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(54) Benævnelse: **Fremgangsmåde til fremstilling af en karosseriformdel**

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The invention relates to a method for manufacturing a car body formed part and a blank for this, according to the features specified in the preamble of claim 1.

Car body formed parts, as have been applied for decades in their millions in the automobile industry, are inexpensively manufactured in large numbers. For this, a sheet metal coil is applied as a starting material, and this sheet metal coil is cut to length into plate-like sections, and subsequently straightened. Such a fine sheet metal section which as a rule is rectangular is then cut to size which is to say blanked in accordance with the shape of the car body formed part which is to be manufactured, and subsequently deformed with a deep-drawing tool or pressing tool. Thereby, it is essential that the surface of the workpiece remains smooth and undamaged up to the edge, in order to avoid further post-machining before the painting.

The cutting to size in the case of car body formed parts which are manufactured in large numbers is typically effected by way of punching which is to say blanking. The machine which is required for this, as well as the tool which is always dependent on the workpiece, is complicated and expensive. Moreover, the punching procedure unfavourably compromises the material structure in the edge region. It is therefore counted as belonging to the state of the art to effect the cutting to size by way of burning, in particular by way of laser cutting, in the case of car body formed parts which are manufactured in smaller and medium numbers. This method however also has the disadvantage that structural changes take place in the edge region, in particular a hardening and embrittlement, which is disadvantageous with regard to the subsequent forming which is to say reshaping procedure, and is not at all desirable. Inasmuch as this is concerned, a particular problem occurring with the application of lightweight metal materials, in particular aluminium, which are being increasing used in recent times, is that its outer side is protected by an oxide layer with an extremely high melting point, but only has a melting point of just above 700° in the inside. In the case of thermal cutting, thus also of electron beam cutting, this leads to the cut surface, in particular in the region, in which the electron beam exits out of the material again, having manufacturing accuracies, which are not at all desirable and frequency render necessary a post-machining. Against this background, it is the object of the present invention, to improve a method for manufacturing a car body formed part, in particular for manufacturing a blank of a fine sheet metal section, to the extent that the disadvantages mentioned above do not occur, and in particular that fine sheet metals of aluminium can also be inexpensively manufactured. Moreover, a design concerning a device and which is necessary for this is to be provided, in order to be able to carry out such an improved method.

The part of the above-mentioned object with regard to the method is achieved by the method according to the invention, according to claim 1. Advantageous designs of the method according to the invention and of the machine table according to the invention are to be deduced from the dependent claims, the subsequent description and the drawing. Hereby, the features which are specified in the dependent claims and the description, in each case per se, but also in a suitable combination, can also further form the solution according to the invention.

The basic concept of the present invention, for manufacturing a blank of a fine sheet metal section for manufacturing a car body formed part, is not to cut out the blank from a fine sheet metal section by way of laser beam, as is the case in the state of the art, but to envisage a material-removing machining for cutting out the blank and to apply a fine sheet metal section of lightweight metal. This method is particularly advantageous as a method for manufacturing a car body formed part, with which a plastic deformation into a hollow body forming the later car body formed part or at least a part thereof is effected subsequently to the formation of the blank. High demands concerning the quality can be met by way of the method according to the invention, and specifically with regard to the absence of structural changes due to the cutting as well as with regard to the high surface quality of all side surfaces, including the cut surface, which can be achieved with this.

The method according to the invention is particularly advantageous for manufacturing blanks of fine sheet metal sections which consist of lightweight metal. Lightweight metal on the one hand can be well machined in a material-removing manner, and on the other hand structural changes in the region of the cutting surfaces and occurring with thermal separation methods do not occur, or not to a noticeable extent, on application of the method according to the invention, particularly with the use of lightweight metal. Car body formed parts, or at least parts thereof can be manufactured inexpensively and with a high precision and high surface quality, even in small and medium numbers, with the method according to the invention

It is particularly with aluminium or fine sheet metals which consist of aluminium alloy, thus sheet metals with a thickness of up to 3 mm, that the cutting-out of the blank can be advantageously effected by way of milling, in particular by way of high-speed cutting. Typically, no cooling or lubrication is necessary during the cutting, with this milling. Small, lightweight machines of a known construction type can be applied. The millers to be used in this context and which have a diameter for example of 6 mm have long tool lives and are inexpensive in procurement. They permit high cutting speeds and thus an economical manufacture of the banks. Thereby, one or more equal or also different millers with suitable drives can be applied, depending on the size and type of the blanks.

According to a further development of the invention, a complete sucking-away of cutting particles is provided during the cutting procedure when cutting out the blank, in order in particular to ensure a high surface quality of the blanks. Such a suctioning is advantageously effected by one or more suction nozzles which are positioned directly next to the miller, or also advantageously by a central suction nozzle surrounding the miller.

