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(54) Title: PERFORATED LAMINATE

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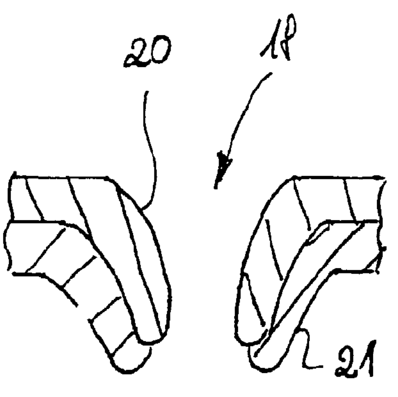

(57) Abstract: The invention relates to a perforated thermoplastic structure comprising at least a first layer (8) and a large number of perforations, which extend through the first layer (8). The perforations have a three-dimensional, preferably approximately conical or cylindrical shape (18). The second layer forms an interior surface (20) of the shape (18), whilst the first layer forms an exterior surface (21) of the shape (18). The first layer contains a thermoplastic material, whose melting point is lower than the melting point of the thermoplastic material of the second layer.

(57) Zusammenfassung: Die vorliegende Erfindung betrifft eine perforierte thermoplastische Struktur mit zumindest einer ersten Lage (8) und mit einer Vielzahl von Perforationen, die sich durch die erste Lage (8) erstrecken. Die Perforationen weisen eine dreidimensionale, vorzugsweise etwa kegelförmige oder zylinderförmige Gestalt (18) auf. Die zweite Lage bildet eine Innenfläche (20) der Gestalt (18) während die erste Lage eine Aussenfläche (21) der Gestalt (18) bildet. Die erste Lage weist ein thermoplastisches Material auf, dessen Schmelzpunkt niedriger ist als ein Schmelzpunkt des thermoplastischen Materials der zweiten Lage.

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Perforated laminate

This invention concerns a perforated laminate with at least one first and one second layer as well as a method of manufacture and a product.

A perforated material becomes apparent from EP 0 472 992 B1. It describes a non-woven fabric that has an increased surface area with an opening. The opening is produced by means of a roller with a plurality of non-heated pins and a roller situated opposite with a plurality of corresponding openings. The fibres of the non-woven fabric should be essentially unsealed. Due to this the fibres should remain mobile, and for this reason they can recluse the opening under corresponding pressure.

The object of this invention is to produce a perforated thermoplastic structure with a three-dimensional construction, that with regard its structure is insensitive to pressure.

According to the present invention, there is provided a product with a perforated thermoplastic structure comprising:

- at least one first layer forming an external surface of the structure, the first layer containing filaments and a plurality of perforations extending through the first layer, the perforations having a three-dimensional, shape and a hole diameter in the machine direction of manufacture of between 1 and 1.8 mm and in the transversal direction of between 0.8 and 1.7 mm; and
- at least one second layer forming an internal surface of the structure and at least partially forming a surface of the product, the second layer being joined at least partly with the first layer, and also containing the plurality of perforations which extend through the second layer; wherein
- the first layer and the second layer are produced in the same manner;

- the first and the second layer have fibres, which are mixed at least partially in the region of the perforation; and wherein
- the first layer comprises a thermoplastic material, the melting point of which is lower than the melting point of the thermoplastic material of the second layer;
- thereby allowing, when forming the perforated structure, the first layer to be at least partly molten in the region of the perforations which stabilises the structure of the product, and the second layer to be substantially not molten in the region of the perforation.

Preferably, the thermoplastic structure has at least one first and one second layer, while a thermoplastic material of the first layer has a melting point that is lower than that of the thermoplastic material of the second layer, wherein the first and second layer are fed via a feeder together to a perforating device with a perforating calender over a wrap-around angle of more than 180°.

Preferably, the product of the present invention is produced using perforating equipment with a perforating calender comprising:

- a perforating roller having protuberations and with a counter roller that is engaged at least partly by the protuberations;
- a third roller which is engaged at least partly by the protuberations of the perforating roller and a feeding for a structure to be perforated is so arranged, that the structure is guided along the counter roller over a wrap-around angle of more than 180°.

Advantageous developments are stated in the sub-claims, while further embodiments are described in the following description.

