METHOD OF PRODUCING
INDIVIDUALIZED VEHICLE PARTS,
PARTICULARLY INDIVIDUALIZED
VEHICLE BODY SKIN PARTS CONSISTING
OF SERIES-PRODUCED VEHICLE BODY
SKIN PARTS, AS WELL AS VEHICLE BODY
SKIN PARTS MANUFACTURED BY THIS
METHOD

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ABSTRACT
A method for producing vehicle parts is provided, particularly shell parts for vehicles, according to which a three-dimensionally preformed semi-finished or finished standard part, especially a standard shell part, is produced for a serially manufactured vehicle type. An individualized part is then produced from the preformed standard part by subsequently embossing a three-dimensional contour into the standard part by use of a mandrel-type reshaping tool which is pressed against the standard part from one side while being displaced relative to the standard part.
METHOD OF PRODUCING INDIVIDUALIZED VEHICLE PARTS, PARTICULARLY INDIVIDUALIZED VEHICLE BODY SKIN PARTS CONSISTING OF SERIES-PRODUCED VEHICLE BODY SKIN PARTS, AS WELL AS VEHICLE BODY SKIN PARTS MANUFACTURED BY THIS METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND AND SUMMARY OF THE INVENTION

[0002] The present invention relates to a method of producing vehicle body skin parts, as well as to a vehicle body skin part produced by this method.

[0003] Vehicle body parts, such as engine hoods, roofs, fenders, side panels, trunk lids, etc. are normally produced by deep drawing from flat starting metal sheets. As known, the tools of deep-drawing presses are very expensive and can, therefore, be used economically only for relatively large piece numbers. In addition, the sheet geometries which can be produced by means of conventional deep-drawing presses are limited with respect to their complexity. However, vehicle designers demand increasingly broader design ranges, which demands cannot always be met by means of conventional deep-drawing tools. Modern vehicle designs are characterized, for example, by transitions between convex and concave component sections, as well as by greatly accentuated characteristic lines or edges with partially very narrow radii of curvature. This already occasionally limits manufacturing possibilities when conventional deep-drawing methods are used.

[0004] The so-called “dieless forming technology”, which is known, for example, from U.S. Pat. No. 6,216,508 B1, uses a completely different approach. As the name indicates, the metal sheet forming takes place in a “dieless” manner; that is, without a mold, in the conventional sense. In the case of the dieless forming, as described in U.S. Pat. No. 6,216,508 B1, a flat sheet metal blank is clamped in its edge area into a holding device. For the forming process, a forming mandrel is used, which is arranged essentially perpendicularly with respect to the clamped-in sheet metal blank and may be moved in the X- and Y-direction. An advancing movement in the Z-direction is possible, either by moving the advancing mandrel or by perpendicularly moving the sheet metal blank clamped in the holding device.

[0005] The basic principle of dieless forming, as known from U.S. Pat. No. 6,216,508 B1, consists of the fact that a flat sheet metal blank, that is, a sheet metal which is not preformed, is formed into a three-dimensional component by use of the forming mandrel. For this purpose, the forming mandrel is pressed against the sheet metal blank. By meandering or spirally moving along the entire sheet metal blank, a three-dimensional sheet metal part can be produced by an incremental advancing of the forming mandrel. In comparison to conventional deep-drawing methods, it is an advantage of this dieless forming method that also very complex component geometries may be produced.

[0006] However, a significant disadvantage of the dieless forming method described in U.S. Pat. No. 6,216,508 B1 is the very long production time. When a large complex sheet metal part, such as a body part for a vehicle, is to be produced from a flat sheet metal blank by this dieless forming method, it is extremely time consuming. In the case of the dieless forming method described in U.S. Pat. No. 6,216,508 B1, the forming mandrel has to move in a meandering or spiral manner along the entire sheet metal blank from one contour to the other, which takes a very long time in comparison to conventional deep drawing. The production of a vehicle body part, for example, of an engine hood, takes a few seconds or fractions of seconds by use of a conventional deep-drawing process. If one were to try to produce such a vehicle body part by the dieless forming method as described in U.S. Pat. No. 6,216,508 B1, this would take several minutes, depending on the component, even up to several hours.