Although the cutting forces which occur, in particular with the high speed cutting of aluminium fine sheet metals of the above-mentioned type, are comparatively small, however it is always necessary to fix the workpiece in a suitable manner during the machining. For this, according to the method according to the invention, one envisages the cutting-out of the blank being effected on a milling machine, preferably on a portal milling machine, which comprises a machine table, on which the fine sheet metal section is held by way of vacuum clamping technology during the cutting. Vacuum clamping technology is not only an inexpensive clamping method which is advantageous with regard to the exchange of the workpiece, but is also particularly suitable in order to obtain a high surface quality, due to the fact that the otherwise common clamping at both sides becomes superfluous. The workpiece surface is loaded over a large area due to the suctioning, so that a compromising of the sensitive workpiece surfaces can be avoided without having to make particular precautions.

According to the invention, a machine table which is advantageously applied on cutting out a blank according to the method according to the invention is provided for spreading out (mounting) the fine sheet metal section, in order to be able to carry out the method according to the invention in an economical manner, in particular with medium numbers. The machine table according to the invention for mounting a fine sheet metal section comprises a multitude of recesses, in particular bores, in the upper side and workpiece support surface of the table, and these recesses are conductively connected to a vacuum source, for example a vacuum pump, in order to suction the workpiece on the workpiece support surface and fix and clamp it on the machine table.

According to the invention, the workpiece support surface comprises at least one preferably recess-free groove, whose course at least in sections corresponds to the contour of the blank which is to be cut. Thereby, according to the invention, the groove is advantageously dimensioned such that a free space for the cutting tool is formed on cutting. The basic concept of the machine table according to the invention is therefore to create a free space for the cutting-through tool, thus typically the miller, on account of the groove. This groove is advantageously designed in a recess-free manner. This is important, so that no suctioning is effected in the region of the groove itself and thus any particles which arise on cutting, in particular swarf or chips, cannot get into a recess or even into the vacuum source. Recess-free in the context of the present

invention is therefore to be understood as those recesses which serve for suctioning the workpiece, i.e. which are connected to a vacuum source.

According to the invention, a separate suctioning is provided for the particles arising on cutting, wherein this separate suctioning particularly in combination with a smooth-surfaced groove which is free of undercuts and recesses is particularly efficient with a suctioning from the tool side. With such a design, it is possible to remove the cutting particles directly after the cutting and in a complete manner, by way of simple air suction.

Thereby, the groove is advantageously dimensioned such that the groove width is slightly larger than the miller diameter, and the groove depth is such that the miller can immerse so deeply into the groove, that the cut is effected completely by the cylindrical part of the miller wall. Basically, it is possible to provide several grooves in a tool support surface, for different blanks, but is particularly advantageous with regard to a high surface quality if a groove is only designed in a peripheral manner corresponding to the contour of the blank, since the particles which arise on cutting can then be removed particularly well and in a complete manner.

Basically, it is useful to suction the workpiece, thus the fine sheet metal section, from which the blank is to be cut out, onto the tool support surface of the machine table over the complete surface of this workpiece, in order to reliably prevent a warping of the material. However, it is particularly advantageous to increase the holding force directly next to the machining region. This, with the machine table according to the invention, is effected by way of a larger number of recesses being provided in the direct vicinity at both sides of the groove, than in the remaining clamped (spread) region. If the recesses are designed as bores and these are equally large, then advantageously a larger number of bores are to be provided in this vicinity of the groove, than in the remaining region. If recesses of a different shape and size are provided, then the sum of the cross-sectional areas of the recesses per unit of surface area should be significantly greater in the region next to the groove than in the remaining clamping region.

Regions with an increased suction force in the vicinity of the groove and which correspond for instance to fourfold to tenfold the groove width have been found to be advantageous in practise. If therefore the groove is 8 mm wide for a 6 mm cutter for example, then the two vicinity regions next to the groove which are provided with an increased number of recesses should each be 16 - 40 mm wide.

Since an adaptation of the machine table to the blank contour by way of the groove and, as the case may be, the increased number of recesses provided in the region of the groove, is envisaged for the inventive design of the machine table, it is particularly advantageous to form this individual adaptation by an adapter component, here an adapter plate forming the workpiece

support surface of the table, wherein this plate is arranged on a main table of the machine table, is exchangeable and can be connected to the main table itself by way of vacuum clamping technology, as well as hold the workpiece by way of vacuum clamping technology.

The machine table according to the invention thus consists of the actual main table, which can be standardised and independent of the workpiece, as well as of the exchangeable adapter plate which is to be attached on this main table and which is adapted to the respective blank to be manufactured. With this further development according to the invention, neither special means need to be provided for fixing the adapter plate onto the main table, nor special means, in order to fixedly clamp the workpiece on the adapter plate. If the recesses which are present in the main table and which are standardised and conductively connectable to a vacuum source are only partly continued in the adapter plate, then the adapter plate is sucked via a part of the recesses in the main table, and the workpiece, i.e. the fine sheet metal section is clamped on the adapter plate via the other recesses in the main table which continue in the adapter plate.

Thereby, with regard to the design of the adapter plate, it is most simple if the recesses which are effective in the adapter plate are aligned with recesses in the main table. However, for reasons of tolerance, it is advantageous if these recesses in the adapter plate are widened towards the main table, since then a conductive connection is also ensured if the adapter plate comes into contact on the main table in a slightly displaced manner.

