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(54) Benævnelse: **Fremgangsmåde til tilvejebringelse af et halvfabrikat til fremstilling af en formstøbt kompositdel**

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The invention relates to a method for producing a semifinished product for the manufacture a composite moulded part, in particular a composite fibre moulded part.

The invention primarily relates to composite moulded parts, in particular a composite fibre moulded part in lightweight design. The term "composite moulded part" means that reinforcing material or non-molten reinforcing material is embedded in a matrix of thermoplastic material. The term "composite fibre moulded part" means that fibres or non-molten fibres are present in the composite moulded part or in the matrix of thermoplastic material. The composite moulded parts or composite fibre moulded parts produced can on the one hand have a two-dimensional form, in particular the shape of a plate or the like. The composite moulded parts or composite fibre moulded parts produced preferably have a three-dimensional shape.

Methods, semifinished products and composite moulded parts of the type mentioned initially are already known from practice in different embodiments. In the known methods, firstly semifinished products are produced that consist of a matrix of thermoplastic material and reinforcing fibres embedded therein. To this end the reinforcing fibres - for example glass fibres - are firstly combined with films, powders, fibres or melts of thermoplastic material. The thermoplastic material is melted by the application of heat and pressure and in this way the reinforcing fibres are impregnated with the melt, so that ultimately the semifinished product made of the thermoplastic matrix with the embedded reinforcing fibres is obtained. These semifinished products are also known as organic sheets and they are generally produced in the form of plates. In order to produce a composite fibre moulded part with a three-dimensional shape the plates must be heated again in a subsequent additional processing step before they can be formed into the required composite fibre moulded part. The

known methods and semifinished products have a number of disadvantages. Firstly in the manufacture of semifinished products - in particular when films of thermoplastic material are used - the extent of the penetration or impregnation of the reinforcing fibres with the thermoplastic material leaves something to be desired. Furthermore air inclusions are frequently produced and as a result weak points are created in the composite moulded part or composite fibre moulded part that is produced. Moreover, the semifinished products that are produced are frequently characterized by insufficient draping properties. Therefore the manufacture of three-dimensional or multi-dimensional composite moulded parts or composite fibre moulded parts is subject to limitations. Furthermore the recycling of known fibre composite materials is difficult when a thermoplastic matrix is reinforced with inorganic or difficult-to-melt reinforcing fibres. In addition, the recycling of thermosetting plastics is also difficult and costly in the case of composite moulded parts or composite fibre moulded parts produced according to the known measures.

A method for producing a semifinished product for the manufacture of a composite moulded part is fundamentally known from EP 0 420 772 A1.

In view of this, the object of the invention is to provide a method of the type mentioned initially, in which the previously described disadvantages can be avoided in an effective and functionally reliable manner.

In order to solve this technical problem, the invention proposes a method for producing a semifinished product for the manufacture of a composite moulded part, in particular a composite fibre moulded part, wherein a higher-melting reinforcing material, in particular higher-melting reinforcing fibres are combined with lower-melting fibres

made of thermoplastic material to form a laminate, wherein the lower-melting fibres are spun and are combined at a fibre temperature T_F with the higher-melting reinforcing material, in particular with the higher-melting reinforcing fibres to form the laminate forming the semifinished product, wherein the fibre temperature T_F lies in a temperature range between a temperature of 25°C below the heat-distortion temperature T_W to 55°C above the heat-distortion temperature T_W of the thermoplastic material of the lower-melting fibres. Thus the following applies: $T - 25°C \leq T_F \leq T_W + 55°C$. It lies within the scope of the invention that the fibre temperature T_F is lower than the melting temperature of the thermoplastic material of the lower-melting fibres. It is also within the scope of the invention that the lower-melting fibres are spun and after the spinning are combined with a fibre thickness < $1.\overline{1}$ tex, preferably <$0.\overline{3}$ tex and particularly preferably < $0.1\overline{6}$ tex and with the fibre temperature T_F with the higher-melting reinforcing material, in particular with the higher-melting reinforcing fibres, to form the laminate forming the semifinished product.

Within the scope of the invention "higher-melting" means that the higher-melting component has a higher melting point than the lower-melting component, the two melting points being measured under the same external conditions. Within the scope of the invention higher-melting reinforcing material also encompasses non-melting reinforcing material and accordingly within the scope of the invention the term "higher-melting reinforcing fibres" also encompasses non-melting reinforcing fibres. These reinforcing fibres - for example carbon fibres - generally disintegrate at very high temperatures. It is recommended that the reinforcing material and in particular the reinforcing fibres are used as laid fabric and/or woven fabric and/or braided fabric and/or knitted fabric and/or meshes or the like. A preferred embodiment is characterized

in that at least one laid fabric and/or at least one woven fabric made of reinforcing fibres forms/form the at least one layer of higher-melting reinforcing fibres. Within the scope of the invention, higher-melting foams or honeycombs can also be used as higher-melting reinforcing material. It is within the scope of the invention that the melting point of the higher-melting reinforcing material or the higher-melting reinforcing fibres is at least 1°C, preferably at least 5°C higher than the melting point of the lower-melting fibres. According to one embodiment of the invention, the melting point of the higher-melting reinforcing material or the higher-melting reinforcing fibres is at least 20°C, preferably at least 30° and preferably at least 50°C higher than the melting point of the lower-melting fibres.