The invention has a perforated thermoplastic structure with at least one first layer and with a plurality of perforations. The perforations extend through the first layer, while the perforations have a three-dimensional, preferably somewhat tapered or cylindrical shape. At least one second layer is joined at least partly with the first layer. The perforations extend also through the second layer. The second layer forms an internal surface of the structure, while the first layer forms an external surface of the structure. Furthermore, the first layer has a thermoplastic material, the melting point of which is lower than the melting point of the thermoplastic material of the second layer.

The first layer is preferably at least partly molten in the region of the perforations and consequently the structure is stabilised. A development provides that the second layer in the region of the perforation is, at least as far as possible, not molten. According to another embodiment the second layer is not molten at all in the region of the perforation.

Therefore a permanent deformation of the perforated structure due to a mechanical action to produce the perforated structure is carried out by a corresponding temperature action. The temperature action is preferably connected with the process of transformation from an unperforated to a perforated structure. For example, it can be carried out by means of a calender, that has at least one first and one second roller. The first roller has preferably a positive structure, that in particular engages a negative structure of the second roller. By feeding a structure through this calender a transformation process is carried out. If at the same time the positive structures, therefore the protuberations on a surface of the first roller, are heated so that the thermoplastic material of the first layer is influenced whereas the thermoplastic material of the second layer remains preferably uninfluenced as far as possible, the structure can be stabilised.

The selection of different melting points of different thermoplastic materials allows to assign different properties to the respective layers. The second layer, that is uninfluenced as far as possible by the energy input during the transformation process, preferably forms at least partly an external surface in a product. The melting temperature of the second layer is particularly so chosen, that the surface properties in the second layer remain unchanged as far as possible. This is significant especially with regard to the use of fibres, in particular non-woven fabric fibres, to be used, foe example, for hygiene products, but also for industrial products and clothing articles. Thus a hardened material is used preferably in the first layer, whereas the second layer remains uninfluenced by the energy input and accordingly its softness remains unchanged. In addition to an energy input during the transformation process there is the further possibility to carry out the energy input following the transformation process. This is possible, for example, by using ultrasound, heat radiation or also chemical reactions. The latter is carried out, for example, by applying chemicals, activating chemicals or releasing chemicals from the first layer, as a result of which at least a partial hardening of the thermoplastic material of the first layer will take place. For example, for this purpose at least in the region of the perforations a hardening agent is directly applied to the first layer by means of a spraying device. The second layer remains essentially uninfluenced by this. An application of the agent can be carried out before or after the transformation process.

According to a further development an agent can be applied between the first and the second layers. During the transformation process energy, for example, is introduced to the structure, due to which the agent reacts chemically, e.g. in the case of Latex, and/or reacts physically, e.g. Hotmelt. The reaction preferably leads to a hardening of the agent itself, thus stabilising the first and the second layers. Furthermore, the nature of the agent can be such, that it serves as an adhesive. Due to this not only the region lying directly around the perforation, but the remaining region of the structure is also stabilised.

Examples of advantageous combinations of thermoplastic materials can be obtained from the following table:

Material of the second layer	Material of the first layer
Spunbonded fabric PP	Spunbonded fabric PE
Carded PP	Spunbonded fabric PE
Spunbonded fabric PP	Spunbonded fabric BICO, e.g. PP/PE
Spunbonded fabric PP	Carded BICO e.g. PP/PE, preferably with PET (e.g. between 10% - 40%)
Film PP	Film PE
Spunbonded fabric PP	Film PE
Spunbonded fabric BICO PP/PE	Spunbonded fabric PE
Spunbonded fabric BICO PP/PE	Film PE
Non-woven fabric PP	Large-volume fabric BICO PP/PE
Spunbonded fabric HDPE	Carded BICO, e.g. PP/PE, preferably with PET (e.g. between 10% - 40%)
Non-woven fabric PP	Carded PE
Non-woven fabric PP	PP non-woven fabric with low melting point, e.g. Softspun™
Spunbonded fabric BICO PP/PE	Carded BICO PP/PE

The following masses per unit area have been tested:

Mass per unit area of the second layer (gsm)	Mass per unit area of the first layer (gsm)
approx. 10 - 15	approx. 10 - 50

The mass per unit area of the first layer is preferably greater than the mass per unit area of the second layer.