According to a further development of the invention, one envisages one or more groove-like recesses which are conductively connected to recesses in the tool support surface of the adapter plate and which engage over several recesses in the main table being provided on the side of the adapter plate which faces the main table, in order to ensure the necessary suction connection concerning the main table side, in particular in the edge regions next to the groove, where an increased suctioning is to take place. Thereby, according to an advantageous further development of the invention, these groove-like recesses not only extend in the region below the recesses in the region of the tool support surface of the adapter plate, but advantageously also next to this, in order to branch off further vacuum capacity from these adjacent regions which in the main table are still provided with recesses, so as to achieve a sufficient clamping force.

The invention is hereinafter explained in more detail by way of one embodiment example which is represented in the drawings. There are shown in:

Fig. 1 in a greatly simplified, schematic perspective representation, a portal milling machine with a machine table, according to the invention,

Fig. 2 in an enlarged representation, a plan view upon an adapter plate,

Fig. 3 a lower view of the adapter plate according to Fig. 2,

Fig. 4 in an enlarged representation, the detail IV of Fig. 2,

Fig. 5 in an enlarged representation, the detail V of Fig. 3 and

Fig. 6 the plan view of a main table array.

The portal milling machine which is represented in Fig. 1 comprises a milling cutter head 1 which forms the rotation drive for a miller 2 at the lower end of the milling-cutter head 1. The milling cutter head is arranged on a portal 3 in a transversely displaceable manner, said portal being longitudinally displaceably mounted on a machine table 4. The milling cutter head 1 for milling is lowered to such an extent that the miller 2 can divide a fine sheet metal section which is clamped or spanned out on the machine table 4, into one or more blanks. Thereby, a preset (programmed) path curve is travelled by way of suitable activation of the milling cutter head transversely to the portal 4 and activation of the portal along the machine table 4, wherein this path curve corresponds to the outer contour and, as the case may be, to the inner contour of the blank.

The machine table 4 consists of a main table 5 which represents the actual supporting and functional table, and of an adapter plate 6 which is arranged on the upper side of this main table and forms a workpiece support surface 7. The main table 5 is constructed as an air table, i.e. it comprises a number of fields (arrays) 8 which, as is represented in Fig. 6, are provided in each case with a number of recesses in the form of bores 9 which are conductively connected within the table and are connected to a vacuum source in the form of a vacuum pump.

The adapter plate 6 consists of two plate halves 6a and 6b, which are deposited next to one another on the main table 5. The adapter plate 6 consists of aluminium sheet metal and is 4 mm thick. In the workpiece support surface 7, it comprises recesses in the form of bores 10 which are distributed over the surface, as well as recesses in the form of bores 11 which extend to both sides of a groove 12 provided in the workpiece support surface 7 of the adapter plate 6. The groove 12 is free of recesses and is arranged in a manner corresponding to the contour of the workpiece 13 which is to be cut out. The groove 12, with the adapter plate 6 represented by way of the figures, encompasses in total six equally large blanks 13. The blanks 13 cannot be seen in the figures since the adapter plate is represented without the fine sheet metal section to be cut to size. However, they are accordingly provided with reference numerals in the figures for a better understanding. The groove 12 has a depth of 2 mm, so that the miller 2 moves

within the groove 12 with play on milling out the blanks 13, but can be lowered to such an extent that its cuts exclusively with its side surface.

As can be recognised by way of Figures 3 and 4, the adapter plate 6 comprises edge regions next to the blanks 13, and these edge regions are free of bores. The adapter plate 6 or both plate halves 6a and 6b are vacuum clamped onto the main table 5 in these edge regions, as soon as the arrays 8 of the main table 5 are connected to a vacuum source. The workpiece itself, i.e. the fine sheet metal section which is to be divided into the blanks 13, is clamped on the adapter plate 6, likewise by way of vacuum clamping technology. For this, the bores 10 and 11 are connected to the vacuum source, and specifically by the bores 9 in the main table 5 which are located therebelow in this region. A part of the bores 10 and 11 are aligned to the bores 9 in the main table 5. The bores 10 and 11 in the adapter plate are designed widening to the bottom, in order to also ensure this if the adapter plate 6 does not lie exactly in the designated position on the main table 5. Moreover, groove-like recesses 14 are provided on the lower side of the adapter plate 6, in the regions in which the bores 11 are arranged, and these recesses on the one hand form a free space connecting these bores 11 arranged with a high surface density, to bores 9 lying therebelow in the main table 5, but on the other hand are also arranged outside the region, in which the adapter plate 6 comprises bores 10, 11. Bores 9 in the main table 5 are conductively connected via these groove-like recesses 14 on the lower side of the adapter plate 6, in order in this manner to improve the suction volume, in particular for the bores 11, and thus the holding force. The bores 11 which are arranged around the groove 12 with a high density, ensure that one can fix the blank on the adapter plate 6 with a particularly high force, in the edge regions of the blanks 13, thus where the miller 2 cuttingly engages into the fine sheet metal section during the cutting procedure, in order on the one hand to thus ensure that an adequate fixation is given, in particular in the cutting region, but on the other hand to also ensure that the contact is effected in a gap-free manner, so that no particles can get into this region.