According to patent claim 1, the fibre temperature T_F of the lower-melting fibres when combined with the reinforcing material or with the reinforcing fibres in the range specified there is lower than the heat-distortion temperature T_W or in the range specified there is higher than the heat-distortion temperature T_W of the thermoplastic material of the lower-melting fibres. Naturally it can also correspond to the heat-distortion temperature T_W. The fibre temperature T_F of the lower-melting fibres when deposited or when combined with the reinforcing material can be measured as process temperature or air temperature during the deposition or combination of the lower-melting fibres in the current method. The heat distortion or the heat-distortion temperature T_W of the thermoplastic material of the lower-melting fibres is a measure of the temperature stability of this thermoplastic material. The heat-distortion temperature can be measured according to DIN EN ISO 75-2:2004, method B (heating rate 50 K/h) on an untempered test piece.

A particularly preferred embodiment of the method according

to the invention is characterized in that the fibre temperature T_F of the lower-melting fibres combined with the reinforcing material lies between a temperature T_F of 20°C - preferably 15°C - below the heat-distortion temperature T_W to 50°C - preferably 45°C - above the heat-distortion temperature T_W of the thermoplastic of the lower-melting fibres. As already set out above, however, it lies within the scope of the invention that the fibre temperature T_F lies below the melting point of the thermoplastic material of the lower-melting fibres.

Expediently in the method according to the invention, after spinning, the lower-melting fibres are supplied endlessly to the reinforcing material or the reinforcing fibres. In this case, the lower-melting fibres have preferably retained the fibre temperature T_F from the heating during the spinning process. Thus it is recommended that a treatment or cooling of the lower-melting fibres only takes place insofar as according to patent claim 1, the fibre temperature T_F according to the invention lies in the range specified there. It lies within the scope of the invention that the reinforcing material has interstices or that interstices are formed between the reinforcing fibres and that during the combination of the lower-melting fibres with the reinforcing material or with the reinforcing fibres, the fibres or the fibre sections of the lower-melting fibres can penetrate into the interstices. In this respect the invention is based on the finding that the lower-melting fibres combined according to the invention with the reinforcing material having the reinforcing fibres with the fibre temperature T_F are sufficiently flexible or malleable or soft that they can easily penetrate into the interstices of the reinforcing material or between the reinforcing fibres at least with fibre sections. This results as it were in an entanglement of the reinforcing material or the reinforcing fibres with the lower-melting fibres. Furthermore the invention is based on the finding

that the laminate produced in the manner described previously is sufficiently stable and consistent in shape or is already sufficiently consolidated, so that it can be delivered directly to the manufacture of the composite moulded part or of the composite fibre moulded part without special consolidation measures. In this case, it is within the scope of the invention that the laminate that can already be used as a semifinished product is supplied free from consolidation, in particular without thermal consolidation or without calendering and/or without needling and/or without stitching and/or without adhesive bonding and/or without chemical consolidation to the further processing to form the composite moulded part or composite fibre moulded part. In this case, "free from consolidation" means in particular that the laminate or the semifinished product can in principle be easily compacted or can be easily compacted by compacting rollers, but is not subjected to any special consolidation method, in particular no thermal consolidation or needling or stitching or adhesive bonding. In this respect, the invention is based on the finding that a special consolidation is not necessary if lower-melting fibres at the fibre temperature T_F according to the invention are combined with the reinforcing material or with the reinforcing fibres to form the laminate or the semifinished product.

In principle, within the scope of the method according to patent claim 1 different materials can be used for the higher-melting reinforcing material, for example higher-melting reinforcing fibres in the form of glass fibres or the like. However, the higher-melting reinforcing material or the higher-melting reinforcing fibres can also consist of a plastic or a thermoplastic material. A preferred embodiment of the invention is characterized in that in the method according to patent claim 1, the higher-melting reinforcing material or the higher-melting reinforcing

fibres on the one hand and the lower-melting fibres on the other hand consist of the same plastic or of the same type of plastic. Thus for example, higher-melting polypropylene fibres can be used as reinforcing fibres and lower-melting polypropylene fibres can be used as lower-melting fibres to produce the semifinished product according to the invention. Further below and with regard to the same plastic or the same type of plastic for the higher-melting reinforcing material and for the lower-melting fibres further embodiments are disclosed that relate or can relate to the method according to patent claim 1. Thus within the scope of the method according to the invention according to patent claim 1, for example higher-melting polypropylene fibres can be used as reinforcing fibres and lower-melting polypropylene fibres can be used as lower-melting fibres.