[0007] Another problem occurring during the production of complete components by use of the dieless forming method is the fact that very considerable changes occur in the crystal structure of a metal sheet during the incremental deformation of the metal sheet, that is, during a “track-by-track” deformation. Tests have shown that often considerable roughnesses occur in case of more complex vehicle body parts, which are produced from flat, that is, not preformed, starting metal sheets completely by “dieless forming”. The roughnesses of the component surface are frequently so extensive that, as a rule, the sheet metal part cannot be painted immediately after its production but has to be reworked at high expenditures before painting; for example, by a leveling-out and grinding of the surface or by other “smoothing work”. On the whole, the dieless forming technology has been confronted by numerous unsolved problems. The dieless forming process has, therefore, not been successful for use in motor vehicle construction, particularly in the series production of motor vehicle parts.

[0008] As mentioned above, there is the dilemma that arbitrarily complex motor vehicle designs cannot be produced by means of conventional deep-drawing methods. Another problem consists of the fact that, because of the expensive tools, deep-drawing methods are economical only in large-scale productions, that is, starting at certain minimum batch sizes.

[0009] Particularly in the case of premium vehicles, many customers have very specific equipment-related wishes which cannot always be satisfied by means of the conventionally offered special equipment program. Even today, many vehicle manufacturers offer so-called “individual or small-series vehicles” for individual vehicle types. However, with respect to the vehicle body area, these individual or small-series vehicles frequently do not differ, or differ only a little from, the normal production vehicles. The reason is that an individual design of the vehicle body skin so far has not been possible in a cost-effective manner. Today, the “individualization” of such vehicles in comparison to conventional vehicles is frequently limited to the offer of unusual materials for the interior as well as to unusual colors.

[0010] An aspect of the invention is to provide a method by which components, particularly, skin components for
vehicles, and particularly those for small-series or miniseries vehicles, may be produced individually and, at the same time, cost-effectively corresponding to the customer’s wishes, or to provide a body skin part which meets these requirements.

[0011] The present invention meets these needs by providing a method for producing vehicle body parts, wherein a three-dimensionally preformed, semifinished or finished serial part is produced from a starting material for a vehicle model manufactured in a series production. An individualized part is produced from the preformed serial part by way of a mandrel-type forming tool, which is pressed from one side against the serial part and is simultaneously moved relative to the serial part in order to additionally impress a three-dimensional contour in the serial part. Advantageous embodiments and further developments of the invention are described and claimed herein.

[0012] As mentioned above, the basic principle of the dieless forming method is known per se and is described in the initially mentioned U.S. Pat. No. 6,216,508 B1. It is explicitly pointed out that the entire technical content of U.S. Pat. No. 6,216,508 B1 is to be the object of the present patent application even if the present invention is not aimed at the method described in U.S. Pat. No. 6,216,508 B1. Thus, if required, it should be possible to fall back in the examination procedure of the present patent application on all characteristics disclosed in U.S. Pat. No. 6,216,508 B1 alone or in combination with other characteristics of U.S. Pat. No. 6,216,508 B1 or of the present text. The dieless forming method per se therefore does not have to be explained in all details in the present text. Accordingly, applicants expressly incorporate by reference the content of U.S. Pat. No. 6,216,508.

[0013] Although the following description of the invention primarily relates to serial skin parts made of sheet metal, it is explicitly pointed out that the invention is not limited to workpieces made of sheet metal. The invention can basically be used for all types of components, such as structural parts. The invention is also not limited to components made of sheet metal. On the contrary, it is also possible to use the invention for workpieces made of plastic material, particularly parts made of a thermoplastic material or other materials.

[0014] The present invention primarily consists of meeting individual customers’ wishes in that a “serial skin part” is “individualized” by use of a finishing using a “forming tool” which is pressed against the serial skin part and is moved relative to the serial skin part.

[0015] A significant difference with respect to U.S. Pat. No. 6,216,508 B1 consists of the fact that the reworking takes place on a “preformed serial part”, which in its entirety is specifically not produced according to the method described in U.S. Pat. No. 6,216,508 B1, but by another production method, such as deep drawing. Only a partial area, or several partial areas, of this preformed serial part are reworked by use of the above-mentioned forming tool, but not the entire serial part.