A suction tube which surrounds the miller 2 and which during the milling procedure moves up to directly above the upper side of the spread sheet metal sections and which sucks with a high vacuum is provided, in order to complete suck away the particles during the milling. A suction flow sets in through the groove 12 due to the fact that the closed groove 12 is arranged at the lower side of the fine sheet metal section, where the kerf is produced by the miller 2, and this suction flow ensures that particles, in particular swarf or chippings, can be reliably sucked away also in this region.

The machine described above serves for manufacturing blanks from fine sheet-metal sections, thus for example from aluminium sheet metal, with a thickness of 0.8 to 2.5 mm, as is applied for blanks for car body formed parts. The adapter plate 6 is adapted to the respective

shape of the blank, i.e. if a blank of a different shape is to be manufactured then the adapter plate 6 is then to be exchanged by a suitably different adapter plate with a different groove course.

List of reference numerals

1	milling head
2	miller
3	portal
4	machine table
5	main table
6	adapter plate
6a	left plate half
6b	right plate half
7	tool support surface
8	arrays
9	bores in 8
10	bores in the surface
11	bores in the region around the groove
12	groove
13	blanks
14	groove-like recesses

Patentkrav

1. Fremgangsmåde til fremstilling af en karosseriformdel, ved hvilken der udskæres mindst et pladeemne fra en sektion af tyndplade, hvilket pladeemne efterfølgende formes til et hullegeme ved plastisk deformering, hvilket hullegeme danner karosseriformdelen eller i det mindste en del af den, **kendetegnet ved,** at sektionen af tyndplade består af letmetal, og udskæringen af pladeemnet udføres ved spåntagende bearbejdning, nemlig ved fræsning, især ved High Speed Cutting.

2. Fremgangsmåde ifølge krav 1, ved hvilken sektionen af tyndplade består af aluminium eller en aluminiumlegering.

3. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved,** at der under skæreprocessen ved udskæringen af pladeemnet sker en fuldstændig udsugning af skærepartikler.

4. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved,** at udskæringen af pladeemnet udføres på en fræsemaskine, især en portalfræsemaskine, med et maskinbord, hvor sektionen af tyndplade fastholdes på maskinbordet under udskæringen ved hjælp vakuumspændeteknik.