The results of the experiments were as follows:

Method Unit	**Sample A**	**Sample B**	**Sample C**	**Sample D**	**Sample E**
Mass per unit area (g/m²)	30	20 + 30	20 + 30	26 + 30	27 + 30
Breaking force MD (N/50 mm)	26.63	62.97	75.44	39.07	41.87
Breaking force CD (N/50 mm)	23.52	24.27	29.91	17.71	10.83
Ratio of breaking forces MD/CD (%)	1.13	2.60	2.52	2.21	3.87
Breaking elongation MD (%)	21.93	23.87	27.18	17.56	18.07
Breaking elongation CD (%)	30.14	39.25	41.58	78.84	75.72
Elongation at 5 N MD (%)	2.52	1.25	1.11	1.67	1.77
Elongation at 5 N CD (%)	7.83	9.03	7.20	22.54	35.28
Elongation at 10 N MD (%)	5.19	2.31	2.12	3.27	3.12
Elongation at 10 N CD (%)	12.06	14.78	12.28	38.16	62.38
Composite adhesion (N/25.4 mm)	-	0.160	0.173	0.037	0.031
Titre of 2nd layer (dtex)	2.4	2.3	2.3	2.4	4.2
Add-on level Topsheet (%)	0.56	0.60	0.60	0.16	0.20
Strike-through (s)	5.68	5.53	10.18	203.34	3.61
Rewet (g)	0.109	0.098	0.113	0.105	0.105
MD/MC hole diameter ratio	1.11	1.19	1.17	1.41	1.18
Area of hole (mm²)	1.28	1.30	1.29	0.90	1.11
Open area (theoretical) (%)	19.69	19.95	19.77	13.85	17.06
Open area (measured) (%)	18.40	18.99	17.84	15.65	17.39

Sample A is a spunbonded fabric from PP and serves as a comparison material. Sample B has spunbonded fabric in the second layer and a carded Bico material in the first layer. Sample C has a spunbonded fabric in the second layer and a carded material in the first layer. Sample D has a BICO spunbonded fabric in the second layer and a carded Bico non-woven fabric in the first layer. Sample E has an HDPE spunbonded fabric in the second layer and a carded Bico material in the first layer. Prior to the perforation each of the samples were bonded into a single layer.

As the comparison particularly between the measured and theoretical open areas as well as preferably the ratio of the MD/MC hole sizes show, particularly perforations with round openings could be successfully stabilised. In MD the hole diameters are between 1 and 1.8 mm and in CD between 0.8 to 1.7 mm.

A further influence on the size of the holes is the speed with which the structure passes through the perforating equipment. The structure was passed through at speeds between 5 m/s up to 130 m/s. Speeds between 45 m/s and 120 m/s, particularly between 60 m/s and 95 m/s have proven themselves as advantageous to produce a stable perforation. For hole diameters in the range of below 0.5 mm a higher speed can be set. In this case speeds up to 200 m/s can be set, preferably speeds over 150 m/s. The hole diameters are then, for example, in a range between 0.5 and 0.1 mm. The perforating roller has preferably a temperature between approx. 100° C and 160° C on the base of the roller, depending on the material. The oil temperature for the heating is set, for example, between 135° C and 180° While the counter roller has preferably a temperature between 45° C and 95° C, particularly between 55° C and 75° C.

According to a further idea a perforating equipment has a guide for a structure to be perforated, that is so arranged that the structure is guided over a wrap-around angle of more than 120°, preferably more than 150° along the counter roller, before the perforation can be carried out. By virtue of this it will be particularly possible to feed, in the case of a heated counter roller, the heated up structure to the perforating roller. Moreover, due to the wrapping around a tension in the material contacting the counter roller, will be reduced. Due to this a particularly stable perforation is achieved.

According to a further configuration the counter roller has a coating, preferably from rubber. In particular the coating has a thickness between 1.5 mm and 15 mm, particularly at least 4 mm. The protuberations of the perforating roller can mesh with the coating. The depth of meshing is preferably approx. 2.5 mm to 6 mm.