[0016] Before the installation into a vehicle body shell, the preformed “serial part”, which may already be a semifinished or finished vehicle body shell part, is additionally impressed by means of a “reworking” with a “geometry” or “contour” deviating from conventional series-produced vehicles. In this manner, characteristic lines, writing patterns, or the like, may be impressed into semifinished or finished vehicle body shell parts, such as front opening hoods, tailgates, doors, side panels, fenders, roofs, etc. In addition, characteristic lines or component edges already present in the serial skin part may be redrawn or deepened and therefore made to be more pronounced than would be possible, or is possible, in the case of the serial skin parts used for conventional series-produced vehicles. By way of such a reworking by using a forming tool, an infinite number of design modifications may be produced from conventional serial skin parts, specifically in a manner which is cost-effective to a degree never before thought possible. In that serial-like vehicles are offered in small series or as individual vehicles, the customers’ wishes for an individualization existing particularly in the case of high-priced vehicles may be met more easily. As a result of such a differentiation, vehicles obtain an individual “design character” and, therefore, are clearly visually different from other vehicles of the respective vehicle type.

[0017] Tests have shown that, in contrast to the production of complete sheet metal parts from flat starting metal sheets by dieless forming, as described in U.S. Pat. No. 6,216,508 B1, in the case of only a reworking of already “preformed” sheet metal parts (serial skin parts), the initially described surface problems do not occur. The reason is that, particularly in the case of a “slight” reworking, for example, when producing characteristic lines or when accentuating already present component structures, only a relatively slight change occurs in the crystal structure of the metal sheet. The surface quality in the area of such characteristic lines, which were produced by a reworking according to the invention, is so good that a high-expenditure surface after treatment, as required in the state of the art, is superfluous. The component may therefore be subjected to the conventional painting process immediately after the reworking.

[0018] The invention is explicitly not limited to the production of skin parts for small-series vehicles or individual vehicles. In the course of their product service life, vehicles are frequently subjected to a “model update”—a so-called “facelift”. Within the scope of model updates, the skin parts of the vehicles are occasionally also updated to a certain extent or made more attractive. Up to now, it has been necessary in this case to procure new pressing tools or correspondingly adapt existing pressing tools to the new design, which is always connected with very high tool costs. By use of the method explained in detail below, it now becomes possible to update or rework vehicle skin parts produced by means of the “old” pressing tools. In this manner, additional characteristic lines, elevations, etc. may be impressed into the “old” skin parts, which permits a “model facelift” at significantly lower costs than previously.

[0019] Another significant advantage of the invention consists of the fact that a corresponding “reworking station” may be integrated without any problem into an existing production line. Serial parts which are intended for individual vehicles or for individualized vehicles are reworked in the “reworking station”. Serial parts for conventional series-produced vehicles pass through the reworking station without being reworked. Naturally, a reworking according to the invention is also contemplated outside the production line in separate working stations.
As mentioned above, the basic principle of the method according to the invention consists of impressing a three-dimensional contour into a sheet metal part by use of a forming tool which may, for example, have a mandrel-type design. In the following, the forming tool is also called a “forming mandrel” which, however, should not be understood to be limiting with respect to a certain tool shape.

During the reworking of a component, the “forming mandrel”, by means of its end, which may be constructed, for example, as a point or as a rounded tip, is pressed against the component. Simultaneously, the component and the forming mandrel are displaced relative to one another. As a result, corresponding to the geometry of the end of the forming mandrel and as a function of the contact pressure force as well as the “clamped-in or supported condition” of the component to be worked, a “shaping-in or shaping-out” or very generally a three-dimensional contour is produced. The contour to be produced may, for example, have the shape of a groove, of an elevation, or another shape.

The invention comprises a “one-curve reworking” as well as to, at a certain extent, an “incremental reworking”.

During the “one-curve reworking”, the forming tool used is applied to the component to be reworked, is pressed against the component, and is subsequently moved in a single movement relative to the component. The reworking therefore takes place in that the forming tool is moved “in one pass”, whereby the desired geometry, for example, an elevation, a characteristic line, or the like, is impressed into the component.

