed. From the milling rolls 140, the tube is drawn over a set of first rollers 150 defining a first bridle. The first rollers 150 are rotated at surface speeds relative to the surface speeds of the milling rolls 140 so as to provide a draw ratio in a range from approximately 1.0 to approximately 1.2. Because of elastic recovery of the polymeric material leaving the milling rolls 140, a draw ratio of approximately 1.0 corresponds to an elongation of approximately 25%. Thus, as compressed by the milling rolls 140 and drawn by the first rollers 150, the tube 30 is oriented longitudinally.

From the first rollers 150, the tube 30 is fed through an annealing unit 170, in which the tube 30 is annealed at a suitable temperature (e.g. approximately 250°F or 121°C) so as to set the elongation of the tube 30. The tube 30 is then drawn over a set of second rollers 160 defining a second bridle. The second rollers 160 are rotated at surface speeds relative to the surface speeds of the first rollers 150 so as to define a draw ratio of approximately 0.95.

The annealed tube 30 is then driven through a water bath 172, which cools the tube 30.

From the water bath 172, the tube 30 is fed through a punching unit 180, in which the holes 38 are punched through the plies 34, 36. From the punching unit 180, the tube 30 is fed into a winding unit 190, in which the flattened, oriented, punched tube 30 is wound onto spools. The tube 30 may be then cut into suitable lengths, each to constitute a roofing batten, as exemplified by the roofing battens 20.

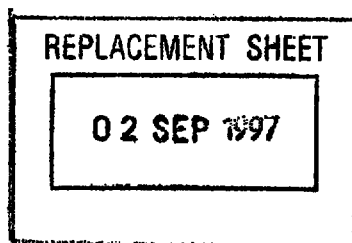


As mentioned above, the plies 34, 36, do not weld to each other when the tube 30 is flattened. Unexpectedly, the plies 34, 36, do not weld to each other when the tube 30 is milled, drawn and annealed.

An alternative method for making a seamless tube according to this invention is contemplated, in which such milling rolls are not used, and in which the flattened tube is oriented by being drawn over a short gap between two sets of rollers being rotated at different speeds.

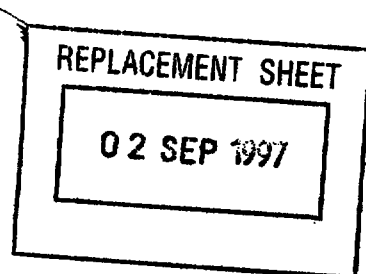
Having superior characteristics of split resistance and pull-through resistance, a roofing batten made from a seamless tube according to this invention performs as well as the two ply batten disclosed in EP-A-0 377 514.

As a possible modification of the preferred embodiment described above, the plies of the seamless tube may be adhesively bonded to each other, via an adhesive introduced before the tube is milled.

**Claims**

- 1 A seamless tube (30) useful in making a roofing batten, extruded from a polymeric material, flattened so as to define two plies (34, 36) and a substantially collapsed lumen (32), and oriented longitudinally, characterised in that the plies (34, 36) are provided with transverse holes (38) therethrough at spaced intervals along the tube (30).
- 2 A method of manufacturing a seamless polymeric tube, which is useful in making a roofing batten, the method comprising the steps of extruding a seamless tube (30) so as to define two plies (34, 16) and a substantially collapsed lumen (32), and orienting the polymeric material forming the tube longitudinally, characterised in that the method further comprises the step of providing the plies (34, 36) with transverse holes there-through at spaced intervals along the tube (30) after the tube has been oriented.
- 3 A method according to claim 2, wherein the tube (30) is extruded with a substantially circular lumen (32), and wherein the method comprises a further step of flattening the tube (30) substantially in a vacuum sizer, which is arranged to flatten the tube and to provide the tube with a substantially elongate lumen (32).
- 4 A method according to claim 2 or 3, wherein the polymeric material of the tube (30) is oriented by milling and drawing the tube (30).





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- 5 A method of manufacturing a roofing batten (20), the method comprising the steps of extruding a seamless tube (30), flattening the tube (30) so as to define two plies (34, 36) and a substantially collapsed lumen (32), milling and drawing the tube (30) so as to orient the polymeric material of the tube (30) longitudinally, and punching transverse holes (38) through the plies (34, 36) at spaced intervals along the tube (30).
- 6 A seamless tube according to claim 1, or a method according to any one of claims 2 to 5, wherein the polymeric materials is oriented so as to have a tensile strength of at least substantially 25,000 psi (172 MPa) in a longitudinal direction.
- 7 A seamless tube according to claim 1 or 6, or a method according to any one of claims 2 to 5, wherein the polymeric material comprises a major amount of polyethylene terephthalate and a minor amount of at least one polyolefin.



A B S T R A C T

SEAMLESS TUBE USEFUL FOR MAKING ROOFING BATTENS

A seamless tube (30) useful in making a roofing batten (20) is extruded from a polymeric material consisting essentially of a major amount of polyethylene terephthalate and a minor amount of at least one polyolefin, flattened in a vacuum sizer (120) so as to define two plies (34, 36), and milled and drawn so as to orient the polymeric material of the tube (30) longitudinally. As milled and drawn, the tube is oriented so as to have a tensile strength of at least substantially 25,000 psi (172 MPa) in a longitudinal direction. The plies (34, 36) are punched so as to have holes (38) therethrough at spaced intervals along the tube (30). When used to make a roofing batten to co-act with conventional fasteners, such as roofing screws, the tube exhibits superior characteristics of split resistance and pull-through resistance.

[Figures 2 and 4]

REPLACEMENT SHEET

25 FEB 1998