According to an embodiment a two-layered structure to be perforated is produced by an integrated production method. In the case of the production of a non-woven fabric, for example, a spunbonded machine with one or several beams are available. By means of one of the beams a polymer mixture with a low melting point, for example, and by means of a second beam a BICO PP/PE non-woven fabric is produced. Furthermore, a second layer can be applied to a pre-produced material and subsequently perforated. There is the further possibility to produce the first and second layers in-line and perforate them in a separate operation. As it is shown on the example of non-woven fabric, there is the further possibility to use combinations of a film and a non-woven material. For example, a film can be extruded, for example, on a carded non-woven fabric and following this fed to a perforating unit.

If, according to an embodiment a non-woven fabric is used as the first layer, it can be successful due to the fact that non-woven fabric fibres can be partly fused and in this manner the geometry of the form can be stabilised. At the same time the non-woven fabric fibres can, for example, lose their form at least partially. According to a further embodiment the non-woven fabric fibres retain to a great part their form and become adhesive. According to a further embodiment the fibres of the first layer are mixed at least partially with the fibres of a non-woven fabric of the second layer, in particular by interlocking. Whereas, for example, two separately produced non-woven fabric layers can have a material border between them, the two partially mixed non-woven fabric layers have a transition of materials. In addition to the transition of the material the two layers have only one thermoplastic material each. Such a construction is produced particularly by means of an in-line production. The perforated structure has preferably a phase transition or according to a further embodiment, a complete mixture for example, of the fibres at least partially in the region of the perforations. The first and the second layers are preferably produced in the same manner. Both layers are, for example, extruded non-woven fabrics produced on the same machine. There is also the possibility to form different materials with different properties into a perforated structure. Whereas one non-woven fabric has at least a predominant PP content, the other non-woven fabric contains predominantly HDPE or DAPP. Moreover, there are possibilities of combinations of various production methods of non-woven fabrics, in particular the use of large-volume staple fibre non-woven fabrics with spunbonded fabrics or also melt-blown non-bonded fabric with spunbonded fabric as well as further combinations.

According to a further embodiment the first layer is joined with a third layer. The third layer has a thermoplastic material, the melting point of which is higher than the melting point of the thermoplastic material of the first layer. By virtue of this a type of "sandwich" can be produced, while the central layer ensures the stability of the three-dimensional construction present in the three layers.

According to a further idea a method to produce a perforated laminate is made available, that has at least one first and one second layer. A thermoplastic material of the first layer has a melting point that is lower than that of the thermoplastic material of the second layer. The first and second layers are fed together to a perforating calender, while in the perforating calender protuberations from one calender roller, preferably at least needle-like projections, penetrate the first and the second layers and the protuberations are preferably heated, while the second layer contacts the protuberations before the first layer.

According to a development the second layer will not be fused by contacting the protuberations, while the first layer will become at least partially adhesive.

According to a further method the second layer is fed through the calender in an unmolten state, whereas the first layer melts at least partially. According to a development it could, however, be provided that the temperature or the energy input is so high, that the thermoplastic material of the first layer loses at least partially the initial construction and resolidifies during cooling off. By setting the temperature in a corresponding manner there is the further possibility that the filaments will fuse in the first layer and at the same time retain their filament form.

Further advantageous features, embodiments as well as developments are explained in detail based on the following drawing. The features described therein can be combined with that described above for further executions. They show in:

Fig.1 - a first perforating equipment, wherein a structure to be perforated is directly fed to a perforating roller,

Fig.2 - a second perforating equipment, wherein the structure to be perforated is first brought to a rotating roller,

Fig.3 - a further perforating equipment, and

Fig.4 - the principle of the progress of a perforation.