In contrast, during the “incremental reworking”, the forming tool is moved several times relative to the component to be reworked and is applied incrementally. A geometry, such as an elevation, produced in a first reworking operation, may be deepened, that is, be made more pronounced, by a corresponding application movement—essentially perpendicular to the component to be reworked—in another reworking operation. As an alternative or in addition, a geometry, such as an elevation, produced by a first reworking operation may be “broadened” and in this manner made more pronounced by a slight displacement of the forming tool relative to the component and essentially transversely to the moving direction of the first reworking operation. By a meandering guidance of the forming mandrel or by a repeated moving-along on “reworking trajectories” situated closely side-by-side, larger three-dimensional shaped-out sections, such as pronounced intake channels, of the “power domes” of an engine hood, or very generally structural elevations may also be produced.

However, as mentioned above, the invention is not directed, as in U.S. Pat. No. 6,216,508 B1, to the production of complete vehicle body parts by the dieless forming method. This would be much too time-consuming and uneconomical. On the contrary, the present invention consists of the “additional” working or individualization of individual areas of semifinished or finished components, particularly body shell parts.

In this context, “finished” means that the body shell part would be finished for a painting operation, but before that painting operation is reworked in one component area or in several component areas. However, in principle, it is also contemplated to “individualize” or differentiate already finished painted serial body skin components by a reworking according to the invention. “Semifinished” means that, after the reworking according to the invention, the body shell part is reworked further; for example, by after treating the surface, trimming or edging of component edges, drilling of holes, threading, or the like, and is painted only subsequently.

Before the reworking according to the invention, the serial skin part or the body shell part is clamped into a holding device. The holding device may, for example, be formed by a plurality of individual “holding points” or “holding sections”. It is also contemplated to use suction-cup-type holding elements. Suction-cup-type holding elements have the advantage that the danger of damage to the body skin sheet metal part, particularly the danger of damaging the component surface, during the clamping-in and during the working is reduced because the workpiece is not clamped between two holding elements, but rather is fixed by a vacuum.

Preferably, the workpiece, that is, the serial body skin part, is clamped in before the reworking in such a manner that its geometry in the edge area is not changed by the reworking. In other words, connection measurements or gap measurements, which occur during the later installation of the body skin parts into a vehicle body, should not be changed by the reworking in comparison to the “normal series-produced vehicle”.

Depending on the complexity of the component geometry to be produced “additionally”; during the reworking, the series-produced body skin part may be held either exclusively by means of a holding device, for example, in its edge area, in the case of more complex component geometries or in the case of three-dimensional contours, which have a considerable surface gradient, particularly in the case of relatively “sharp” edges, one or more counterholders or supported elements may be used. Such counterholders or supporting elements are pressed from the side situated opposite the forming mandrel, that is, “from behind” against the series-produced body skin part. Edge-shaped or curved “supporting elements” may be used as the counterholders. As an alternative thereto, the counterholder may also have the shape of a “die”, which has a “negative shape” corresponding to a three-dimensional contour to be produced. However, the use of such a counterholder is not a necessity.

If two counterholders are used, one counterholder is preferably arranged in the moving direction of the forming tool on the left beside the geometry to be produced, and the other counterholder is preferably arranged on the right beside the geometry to be produced. Even the selection or the change of the mutual spacing of the counterholders and the lateral distance of the counterholders from the geometry to be produced can influence the shape of the geometry to be produced, which will be explained in detail below.

The forming mandrel may, for example, have a smooth, convexly curved tool tip. It may be symmetrical or asymmetrical. The tool tip may also be formed by a rotatably disposed ball which rolls on the series-produced skin part during the working of the series-produced skin part, whereby the mechanical stressing of the series-produced skin part is reduced in the forming area. As an alternative, a “rolling mandrel” may also be used, in the case of which the tool tip is formed by a wheel or by a roller. Multiple
mandrels or multiple-armed mandrels may also be used. However, the forming mandrel must not necessarily have a round or rounded tip. On the contrary, a forming mandrel with a relatively sharp-edged tip may also be used. As an alternative, the tip may also end flatly, be wheel-shaped, plow-shaped or similar to a hull shape. A forming mandrel with a faceted tool tip is also contemplated.