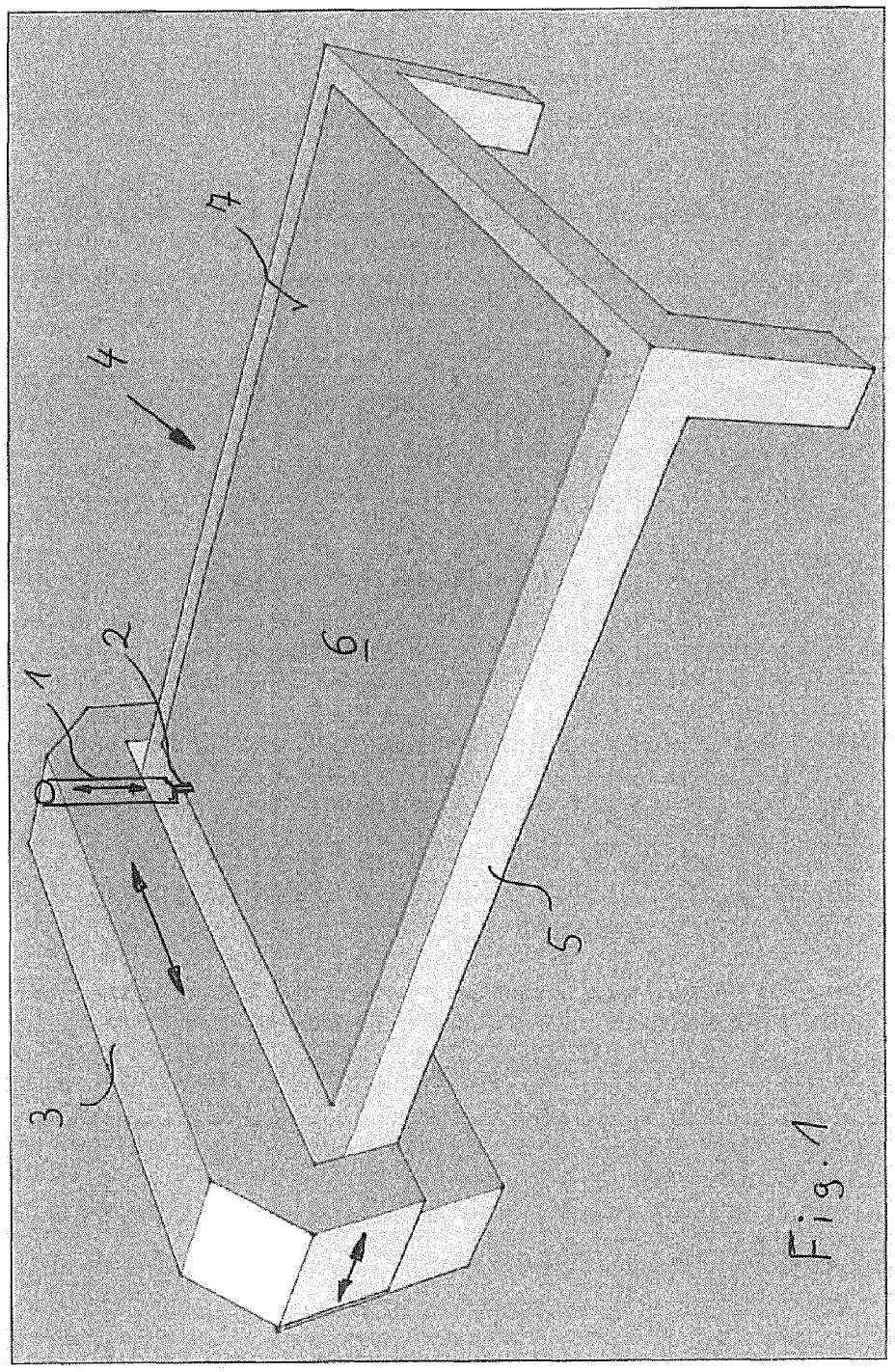


Fig. 1

Fig. 2