Fig.1 shows a perforating equipment 1 with a perforating roller 2. The perforating roller 2 is arranged opposite a counter roller 3. Offset to them there is a further, third roller 4. Protuberations 5, extending from the perforating roller 2, engage at least partially the counter roller 3 as well as the third roller 4. The perforating roller 2, the counter roller 3 and the third roller 4 form a perforating calender 6. The rotational speed of the rollers can be adjusted by means of appropriate gearboxes and control of the electric motors. A thermoplastic structure 7 is introduced into the perforating calender 6. The thermoplastic structure is a flat formation, that according to this embodiment has a first layer 8 and a second layer 9. The first layer 8, just like the second layer 9, are fed in this case from an uncoiler 10 each to the perforating calender 6. However, prior to this the first layer 8 and the second layer 9 are guided together over a expansion roller 11. By bringing together the two layers 8, 9 by means of the expansion roller 11 it will be achieved that both layers 8, 9 will lie against one another on the entire surface without forming any folds. To provide a tension in the thermoplastic structure 7, the perforating equipment 1 according to this embodiment has at least one further deflector roller 12. As illustrated here, the deflector roller 12 is independent from the expansion roller 11. It is, however, also possible to achieve the tensioning of the material by combining the deflector roller and the expansion roller by guiding the first layer 8 and the second layer 9 over the expansion roller 11 directly to the perforating calender 6. The thermoplastic structure 7 is heated at least partly in the perforating equipment 1. In this case the thermal energy is introduced into the structure 7 by means of a hot air blower 13. The hot air blower 13 is arranged in the immediate vicinity of the perforating calender 6. Preferably the hot air blower

13 is provided directly to the perforating roller 2. The temperature of the heated medium flowing from the hot air blower 13 is adjusted to suit the softening temperature of the thermoplastic material of the first layer. According to an embodiment the medium is heated at least close to this temperature. According to a development the medium has such a temperature, that the first layer is heated to a temperature between the softening temperature of the thermoplastic material of the first layer and the softening temperature of the thermoplastic material of the second layer. Such a temperature range for the structure to be perforated is preferably chosen also when the methods of introducing the energy are different. Decisive in this case is that temperature which is perceived by the thermoplastic material of the first layer. Due to energy losses, for example at the exit from the hot air blower 13 up to its impacting on the structure 7 and passing on the energy to the first layer 8, the medium can be set to a higher temperature. The same is valid, for example, for the heating of the protuberations 5 of the perforating roller 2 or also when the methods of introducing the energy are different.

The counter roller 3 illustrated in Fig.1 preferably has openings 14 on its surface, that extend into the counter roller 3. The dimensions of the openings 14 approximately correspond to the protuberations 5 of the perforating roller 2. The openings can be round holes, elongated holes or even channels, like those occurring by forming webs on the surface of the counter roller 3. The thermoplastic structure 7 is perforated by virtue of the interacting of the perforating roller 2 with the counter roller 3. The perforated thermoplastic structure 7 is fed along the counter roller 3 to the third roller 4, while the thermoplastic structure 7 is preferably cooled. Due to the interaction of the counter roller 3 with the third roller 4, the thermoplastic perforated structure 7 is placed on the third roller 4, from there guided to a deflector roller 12, from which the perforated thermoplastic structure 7 reaches again an expansion roller 11. From the expansion roller 11 the thermoplastic structure 7 passes to a spool 15. A coiling of the perforated structure 7 is carried out under a certain tension that can be adjusted via the deflector roller 12 and the expansion roller 11. An adjustment of the tension is carried out particularly depending on the speed at which the structure 7 travels to the spool 15. The expansion roller 11 ensures that no folds will be formed during the coiling operation. At the same time the tension is so adjusted, that a pulling apart and consequently ruining of the three-dimensional structure is prevented. The three-dimensional structure produced in this manner can be coiled with greater tensions in comparison with a thermoplastic structure 7, that is not molten.

As it becomes obvious form Fig.1, pre-produced layers are brought together and subsequently coiled. The joint achieved by the perforation of the first and second layers is sufficient to store the material by means of the spool 15 for a further processing, without the danger that the two layers 8, 9 would become separated again. According to a development (not illustrated here) it is possible to use a structure that is joined with one another at least partly before and/or after the perforation in a conventional manner, known from the state-of-the-art.