[0032] The forming mandrel also does not necessarily have to consist of steel or tool steel. Forming mandrels made of a plastic material, of wood, ice, sand, concrete or other materials are also contemplated. The tool tip of the forming mandrel may be hardened, unhardened, coated or uncoated. It may, for example, be provided with a wear-resistant single or hybrid coating. In this case, the forming mandrel may be guided in up to six axes relative to the component in order to achieve the desired “forming result”. During the reworking, the forming mandrel or the tool tip of the forming mandrel may be rotated or oscillated also about the longitudinal axis of the forming mandrel.

[0033] A forming mandrel with or without lubrication may be used. A lubricating system may, for example, be integrated in the forming mandrel. The lubricating system may also be arranged on the outside on the forming mandrel. The lubrication system ensures that the “working point”, that is, the point at which the forming mandrel touches the series-produced skin part, is continuously supplied with sufficient lubricant. A lubricating oil may be used as the lubricating fluid.

[0034] In addition, a forming mandrel may be used whose tool tip can be adjusted during the working operation. It may, for example, be provided that the width of the tool tip can be changed transversely to the moving direction of the tool mandrel during the working operation. In this manner, geometries of a variable “broadness” may be produced in a single operation.

[0035] The moving speed at which the forming mandrel is moved during the reworking relative to the series-produced vehicle body skin part does not have to be constant. On the contrary, the moving speed may be varied as a function of the momentary “degree of deformation” of the series-produced skin part. At lower degrees of deformation, a high moving speed can be selected; at higher degrees of deformation, a lower moving speed can be selected.

[0036] During the working, the forming mandrel as well as the “workpiece” may be heated or cooled or have an ambient temperature, if required. In the case of series-produced vehicle body skin parts made of sheet metal, but mainly in the case of “workpieces” made of a plastic material, it may be advantageous to heat the forming mandrel or the tool tip of the forming mandrel during the working of the series-produced skin part. A heating of the forming mandrel results in a feeding of heat into the area of the workpiece to be formed, whereby its ductility is increased, which facilitates the forming. Particularly in the case of plastic parts, this facilitates the forming.

[0037] As an alternative or in addition thereto, the series-produced skin part may also be preheated or heated directly during the reworking. The series-produced skin part may be heated by hot air, heat radiators, lasers or by another heat source. Series-produced vehicle body skin parts may be preheated during the reworking to barely below a material-specific “softening temperature” and/or may be heated by means of a heated forming mandrel or a point-type additional heating at the intervention point locally to a suitable “forming temperature”.

[0038] Before the reworking, the workpiece may also be pretreated by other methods. It can, for example, be irradiated, coated, etched, hardened, roughened, smoothed, polished, sprayed with a lubricating liquid or ground. It can also be pretreated by sand-blasting before the reworking.

[0039] The reworking of the series-produced vehicle skin part preferably takes place in a fully automatically controlled manner. The forming mandrel may either be constructed as a working tool of a CNC machine tool, similar to U.S. Pat. No. 6,216,608 B1, or may be arranged on an arm of a correspondingly programmed working robot. Naturally, such a “working station” may also have additional “tools”, such as a laser cutting device, by means of which the body skin part may additionally be trimmed.

[0040] Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041] FIG. 1 is a view of a vehicle body skin part having a form elevation, which was produced by a reworking according to the invention;

[0042] FIGS. 2, 3 are sectional views of the vehicle body skin part of FIG. 1;

[0043] FIG. 4 is a view of the basic principle of the reworking of a series-produced vehicle body skin part according to the invention;

[0044] FIG. 5 is a view of the basic principle of the reworking according to the invention when using a die-type counterholder;

[0045] FIGS. 6 to 8 are various cross-sectional views of a form elevation impressed additionally into a prefabricated component;

[0046] FIGS. 9 to 11 are views of embodiments in which the component to be reworked is supported by counterholders;

[0047] FIG. 12 is a schematic representation of a possible movement of the forming tool;

[0048] FIG. 13 is a view of an embodiment in which a front opening hood is reworked; and

[0049] FIG. 14 is a view of a die-type counterholder.