Expediently the lower-melting fibres or at least a layer of lower-melting fibres are used in the form of a nonwoven fabric or in the form of a random nonwoven. It lies within the scope of the invention that the lower-melting fibres are produced or spun as endless filaments. As is explained in greater detail below, according to a particularly recommended embodiment of the invention the lower-melting fibres are spun as melt-blown fibres and particularly preferably as biax melt-blown fibres. The lower-melting fibres then preferably have a fibre diameter from 1 to 10 µm. In principle, the lower-melting fibres can also be produced as a spunbond made of endless filaments by a spunbond method. This method is also explained in greater detail below. According to another embodiment, the lower-melting fibres can also be produced in the course of a hot-melt method with the aid of a hot-melt blow head.

A recommended embodiment of the invention is characterized in that the layer of higher-melting reinforcing material - in particular the layer of higher-melting reinforcing fibres - is disposed between at least two layers and in

particular between two layers of lower-melting fibres of thermoplastic material to form the laminate. According to one embodiment of the invention, a three-layer laminate is thus provided. In principle in the laminate produced within the scope of the invention, further layers of reinforcing material/reinforcing fibres and/or of lower-melting fibres are possible.

An embodiment that is particularly important within the scope of the invention is characterized in that the at least one layer of lower-melting fibres of thermoplastic material is a nonwoven fabric. It is within the scope of the invention that the nonwoven fabric is a random nonwoven. In the laminate according to the invention, all layers made of lower-melting fibres of thermoplastic material are expediently nonwoven fabrics. According to a particularly recommended embodiment of the invention, a nonwoven fabric made of lower-melting fibres is a spunbond made of endless filaments.

It is within the scope of the invention that such a spunbond is produced from endless filaments by a spunbond method. In this case, endless filaments of thermoplastic material are spun from a spinneret and are then cooled in a cooling chamber. These cooled endless filaments are then expediently introduced into a stretching unit and preferably finally deposited on a conveyor belt or depositing foraminous belt. It is recommended that the endless filaments of the spunbond have a fibre diameter of 10 to 35 µm, and preferably the fibre diameter of the endless filaments is greater than 10 µm or significantly greater than 10 µm. The melt flow index (MFI) of the polypropylene used to produce a spunbond is expediently 10 to 100 g/10 min. Within the scope of the invention the melt flow index (MFI) is measured according to EN ISO 1133 at a test temperature of 230°C and at a nominal mass of 2.16 kg. According to a preferred embodiment of the invention, a

layer of higher-melting reinforcing material - in particular of higher-melting reinforcing fibres - is disposed between two spunbonds made of endless filaments of thermoplastic material.

A particularly preferred embodiment in the context of the method according to the invention is characterized in that a melt-blown nonwoven is used as nonwoven fabric and preferably a biax melt-blown nonwoven is used. Melt-blown nonwovens and in particular biax melt-blown nonwovens have proved particularly successful within the scope of the invention. Melt-blown nonwovens are produced in melt-blown machines that have a nozzle head or melt-blown blow head that is equipped with a plurality of nozzle orifices arrayed in at least one row. From these nozzle orifices the plastic melt or the molten plastic filaments is/are extruded into a very fast blown air stream. As a result the melt is converted into fine fibres, solidified, and the fibres are then deposited on a depositing device, in particular on a depositing foraminous belt - to form a fine-fibre melt-blown nonwoven. In the conventional melt-blown method, an extensive blown air stream or extensive blown air streams is/are applied to the curtain of extruded plastic filaments from the side or from opposite sides. In contrast to this, in the biax melt-blown method a separate blown air stream or a blown air stream surrounding the filament in the manner of a sheath is applied to each individual nozzle orifice or each individual extruded plastic filament. Biax melt-blown nonwovens produced by the biax melt-blown method have proved quite particularly successful within the scope of the invention. The melt-blown nonwovens or biax melt-blown nonwovens used in the method according to the invention have fibres with a fibre diameter of expediently 1 to 10 µm. A polypropylene with a melt flow index (MFI) of 75 to 2,500 g/10 min is used for example to produce the melt-blown nonwovens or biax melt-blown nonwovens. A melt flow index of 100 to 150 g/10 min

has proved quite particularly successful. According to a particularly recommended embodiment of the method according to the invention, a layer made of higher-melting reinforcing material or of higher-melting reinforcing fibres is used that is disposed between or directly between two melt-blown nonwovens and preferably between two biax melt-blown nonwovens. In principle in this embodiment, with the same plastics or the same types of plastic, the lower-melting fibres can also be produced within the framework of a hot-melt method with the aid of a hot-melt blow head.

According to a proven embodiment of the method according to the invention, lower-melting fibres of at least one polyolefin, preferably of polypropylene and/or polyethylene, are used. However, in principle the lower-melting fibres can also be made of other thermoplastics, in particular also of a polyester, for example of polyethylene terephthalate (PET) or of polyamide (PA).