Fig.2 shows a second perforating equipment 16, that is similar to that of Fig.1, that again has a perforating calender 6. A thermoplastic structure 7 is perforated from the uncoilers 10 in this case also and coiled by means of a spool 15. In contrast to the first perforating equipment 1, in the case of the second perforating equipment 16, however, the first layer 8 and the second layer 9 are fed first to the counter roller 3, heated there by means of the hot air blower 13 and only following this fed to the perforating roller 2. Accordingly, a tensioning of the material to be set in the thermoplastic structure 7 is controlled via the rotational speed of the counter roller 3 and the uncoiling speed for the first and the second, respectively, layers 8, 9. The feeding to the counter roller 3 makes it further possible that the energy to be introduced to the first layer 8 can be introduced via the second layer 9 without the necessity of the first layer 8 coming into direct contact with the medium. Furthermore, the perforating calender 6 has a deflector roller 17 positioned downstream from the perforating roller 2. The deflector roller 17 is preferably so arranged, that the perforated structure 7 is first guided away under tension from the perforating roller 2 and the third roller 4 before the structure 7 is fed again to the third roller 4. The deflector roller 17 is particularly advantageous for material widths of > 500 mm. On this occasion the perforating calender 6 can be complemented also by an expansion roller, neither of them being shown here in detail.

The perforating equipment 1, 2, illustrated in Figs.1 and 2, have three rollers constituting the perforating calender 6. The arrangement of the rollers relative one another as illustrated is such, that the centres of their rollers are arranged approximately in a straight line. However, the rollers can also be arranged offset to one another, i.e. at an angle preferably between 160° and 40°. The perforating equipment 1, 2 may comprise additional devices, like spraying equipment, ultrasonic appliances, measuring devices.

Fig.3 shows a third perforating equipment 19, wherein the perforating calender 6 has only one counter roller 3 and a perforating roller 2. The structure 7 is fed first to the counter roller 3, where it remains along a wrap-around angle which, as illustrated here, is preferably greater than 180°, particularly in the range between 190° and 220°.

Figs.4 and 5 show schematically the progress of a perforation of a thermoplastic structure with a first layer 8 and a second layer 9. Whereas the first layer 8 is at least partially fused at least in the region of the perforation, preferably at least partially completely molten, the second layer 9 retains its form. By virtue of this a stabilisation of a three-dimensional structure 18, formed by perforation, is achieved, wherein the first layer 8 forms an external surface 21 of the structure 18, while the second layer 9 forms an internal surface 22 of the structure 18.

Examples of application of the laminate and of the structure in a product are hygiene products, sanitary and household articles, in particular wiping cloths, medical products, surface applications for products, filter materials, protective clothing, geotextiles, single use products.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A product with a perforated thermoplastic structure comprising:
    - at least one first layer forming an external surface of the structure, the first layer containing filaments and a plurality of perforations extending through the first layer, the perforations having a three-dimensional, shape and a hole diameter in the machine direction of manufacture of between 1 and 1.8 mm and in the transversal direction of between 0.8 and 1.7 mm; and
    - at least one second layer forming an internal surface of the structure and at least partially forming a surface of the product, the second layer being joined at least partly with the first layer, and also containing the plurality of perforations which extend through the second layer; wherein
    - the first layer and the second layer are produced in the same manner;
    - the first and the second layer have fibres, which are mixed at least partially in the region of the perforation; and wherein
    - the first layer comprises a thermoplastic material, the melting point of which is lower than the melting point of the thermoplastic material of the second layer;
    - thereby allowing, when forming the perforated structure, the first layer to be at least partly molten in the region of the perforations which stabilises the structure of the product, and the second layer to be substantially not molten in the region of the perforation.

2. A product according to claim 1 in which the perforations are of a generally tapered or cylindrical shape.

3. A product according to claim 1, characterised in that the second layer is not molten in any part in the region of the perforation when forming the perforated structure.

4. A method to produce a product according to any one of claims 1 to 3, that has at least one first and one second layer, while a thermoplastic material of the first layer has a melting point that is lower than that of the thermoplastic material of the second layer, wherein the first and second layer are fed via a feeder together to a perforating device with a perforating calender over a wrap-around angle of more than 180°.

5. A method according to claim 4 in which the wrap around angle is between 190° and 220°, along the counter roller, while in the perforating calender protuberations of a perforating roller penetrate the first and the second layers and partially engage the counter roller, while the second layer contacts the protuberations before the first layer thereby producing a product in which the region of the perforations the second layer remains unmolten when forming the perforated structure and forms an internal surface of the structure of the product, while the first layer melts at least partially when forming the perforated structure and forms an external surface of the structure of the product and stabilises the structure of the product.

6. A method according to claim 4 or 5, in which the filaments of the first layer will fuse and at the same time retain their filament form.