DETAILED DESCRIPTION OF THE DRAWINGS

[0050] FIG. 1 illustrates a series-produced vehicle body skin part 1. The series-produced body skin part 1 of FIG. 1 is an “outer door skin”. A form elevation 2 was “additionally” formed into the series-produced vehicle skin sheet metal part 1, which will be explained in detail in connection with the following figures.

[0051] FIG. 2 is a sectional view of the skin part 1 of FIG. 1 along the intersection line A-A. The form elevation 2 has a length l and a depth t. The depth t of the form elevation 2
has its maximum in the area of the z-axis of FIG. 2 and decreases toward the ends of the form elevation 2.

[0052] FIG. 3 is a cross-sectional view of the vehicle body skin part 1 along the intersection line B-B of FIG. 1. It is shown that the form elevation 2 is relatively sharp-edged. Very accentuated characteristic lines of this type are difficult to produce or cannot be produced at all by use of conventional deep-drawing methods.

[0053] FIG. 4 schematically describes the reworking operation of the series-produced vehicle body skin part 1. The series-produced body skin part 1 is clamped into a holding device 3 (not shown in detail) or is fixed on a holding device 3. In the embodiment illustrated here, the series-produced vehicle body skin part 1 is fixed on the holding device 3 only in its edge areas. Subsequently, a forming mandrel 4 is guided onto the series-produced skin part 1 and is pressed with a defined contact pressure force against the series-produced body skin part 1. In a next step, the forming mandrel 4 is moved relative to the series-produced vehicle body skin part 1 in the direction of the arrow 5. Simultaneously, an “application movement” of the forming mandrel 4 relative to the series-produced vehicle body skin part 1 takes place, whereby the form elevation 2 is impressed into the series-produced body skin part 1 by way of the tip 6 of the forming mandrel 4.

[0054] FIG. 5 shows an embodiment in which a counter-pressure is applied by means of a die-type counterholder 7 from the side of the series-produced vehicle body skin part 1 situated opposite the forming mandrel 4. Thus, the series-produced body skin part 1 is supported by the die-type counterholder 7, which permits the production of a sharp-edged contour, as illustrated in FIG. 5, without any problem. The die-type counterholder may be a component-specific tool or a “universal tool”, which may also be used for the individualization of other series-produced body skin components.

[0055] FIGS. 6 to 8 are different cross-sectional views A-A, B-B and C-C, respectively, of a form elevation 2 additionally impressed into a series-produced skin part 1.

[0056] FIG. 6b is a cross-sectional view along the intersection line A-A. FIGS. 6a, 6b illustrate an embodiment in which a very accentuated form elevation 2 was additionally impressed in the series-produced skin part 1, the “tip” of the form elevation 2 being slightly rounded.

[0057] FIG. 7b is the cross-sectional view B-B. In this area, the form elevation 2 is less accentuated. In comparison to FIG. 6b, the “tip” of the form elevation 2 has a greater radius of curvature.

[0058] FIG. 8b is the cross-sectional view C-C. In this area, the form elevation 2 is again more accentuated. Similarly to FIG. 6b, the “tip” of the form elevation 2 has a relatively small radius of curvature.

[0059] FIG. 9 illustrates an embodiment in which, during the reworking, the series-produced skin part 1 is supported by two essentially equally wide counterholders 8, 9 from the side situated opposite the forming mandrel 4. Reference number 1 indicates the contour of the series-produced skin part before the reworking. Here, the “tip” of the forming mandrel 4 is more accentuated than in the case of the forming mandrel 4 illustrated in FIG. 10. The counterholder 8 is arranged at a distance L1 from the “center” of the form elevation to be produced or from the tip of the forming mandrel 4; the counterholder 9 is arranged at a distance L2. The counterholders 8, 9 therefore have a spacing L3 which is equal to the sum of the spacings L1 and L2. Here, L1 is smaller than L2. The supporting therefore takes place asymmetrically with respect to the position of the tip of the forming mandrel 4. By changing the spacings L1, L2 and L3 respectively, the supporting or clamping-in condition of the series-produced skin part 1, and therefore, also the form of the form elevation to be produced may be changed.