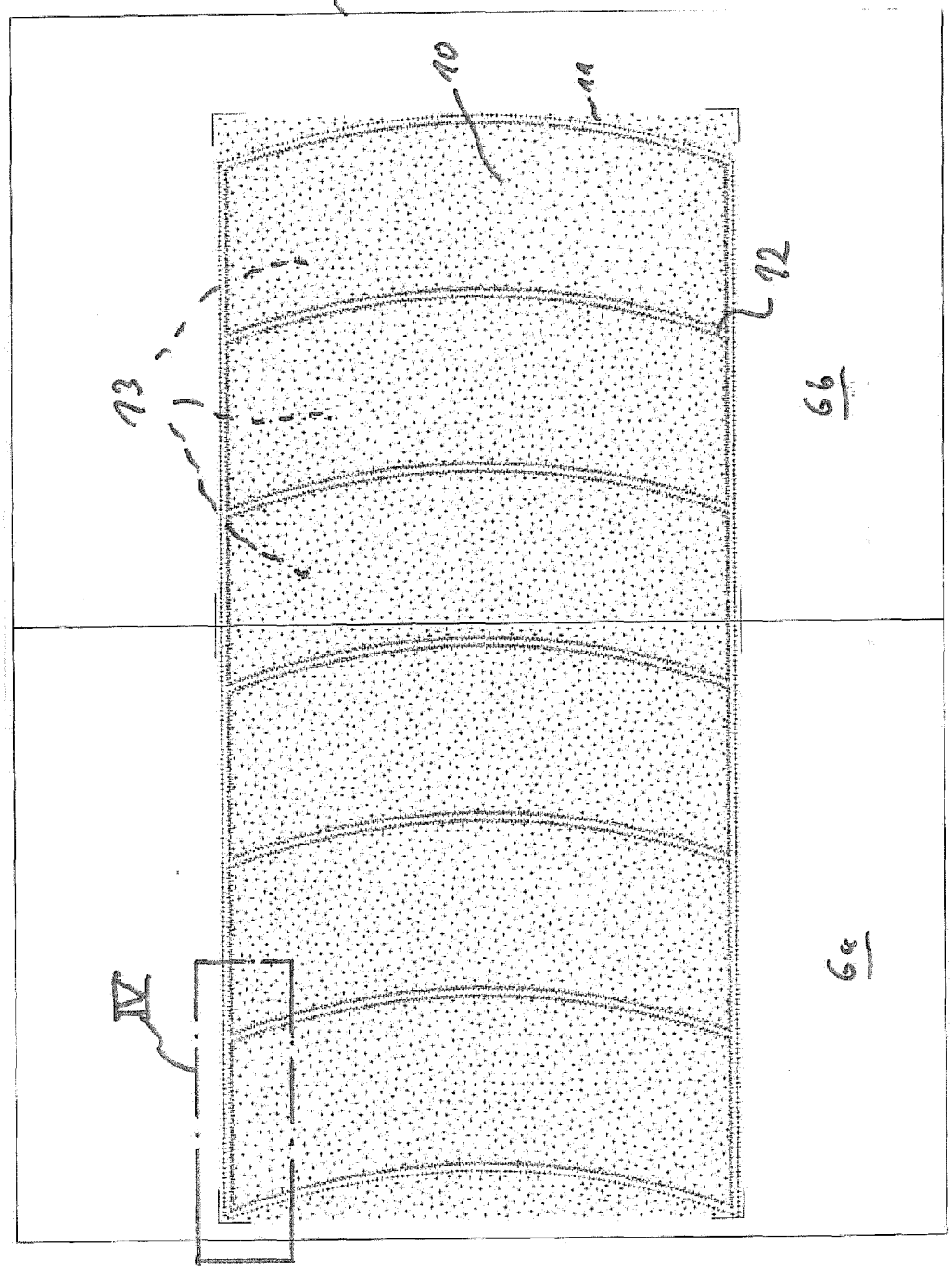
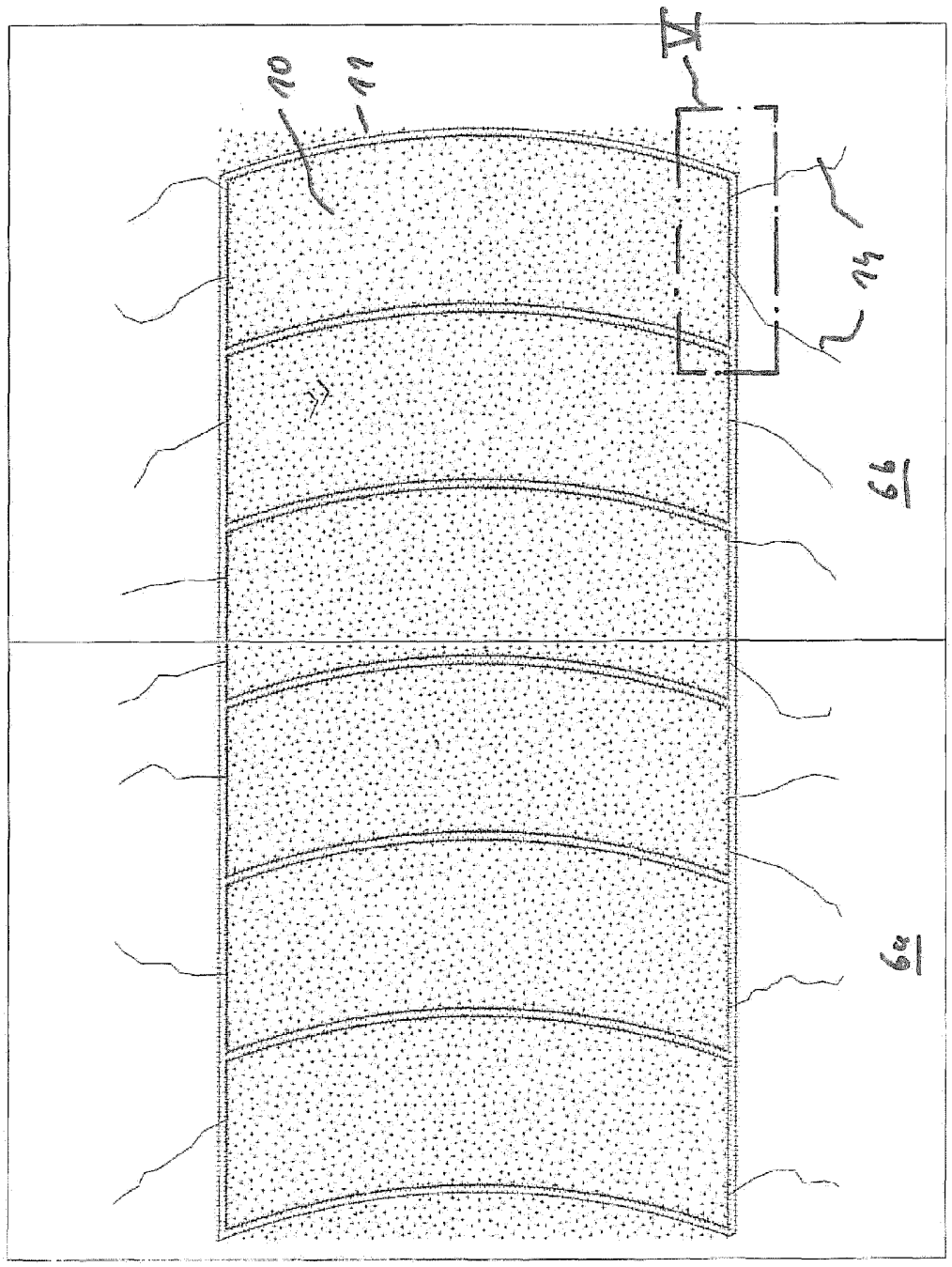