It is recommended that for a layer made of higher-melting reinforcing fibres at least one fibre type from the group "glass fibres, aramid fibres, carbon fibres, metal fibres, fibres of thermoplastic material" is used. In principle the higher-melting reinforcing fibres can also be natural fibres. The fibres can be used as short fibres and/or long fibres. It lies within the scope of the invention that the layer of higher-melting reinforcing fibres is a laid fabric and/or a woven fabric and/or a braided fabric and/or a knitted fabric. Laid fabrics and woven fabrics have proved particularly successful. Thus for example a laid fabric of glass fibres can be used as a layer of higher-melting reinforcing fibres. According to another preferred embodiment of the invention, the layer of higher-melting reinforcing fibres is a nonwoven fabric of higher-melting reinforcing fibres, preferably of higher-melting plastic fibres. Thus for example, a nonwoven fabric of PET fibres can be used as a layer of higher-melting reinforcing

fibres, wherein this nonwoven fabric is for example disposed between two melt-blown nonwovens made of polypropylene fibres. Moreover it has proved successful for the reinforcing fibres to be admixed with an impregnating agent or with an adhesion promoter in order to achieve a better contact or adhesion with the molten thermoplastic material.

According to one embodiment, the at least one layer of reinforcing fibres as roll material is combined with the at least one layer of lower-melting fibres or the reinforcing fibres are for example combined in an air-laid method with the at least one layer of lower-melting fibres. The at least two layers can also be applied to one another continuously as roll material or discontinuously as two-dimensional sheet materials. It is within the scope of the invention that the laminate produced according to the invention can be rolled up into a roll and thus can be further used as roll material as it were. This is made possible by the flexible properties and by the good draping properties of the laminate produced according to the invention.

The manufacture of a composite moulded part, in particular a composite fibre moulded part, according to the invention is explained hereinafter. In the composite moulded part or composite fibre moulded part, higher-melting reinforcing material or higher-melting reinforcing fibres are embedded in a matrix of thermoplastic material. In order to produce the composite moulded part or the composite fibre moulded part, heat and/or pressure is applied to the laminate or the semifinished product produced according to the invention, so that the lower-melting fibres of thermoplastic material melt and the non-molten reinforcing material or the non-molten reinforcing fibres are impregnated with the thermoplastic melt or are embedded in the matrix of thermoplastic material. The application of

heat and/or pressure to the laminate or to the semifinished product can take place "inline" or "offline." It lies within the scope of the invention that when heat and/or pressure are applied, the heating temperature is selected or adjusted so that only the lower-melting fibres melt or that substantially only the lower-melting fibres melt. It is understood that after the application of heat and/or pressure or after the moulding of the composite moulded part/composite fibre moulded part, a cooling of the matrix of the thermoplastic material with the embedded reinforcing material or with the embedded reinforcing fibres takes place. With the method according to the invention, a composite moulded part or composite fibre moulded part is preferably produced in lightweight design.

For the application of warmth or heat and/or pressure the laminate or the semifinished product produced according to the invention is expediently introduced into a pressing tool and is preferably deformed there under the action of heat and the action of pressure. The impregnation of the reinforcing material or the reinforcing fibres with the thermoplastic melt and the embedding of the reinforcing material or of the reinforcing fibres in the matrix of thermoplastic material should take place within the scope of the invention as completely as possible and with minimization of air inclusions.

A quite particularly preferred embodiment of the method according to the invention is characterized in that the laminate/semifinished product produced according to the invention is converted into a composite moulded part or composite fibre moulded part by application of heat and/or pressure directly in the course of a thermoforming process and/or an injection-moulding process. Thus, in contrast to the initially described method known from practice, the laminate/semifinished product is then processed to form the end product directly and without an intermediate melting

and hardening process. Thus there is no need to produce an additional semifinished product from the reinforcing material or from the reinforcing fibres and a thermoplastic matrix and therefore a processing step can be saved compared with the known method. "Thermoforming process" means in particular a deep-drawing process. In the previously described preferred embodiment the laminate/semifinished product produced according to the invention can therefore be directly deep-drawn. As a result of the good handling and good draping properties of the laminate/semifinished product, three-dimensional or multi-dimensional moulded parts can easily be produced according to the invention.

According to another embodiment of the method according to the invention, heat and/or pressure is applied to the laminate/semifinished product in a first step and a further or second semifinished product is formed with a matrix of thermoplastic material and reinforcing material embedded therein or reinforcing fibres embedded therein. This further or second semifinished product of thermoplastic matrix and embedded reinforcing material or embedded reinforcing fibres is then converted, only subsequently or in a second step, into a composite moulded part or a composite fibre moulded part by application of heat and/or pressure in the course of a thermoforming process and/or an injection-moulding process. Thus here, as in the method known from practice, firstly in an additional step a further semifinished product is produced that is then processed subsequently to form the end product, for example by deep-drawing to form a three-dimensional or multi-dimensional moulded part. Expediently the further or second semifinished product is produced from the thermoplastic matrix and the embedded reinforcing material in the form of plates.

The semifinished product produced can be used to produce a

composite moulded part, in particular a composite fibre moulded part, with reinforcing material or reinforcing fibres embedded in a matrix of thermoplastic material, wherein at least one layer of higher-melting reinforcing material - in particular of higher-melting reinforcing fibres - is combined with at least one layer of lower-melting fibres of thermoplastic material to form a laminate. The laminate forms the semifinished product from which the composite moulded part or composite fibre moulded part can be produced. A distinction is made between the first semifinished product (laminate) described here and the optional further or second semifinished product (semifinished product made of thermoplastic matrix with embedded reinforcing material) described above. The invention is based on the finding that the semifinished product in the form of the laminate is relatively easy to handle and particularly because of its good draping properties can be wound onto rolls and can be used as roll material. In particular, a laminate having at least one melt-blown nonwoven as lower-melting component can frequently be handled easily without additional consolidation because of the good adhesion and can be further processed to form the composite moulded part/composite fibre moulded part directly or for example can be wound onto a roll.