[0060] FIG. 10 shows an embodiment in which the counterholder 8 is wider than the counterholder 9. Here, the supporting with respect to the tip of the forming mandrel 4 takes place only slightly asymmetrically. The reason is that L1 is only slightly larger than L2. In comparison to FIG. 9, the tip of the forming mandrel 4 is more blunt here, which results in a correspondingly less accentuated form elevation.

[0061] FIG. 11 shows an embodiment in which the counterholders 8, 9 are arranged at a relatively small mutual distance L3. This permits relatively large degrees of deformation and, as illustrated in the drawing, the production of a relatively strongly accentuated form elevation.

[0062] FIG. 12 shows the moving path of the forming mandrel on the example of a series-produced vehicle skin part 1, such as an engine hood, into which two characteristic lines 2a, 2b are impressed. From a point 10 in space, which is here called the “starting point” of the forming tool, the forming tool (not shown) is first lowered onto the series-produced skin part 1. Pressed against the series-produced skin part 1 while a suitable contact pressure force is applied, the forming tool is then moved along the characteristic line 2a to be produced. After the production of the characteristic line 2a, the forming tool is lifted and reaches the point 11 in space. From there, the forming tool is moved to point 12 in space. Subsequently, it is again lowered to the series-produced skin part 1 and is moved along the characteristic line 2b to be produced. After the production of the characteristic line 2b, the forming tool is lifted and reaches point 13 in space.

[0063] FIG. 13 shows the “engine hood” of FIG. 12 after the production of the characteristic lines 2a and 2b. In addition, according to the same method, a center elevation 2c was impressed into the engine hood metal sheet, which elevation 2c protrudes upward out of the engine hood, similar to the illustration in FIGS. 6 to 8.

[0064] FIG. 14 shows a die 14 which can be used for producing a form elevation, such as the form elevation 2c of FIG. 13. The die 14 is pressed against the series-produced body skin part (not shown here), specifically from the side situated opposite the forming tool 4. The die 14 is provided for the partial supporting of the forces exercised by the forming tool 4 upon the series-produced body skin part. Similar to FIG. 14, the die 14 may be U-shaped; that is, open on one side. As an alternative, it may also be closed which is comparable to a plate with an oblong hole. However, the invention is not limited to a certain die form but covers all die forms.

[0065] As illustrated in FIG. 14, the inner edge of the die 14 is flattened diagonally toward the interior in the “inlet area” of the forming tool 4. In contrast, in the lateral areas
of the die 14, the inner edge is essentially perpendicular to the supporting surfaces 17, 18 of the die 14, which supporting surfaces 17, 18 press “from the rear” against the series-produced body skin part during the reworking operation and in the process support the forces exercised by the forming tool. For the purpose of completeness, the moving path 19 of the forming tool should also be mentioned, which extends essentially in the center with respect to the two legs of the die 14.

[0066] The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.

What is claimed is:

1. A method of producing a vehicle part, the method comprising the acts of:

producing, from a starting material, a three-dimensional preformed serial part for a vehicle model manufactured in a series production, the preformed serial part being at least one of a semi-finished and finished serial part for the vehicle model manufactured in the series production;

pressing a mandrel-type forming tool against one side of the preformed serial part and simultaneously moving the mandrel-type forming tool relative to the serial part to impress an additional three-dimensional contour in the serial part to produce an individualized part from the serial part.

2. The method according to claim 1, wherein the individualized vehicle part produced is at least one of a vehicle body skin part and a series-produced vehicle body skin part.

3. The method according to claim 2, wherein the starting material is a metal sheet, and the serial part, as well as the body skin part to be produced therefrom, each are sheet metal parts.

4. The method according to claim 2, wherein the starting material is a plastic material, and the serial part, as well as the body skin part to be produced therefrom, each are plastic parts.

5. The method according to claim 2, wherein the starting material is a thermoplastic material.

6. The method according to claim 4, wherein the starting material is a thermoplastic material.

7. The method according to claim 2, wherein the series-produced body part is held by a holding device in edge areas of the series-produced body part during deforming by the mandrel-type forming tool.