7. A method according to one of claims 4 to 6, in which the protuberations are heated.

8. A method according to any one of claims 4 to 7, in which the first layer is heated at least up to the softening temperature of the thermoplastic material of the second layer.

9. Perforating equipment with a perforating calender to produce a product according to any one of claims 1 to 3 and to carry out the method according to any one of claims 4 to 8 comprising:

- a perforating roller having protuberations and with a counter roller that is engaged at least partly by the protuberations;
- a third roller which is engaged at least partly by the protuberations of the perforating roller and a feeding for a structure to be perforated is so arranged, that the structure is guided along the counter roller over a wrap-around angle of more than 180°.

10. Perforating equipment according to claim 9, in which the wrap-around angle is between 90° and 220° before a perforation can be carried out; wherein the equipment forms a product comprising:

- a second layer which forms, at least partially, a surface of the product;
- a first layer which is at least partly molten in the region of the perforations and stabilises the structure, and the layers having;
- perforations having a hole diameter in the machine direction of manufacture between 1 and 1.8 mm and in the transversal direction between 0.8 and 1.7 mm; and wherein
- the first and the second layer have fibres, which are mixed at least partially in the region of the perforation; and
- the first layer and the second layer are produced in the same manner and that the second layer is, at least as far as possible, not molten in the region of the perforation when forming the perforated structure.

11. Perforating equipment according to claim 10, in which the counter roller has a temperature that is at least 30°C lower than the temperature of the perforating roller.

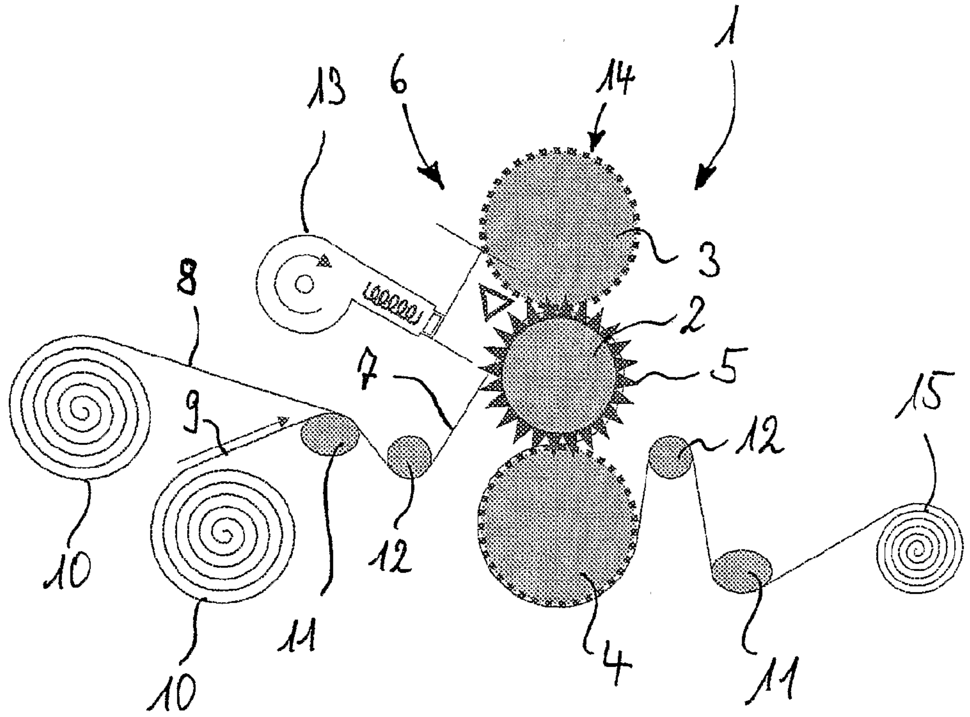
12. A product with a perforated thermoplastic structure substantially as herein described with reference to the accompanying drawings.

13. A method of producing a product with a perforated thermoplastic structure substantially as herein described with reference to the accompanying drawings.