A composite moulded part, in particular a composite fibre moulded part can be produced by the method according to the invention or from the semifinished product produced thereby, in which a higher-melting reinforcing material - in particular higher-melting reinforcing fibres - is/are embedded in a matrix of lower-melting thermoplastic material and wherein the matrix has been produced from lower-melting fibres of the thermoplastic material.

The invention is based firstly on the finding that the semifinished products produced by the method according to

the invention are characterized by a particularly effective or firm connection of the layers forming them. These semifinished products constitute surprisingly dimensionally stable assemblies that can be further processed or further handled without further consolidation or at least without energy-intensive consolidation measures. The laminates or semifinished products produced according to the invention are characterized by excellent handling and in particular draping properties. The semifinished products can expediently be processed directly to form the composite moulded part or the composite fibre moulded part or can be wound directly onto rolls. In this respect, the invention is characterized by low complexity and low costs. The semifinished products can easily be used as flexible roll material and three-dimensional or multi-dimensional moulded parts can be produced in a simple manner. Furthermore, the invention is based on the finding that when the measures according to the invention are implemented, an optimal impregnation or wetting of the reinforcing fibre with the melt of thermoplastic material is possible. Air inclusions in the thermoplastic matrix can be avoided or at least largely avoided. In the method according to the invention the impregnation or wetting and the formation of the moulded parts can take place in a simple manner in a single pressing tool. The composite moulded parts or composite fibre moulded parts produced according to the invention are also characterized by excellent mechanical characteristics. Furthermore it should be pointed out that in particular with an appropriate choice of material, the composite moulded parts or composite fibre moulded parts produced according to the invention can be recycled in a simple and inexpensive manner. Overall the invention according to the invention is characterized by low complexity and low costs.

The invention is explained in greater detail hereinafter with reference to drawings that show only one exemplary

embodiment. In the drawings, in schematic representation:

Fig. 1 shows schematically the production of a laminate forming a semifinished product according to the invention,

Fig. 2 shows a device for carrying out the method according to the invention,

Fig. 3 shows a section through a composite fibre moulded part produced according to the invention, and

Fig. 4 shows a perspective view of a composite fibre moulded part produced according to the invention.

Figure 1 shows completely schematically the production of a laminate 4 forming a semifinished product according to the invention. The laminate 4 here consists of a layer of higher-melting reinforcing fibres in the form of a glass-fibre fabric 5 made of glass fibres 8. Lower-melting fibres 10 are produced preferably and in the exemplary embodiment by a biax melt-blown method. These fibres can be lower-melting polypropylene fibres that are combined with the glass fibres 8 or with the glass-fibre fabric 5. Expediently and in this exemplary embodiment, a biax melt-blown nonwoven 6 is laid on the glass-fibre fabric 5. According to the invention, the lower-melting fibres 10 or the polypropylene fibres have a fibre temperature T_F in the region of the heat-distortion temperature T_W of the polypropylene. It can be seen from Fig. 1 that because of their fibre temperature T_F the lower-melting fibres 10 combined with the glass fibres 8 or with the glass-fibre fabric 5 are so soft or flexible and malleable that they penetrate with fibre sections 11 into interstices 12 formed between the glass fibres 8 of the glass-fibre fabric 5. In this way, an effective entanglement or connection between the higher-melting glass fibres 8 and the lower-melting fibres 10 is produced. The laminate 4 that is formed can in

principle be supplied without special consolidation for further processing to form the composite moulded part or the composite fibre moulded part 7.

Figure 2 shows highly schematically a pressing tool 1 with two press plates 2 and 3. In the exemplary embodiment, a three-layer laminate 4 is disposed between the press plates 2 and 3. This laminate 4 has a central layer of higher-melting reinforcing fibres in the form of a glass-fibre fabric 5. This glass-fibre fabric 5 is disposed between two biax melt-blown nonwovens 6 made of polypropylene fibres. When the press plates 2 and 3 are pressed together, heat and pressure is applied to the laminate so that the lower-melting polypropylene fibres melt. The heating temperature is selected so that only the polypropylene fibres melt and the glass fibres 8 of the glass-fibre fabric 5 on the other hand are not melted. On the contrary, the glass fibres 8 are impregnated or wetted by the thermoplastic polypropylene melt and in this way the glass fibres 8 are embedded in a matrix of thermoplastic material (PP). According to a preferred embodiment of the invention, a composite fibre moulded part 7 can be produced directly in the manner described previously. A simple pressing tool 1 is shown only very schematically in Fig. 2. In principle within the scope of the invention, three-dimensional or multi-dimensional moulded parts with complex structures can be produced in a simple manner using special pressing tools. The flexible handling and good draping properties of the laminate 4 contribute to this.