8. The method according to claim 7, wherein the holding device has a plurality of holding points.

9. The method according to claim 8, wherein the holding points are each formed by a suction-cup-type holding element, which hold the serial part via a vacuum.

10. The method according to claim 7, wherein the serial part is held during deforming by the mandrel-type forming tool exclusively in its edge areas by the holding device and is neither supported nor otherwise held in the component areas situated in-between.

11. The method according to claim 7, wherein the serial part is held by the holding device during deforming by the mandrel-type forming tool and, in a component area situated in-between, is supported at least at one point by a counterholder, which is arranged on the side of the serial part situated opposite the mandrel-type forming tool.

12. The method according to claim 11, wherein the counterholder is a die-type component which acts as a negative mold with respect to the three-dimensional contour to be produced.

13. The method according to claim 1, wherein the mandrel-type forming tool has a smooth, convexly curved tool tip.

14. The method according to claim 1, wherein the tool tip of the mandrel-type forming tool is formed by a rotatably disposed ball, which rolls on the serial part during the working of the serial part.

15. The method according to claim 1, wherein the mandrel-type forming tool has an adjustable tool tip whose width transversely to the moving direction of the mandrel-type forming tool is changed relative to the serial part during the working operation.

16. The method according to claim 1, wherein the mandrel-type forming tool is heated during deforming of the serial part at least in an area of the tool tip.

17. The method according to claim 1, wherein the serial part is heated by a heat source during deformation.

18. The method according to claim 1, wherein the forming tool is rotated about a longitudinal axis of the forming tool during deformation of the serial part.

19. The method according to claim 1, wherein the forming mandrel is oscillated about an longitudinal axis of the forming mandrel during deformation of the serial part.

20. The method according to claim 1, wherein design-relevant, line-type characteristic contours are impressed into the serial part by use of the mandrel-type forming tool.

21. The method according to claim 1, wherein the serial part is a pressed piece, which is produced by using a mold-type tool.

22. The method according to claim 1, wherein the serial part is a sheet metal part produced by deep drawing.

23. The method according to claim 1, wherein a contour already existing in the serial part is redrawn or deepened by reworking with the mandrel-type forming tool.

24. The method according to claim 1, wherein the serial part is one of a front opening hood, a tailgate, a door, a side part, a fender, or a roof.

25. The method according to claim 1, wherein the mandrel-type forming tool is arranged on an arm of a robot.

26. The method according to claim 1, wherein the mandrel-type forming tool is part of a CNC machine tool.

27. The method according to claim 1, wherein, during working of the serial part, the mandrel-type forming tool rotates about its longitudinal axis, whereby a drilling-friction type contact occurs at a tip of the forming mandrel and the serial part.

28. The method according to claim 1, wherein, during deformation, the serial part is held such that its geometry in its edge areas is not changed with respect to its starting condition.

29. The method according to claim 28, wherein connection measurements or gap measurements, which occur during a later installation into a vehicle body shell, do not change with respect to the serial part in its starting condition.
30. The method according to claim 1, wherein the three-dimensional contour to be additionally produced in the serial part is produced by a one-time moving of the mandrel-type forming tool in a single pass.

31. The method according to claim 1, wherein the three-dimensional contour to be additionally produced in the serial part is produced by a repeated moving and incremental application of the mandrel-type forming tool.

32. The method according to claim 31, wherein the mandrel-type forming tool is applied from one reworking pass to the next reworking pass essentially perpendicularly with respect to the serial part, so that the contour is deepened from one reworking pass to the next.

33. The method according to claim 31, wherein, from one reworking pass to the next reworking pass, the mandrel-type forming tool is applied essentially transversely to the moving direction of the forming tool, so that the contour is widened from one reworking pass to the next.

34. The method according to claim 32, wherein, from one reworking pass to the next reworking pass, the mandrel-type forming tool is applied essentially transversely to the moving direction of the forming tool, so that the contour is widened from one reworking pass to the next.

35. A vehicle body skin part which is produced from a serial part according to the method of claim 1.

36. A vehicle body skin part according to claim 35, wherein the serial part is made of sheet metal.

37. The vehicle body skin part according to claim 35, wherein the serial part is made of a plastic material.

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