Fig. 3



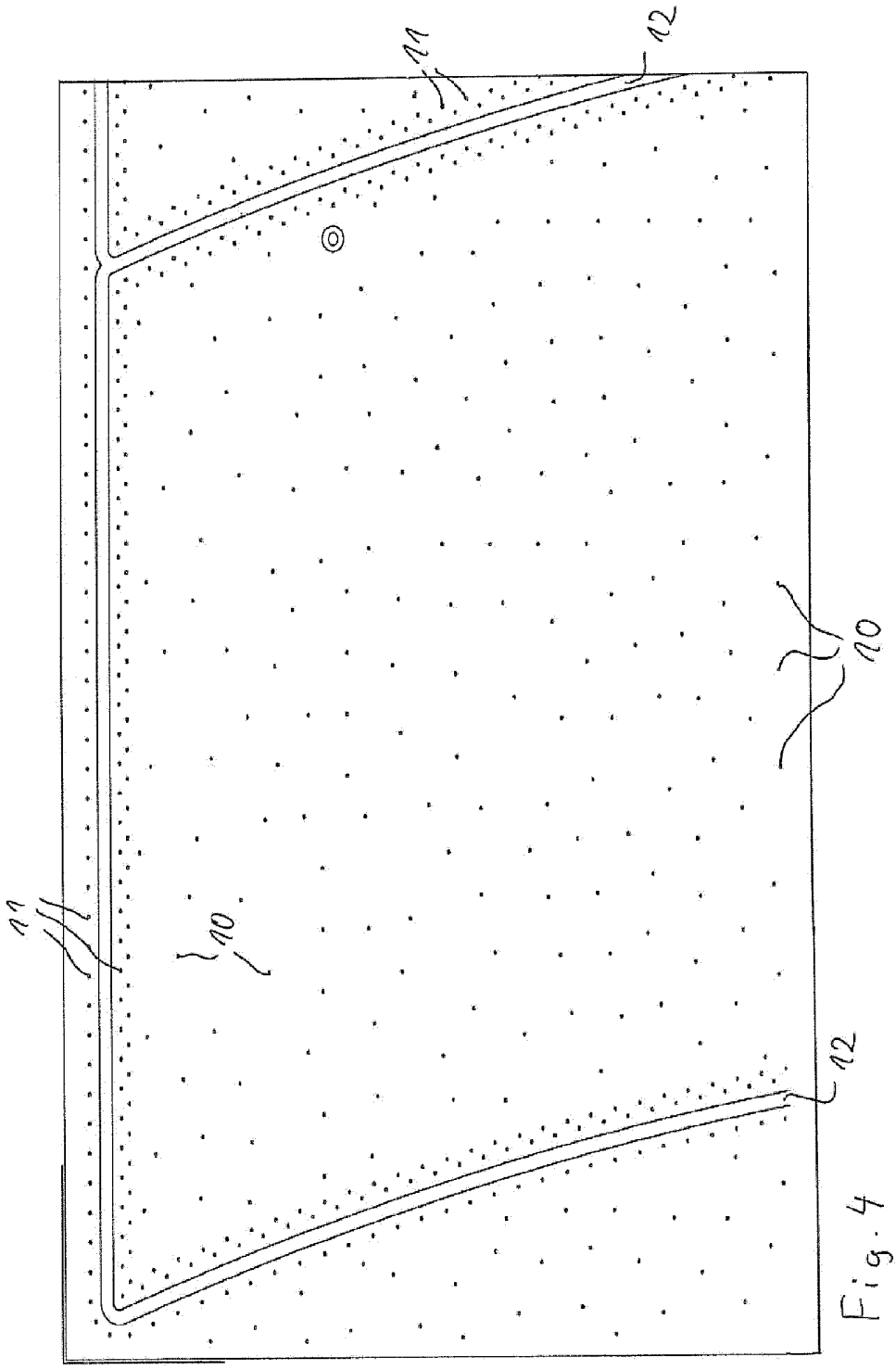


Fig. 4