Figure 3 shows a section through a composite fibre moulded part 7 produced by the method according to the invention after cooling. It can be seen that the glass fibres 8 of the glass-fibre fabric 5 are completely embedded in the thermoplastic polypropylene matrix. Perturbing air inclusions are not observed and they can be avoided in a simple manner when the measures according to the invention

are implemented. The composite fibre moulded parts 7 produced in this way according to the invention have optimal mechanical characteristics. Figure 4 also shows a further composite fibre moulded part 7 with multi-dimensional structure produced according to the invention. Within the scope of the method according to the invention multi-dimensional structures can be implemented simply and easily.

Patentkrav

1. Fremgangsmåde til tilvejebringelse af et halvfabrikat til fremstilling af en formstøbt kompositdel, især en formstøbt fiberkompositdel (7), hvor et højeresmeltende forstærkningsmateriale (5), især højeresmeltende forstærkningsfibre (8) kombineres med laveresmeltende fibre (10) af termoplastisk kunststof til et laminat (4), hvor de laveresmeltende fibre (10) spindes og efter spindingen ved en fibertemperatur T_F kombineres med et højeresmeltende forstærkningsmateriale (5), især med de højeresmeltende forstærkningsfibre (8) til laminatet (4), der danner halvfabrikatet, hvor fibertemperaturen T_F ligger i et temperaturområde mellem en temperatur på 25 °C under varmeformbestandighedstemperaturen T_W til 55 °C over varmeformbestandighedstemperaturen T_W af det termoplastiske kunststof af de laveresmeltende (10) fibre.

2. Fremgangsmåde ifølge krav 1, hvor de laveresmeltende fibre (10) efter spindingen kontinuerligt tilføres til forstærkningsmaterialet (5) hhv. forstærkningsfibrene (8), og hvor de laveresmeltende fibre (10) foretrukket har bibeholdt fibertemperaturen T_F fra opvarmningen ved spindeprocessen.

3. Fremgangsmåde ifølge et af kravene 1 eller 2, hvor fibertemperaturen T_F af de laveresmeltende fibre (10) ved kombinationen med hhv. forstærkningsmaterialet (5) og med forstærkningsfibrene (8) ligger på mellem en temperatur på 20 °C - foretrukket 15 °C - under varmeformbestandighedstemperaturen T_W til 50 °C - foretrukket 45 °C - over varmeformbestandighedstemperaturen Tw af det termoplastiske kunststof af de laveresmeltende fibre (10).

4. Fremgangsmåde ifølge et af kravene 1 til 3, hvor forstærkningsmaterialet (5) har mellemrum hhv. hvor der mellem forstærkningsfibrene (8) er dannet mellemrum, hvor hhv. fibrene og fibersektionerne af de laveresmeltende fibre (10) i løbet af kombineringen af de laveresmeltende fibre (10) med forstærkningsmaterialet (5) hhv. med forstærkningsfibrene (8) trænger ind i mellemrummene.

5. Fremgangsmåde ifølge et af kravene 1 til 4, hvor halvfabrikatet tilføres hærdningsfrit til den videre forarbejdning til den formstøbte kompositdel, især til den formstøbte fiberkompositdel (7), især uden kalandrering og/eller uden

nåling og/eller uden sammensyning og/eller uden termisk bonding med varmluft og/eller uden sammenklæbning og/eller uden kemisk hærdning.

6. Fremgangsmåde ifølge et af kravene 1 til 5, hvor de laveresmeltende fibre (10) efter spindingen med en fibertykkelse på < 1,1 tex, foretrukket < 0,3 tex og særligt foretrukket < 0,16 tex, kombineres med det højeresmeltende forstærkningsmateriale (5), især med de højeresmeltende forstærkningsfibre (8), til laminatet (4), der danner halvfabrikatet.

7. Fremgangsmåde ifølge et af kravene 1 til 6, hvor de laveresmeltende fibre (10) i form af et random-non-woven hhv. i form af et non-woven kombineres med forstærkningsmaterialet (5) hhv. med forstærkningsfibrene (8).

8. Fremgangsmåde ifølge et af kravene 1 til 7, hvor de laveresmeltende fibre (10) tilvejebringes hhv. spindes som endeløse filamenter.

9. Fremgangsmåde ifølge et af kravene 1 til 8, hvor de laveresmeltende fibre (10) spindes som meltblown-fibre og særligt foretrukket som biax-meltblown-fibre.

10. Fremgangsmåde ifølge et af kravene 1 til 9, hvor smeltepunktet for det højeresmeltende forstærkningsmateriale (5) hhv. af de højeresmeltende forstærkningsfibre (8) ligger mindst 1 ° C, fortrinsvis mindst 5° C højere end smeltepunktet for de laveresmeltende fibre (10).

11. Fremgangsmåde ifølge et af kravene 1 til 10, hvor der anvendes højeresmeltende forstærkningsfibre (8) fra i det mindste en fibertype fra gruppen "glasfibre, aramidfibre, kulstoffibre, metalfibre, fibre af termoplastisk kunststof".