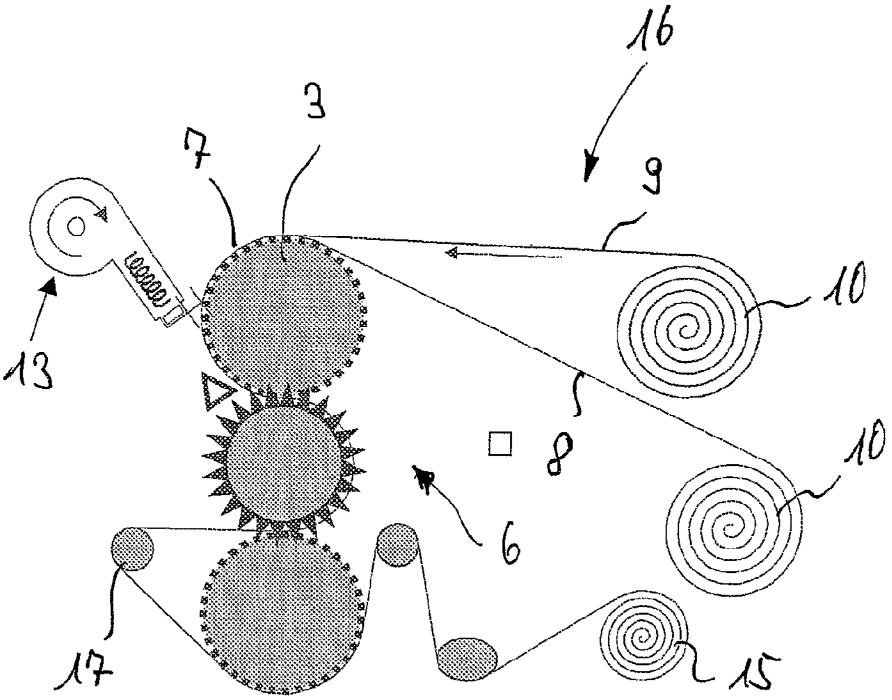
14. Perforating equipment to produce a product with a perforated thermoplastic structure substantially as herein described with reference to the accompanying drawings.

Dated this 19th day of September 2005
COROVIN GMBH
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent and
Trade Mark Attorneys of Australia

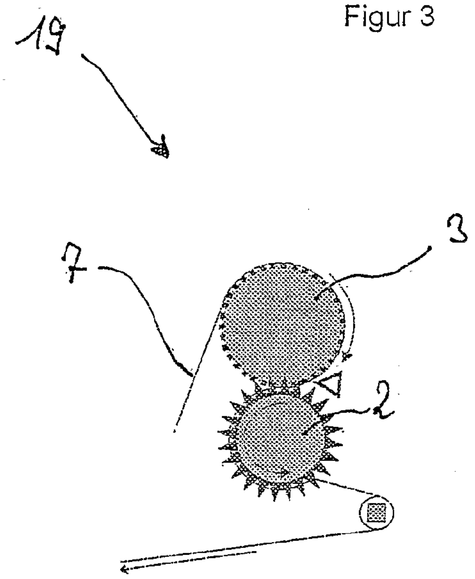
Figur 1

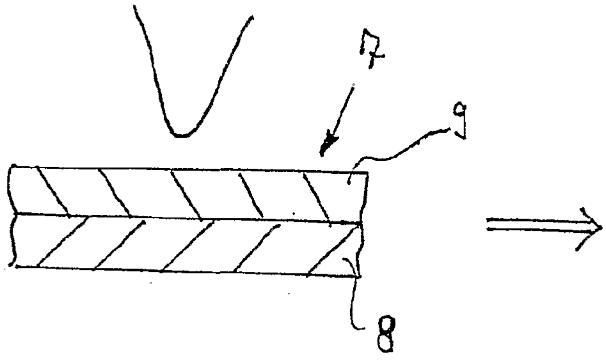


Figur 2

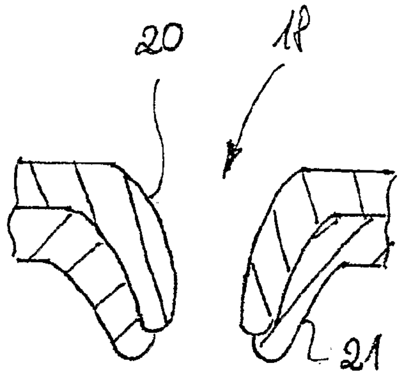


Figur 3





Figur 4



Figur 5