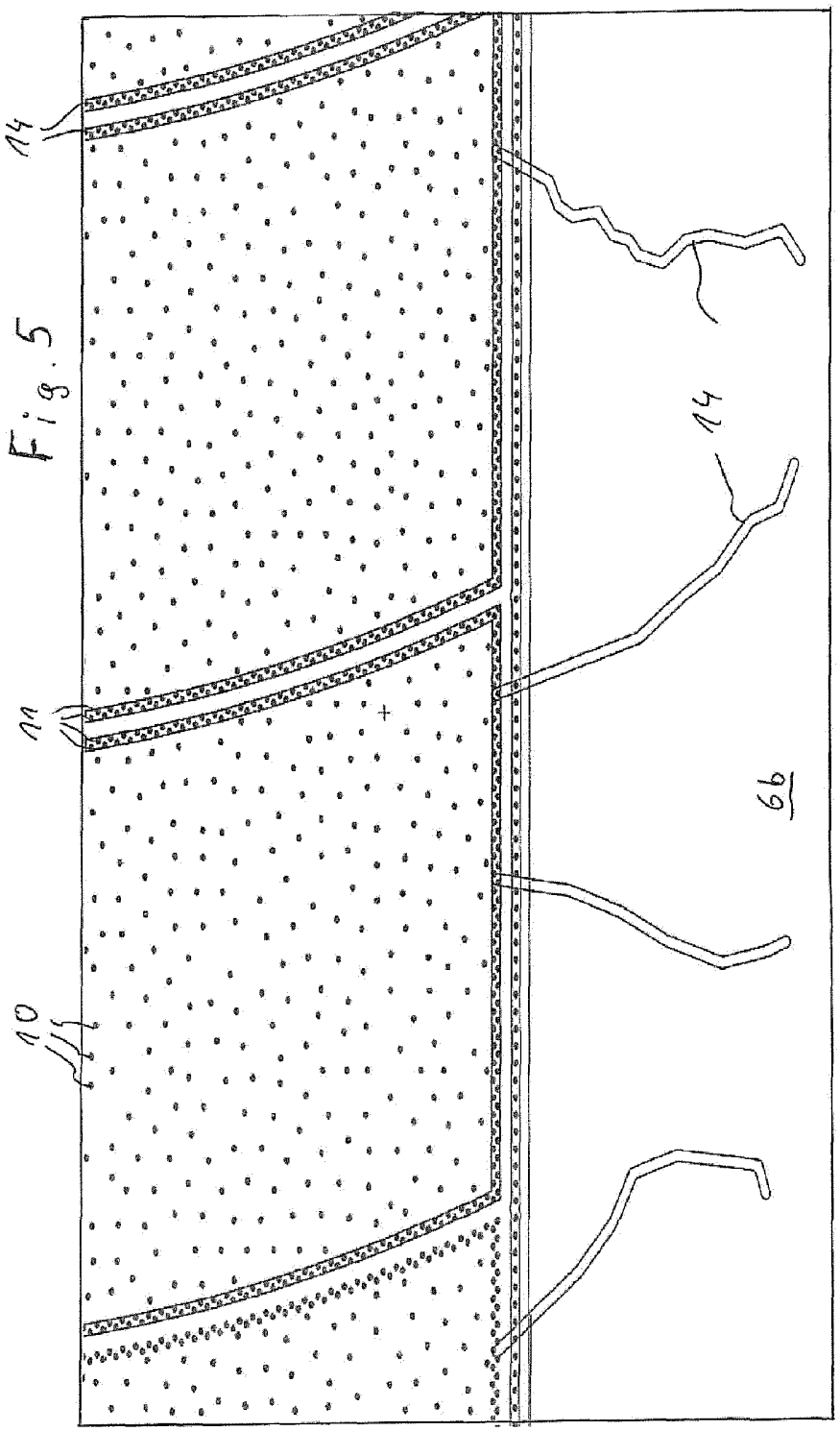


Fig. 5

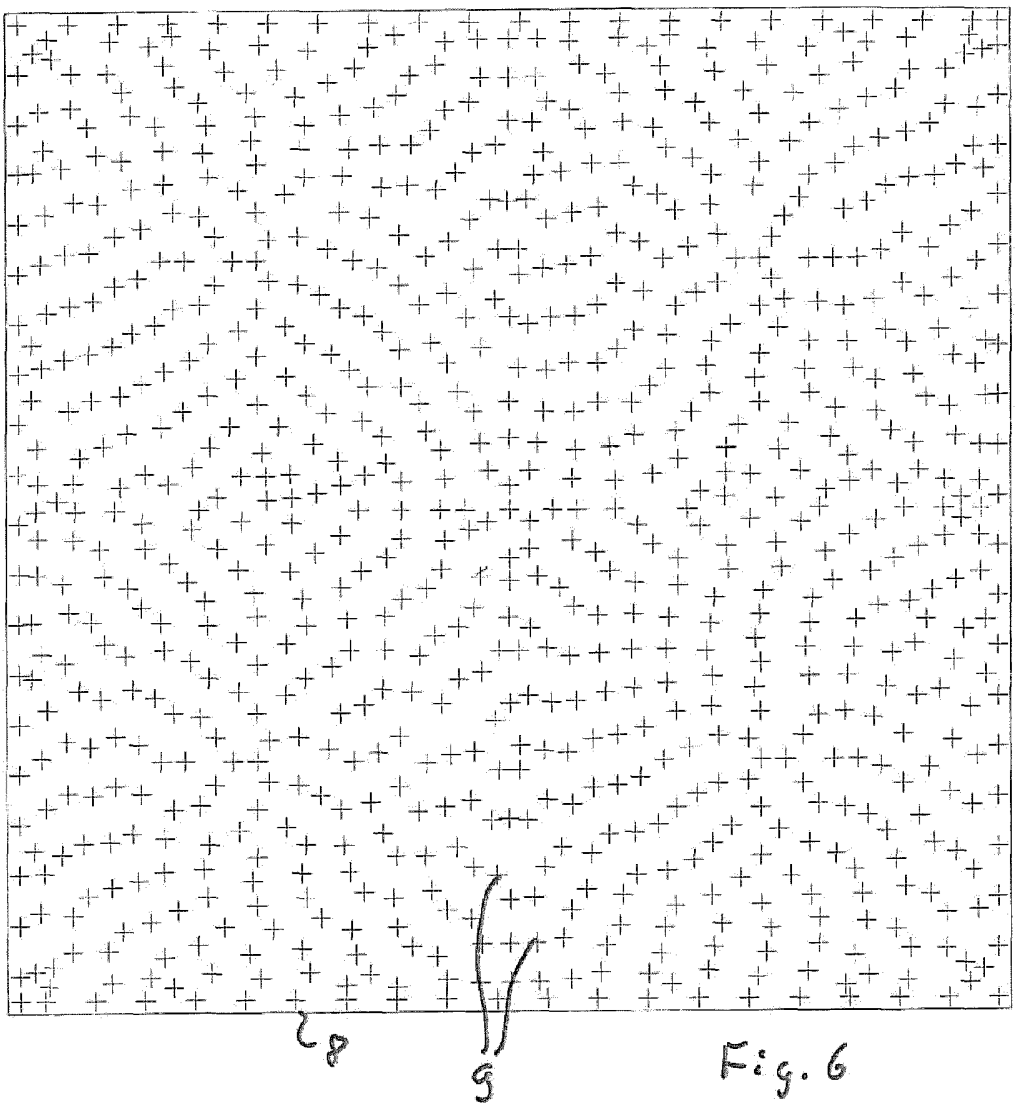


Fig. 6