12. Fremgangsmåde ifølge et af kravene 1 til 11, hvor et lag af det højeresmeltende forstærkningsmateriale (5) - især af højeresmeltende forstærkningsfibre (8) - anbringes mellem to lag af laveresmeltende fibre (10) til laminatet (4).

13. Fremgangsmåde til fremstilling af en formstøbt kompositdel, især en formstøbt fiberkompositdel (7), hvor et halvfabrikat - fremstillet ifølge et af kravene 1 til 12 - påvirkes med varme og/eller tryk, således at de laveresmeltende fibre

(10) smelter og forstærkningsmaterialet (5) - især forstærkningsfibrene (8) - imprægneres af smeltemassen hhv. indlejres i matrixen af termoplastisk kunststof.

14. Fremgangsmåde ifølge krav 13, hvor halvfabrikatet omdannes til den formstøbte kompositdel hhv. den formstøbte fiberkompositdel (7) ved påvirkning med varme og/eller tryk i løbet af en termoformningsproces og/eller en sprøjtestøbningsproces.

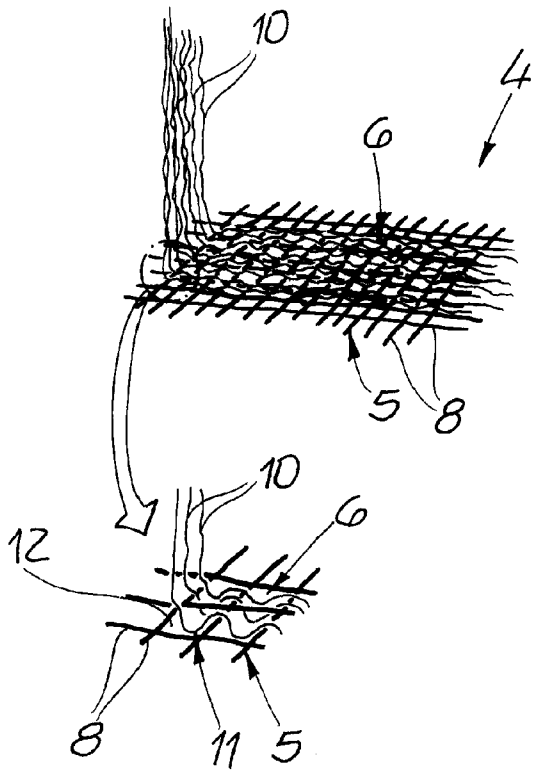
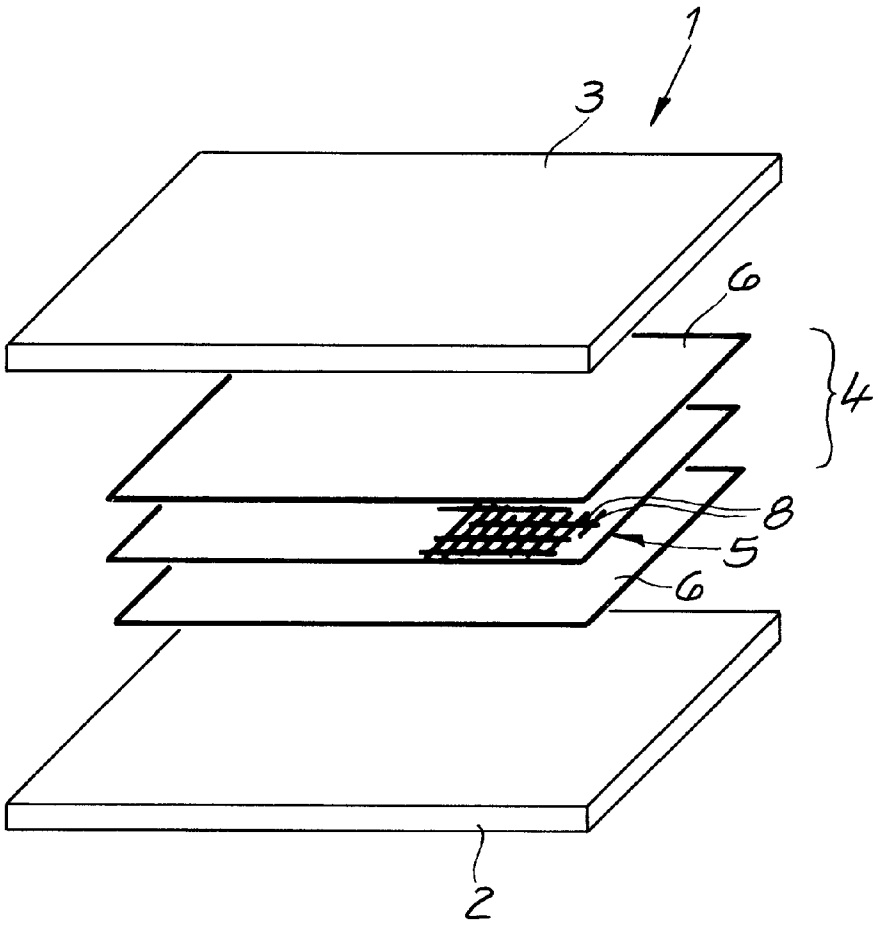


Fig.1

Fig.2



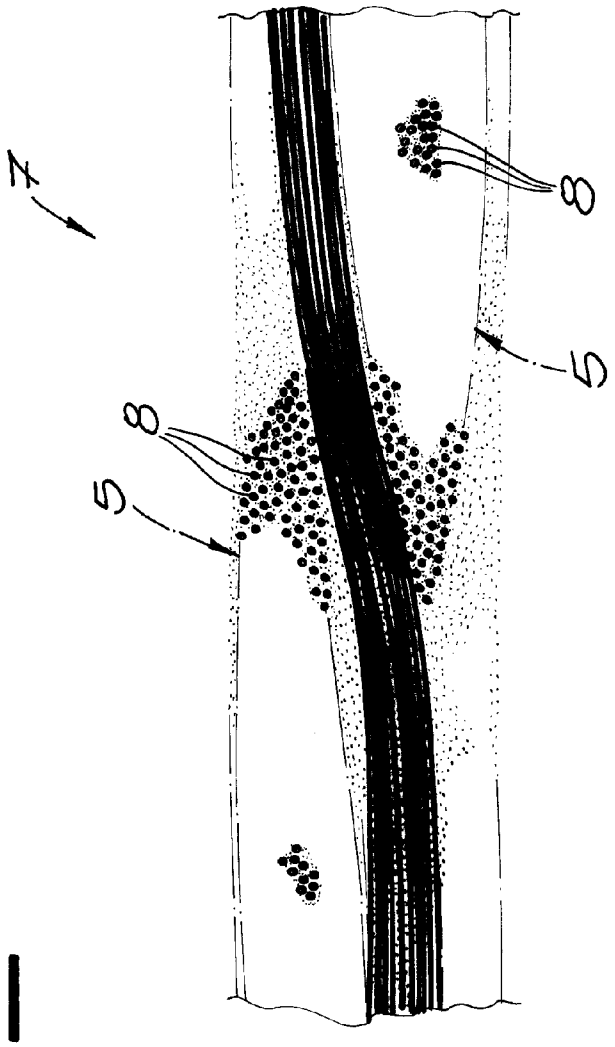


Fig.3

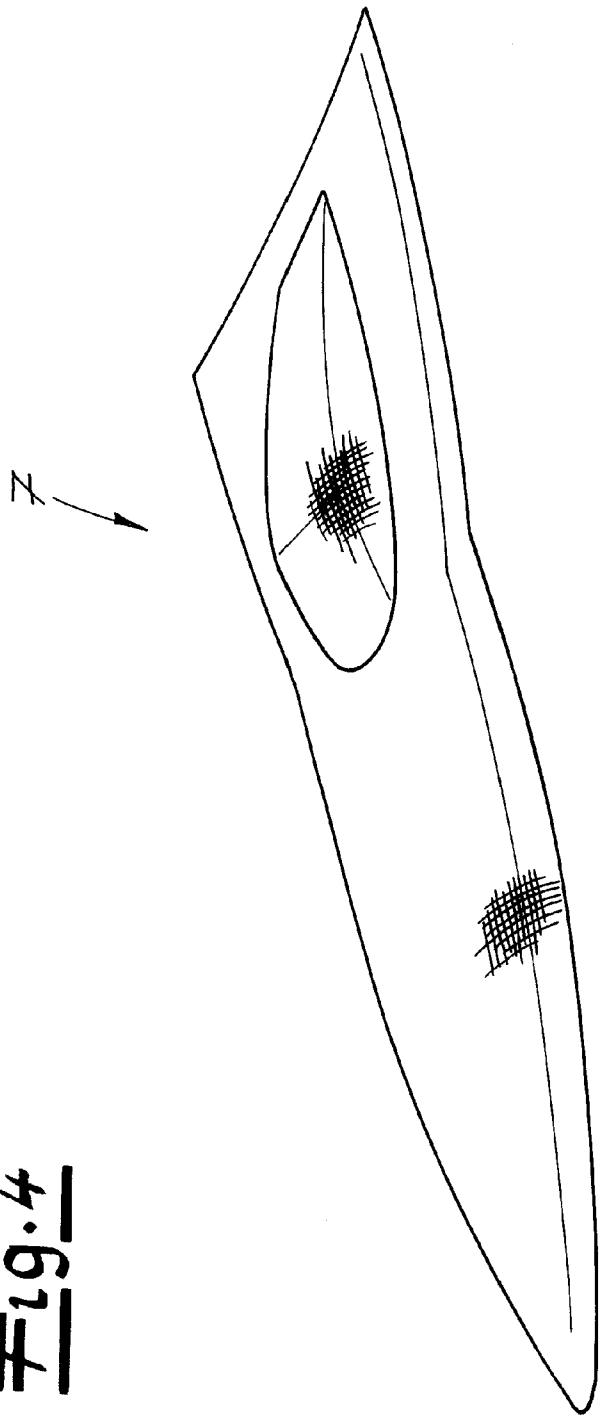


Fig.4