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(54) **Process for manufacturing of an elongated metal beam used as a vehicle body component and manufacturing stand to perform such process**

(57) The invention relates to a process for manufacturing of an elongated metal beam (1) used as a vehicle body component, wherein the finished metal beam (1) has a width and/or height varying in its lengthwise direction. In this process in the course of a relative movement of a counter die (3) on the one hand and a profiling machine (7) with profiling means (7b) on the other hand a

semi-shaped portion (2d) of a semi-finished metal beam (2) is profiled towards a contoured buttress face (6) of the counter die (3) which extends in the lengthwise direction of the metal beam (2). The contour of the buttress face (6) conforms to the shape of the finished metal beam. Apart from this general process a manufacturing stand allowing to work this process is disclosed as well.

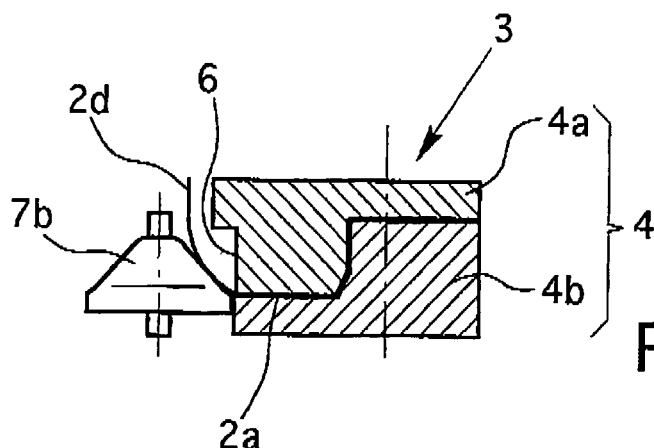


Fig. 3b

Description

[0001] The invention relates at first to a process for manufacturing of an elongated metal beam used as a vehicle body component, wherein the finished metal beam has a width and/or height varying in its lengthwise direction. Insofar this is the subject matter of claim 1. Further, the invention relates to a manufacturing stand for performing such a manufacturing process. This is the subject matter of independent product claim 17.

[0002] Elongated metal beams are widely used as vehicle body components at different locations of the vehicle body. One important example of such an elongated metal beam is a side impact protection beam within the side door of the passenger compartment of a motor vehicle. However, other locations for elongated metal beams are well known, like longitudinal support beams for the vehicle body, bumper cross beams, dashboard reinforcement beams or the like.

[0003] Elongated metal beams as vehicle body components may be manufactured from steel sheet or strip material as well as light metal sheet or strip material, in particular aluminum sheet or strip material. So the present invention covers all types of metal sheet or strip material.

[0004] For many applications it is necessary or recommended to use high strength steels or ultra high strength steels to provide the required strength of the metal beam. Manufacturing of an elongated metal beam from high strength or ultra high strength steel is a complicated process. In particular deep drawing is a manufacturing method that is not well suited to the demands of manufacturing for such high strength material.

[0005] As far as high strength and ultra high strength steels are concerned details may be obtained from ThyssenKrupp-publications on their website, in particular "Forming properties of high-strength and ultra high-strength multi-phase steels"; available here since October 11, 20Q5).

[0006] Generally it is desirable to provide a more or less continuous manufacturing process. Insofar roll forming of a planar strip of metal sheet material with a predetermined width is an advisable and cost-effective process.

[0007] Conventional manufacturing stands for a continuous manufacturing process comprise a profiling machine, preferably a roll-forming machine, that is able to form a roll-formed section from a metal strip material that has a constant cross-sectional configuration in the lengthwise direction. This can be practiced in by-the-piece processes as well as continuous processes. Conventional profiling machines do not provide for making special-purpose sections to end with a finished metal beam that has a width and/or a height that varies in its lengthwise direction. However, this kind of metal beams are particularly useful for application as vehicle body components.

[0008] For example, a demand for a side impact pro-

tection beam is that the ends of the elongated metal beam should have reduced cross sections so that the metal beam may be connected to a surrounding framework of the side door. This is only one example where a width and/or a height varying in the lengthwise direction is advantageous or even compulsory.

[0009] Varying cross-sections for elongated metal beams used as vehicle body components can be achieved by a manufacturing process where a planar strip of steel is stamped in sections so that at least two sections are mutually displaced vertically with respect to the longitudinal extension of the strip. After stamping the profile is bent so that the mutually displaced sections present a different cross section. The elongated metal beam shows an essentially U-shaped cross section with two different heights in the segment with full cross section and the segment with reduced cross section. Finally the edges of the U-shaped arms of the two sections are cut to substantially the same height (EP-B-1 344 583).

[0010] A further prior art process for manufacturing of elongated metal beams used as vehicle body components leads to metal beams with freely varying width and/or height in the lengthwise direction (US-A-4,558,577). This prior art forms the starting point of this invention.

[0011] In above mentioned prior art the result is achieved by using a roll-forming machine with a stationary row of profiling stands in the form of roll-forming stands positioned along a conveyor line for the metal strip material. Each roll-forming stand is equipped with roll-forming means transversely movable by drive means individually.

[0012] In this prior art process a metal strip material from a coil is fed to drive rollers of a straightener. Following the straightening step the strip is passed to a slitter where the strip is longitudinally cut to reflect an alternating width lengthwise thereof. As an alternative it is possible to eliminate the slitter at this position and use a steel strip material of constant width. Then some kind of trimming of the edges of the finished metal beam must follow at a later stage of the process.

[0013] In this prior art, if a by-the-piece process is practiced, the step of cutting the strip material into length will follow. In a continuous process the strip is now fed into the roll-forming machine on the conveyor line. The roll-forming stands of the roll-forming machine provide bending of the initially plan material through an angle per pass according to the required forming pattern. The pass size is enlarged or reduced by drives of the roll-forming stands effectively moving the profiling means transversely under command from a control unit. The signals from the control unit are interrelated with the speed of the roll-forming process and the distance from a particular point of the metal strip to a corresponding roll-forming stand.

[0014] Whereas the above explained prior art process (US-A-4,558,577) is convincing as far as the result at the finished metal beam is concerned, namely a freely variable width and/or height of the finished product, the

requirements for the equipment are high. Each roll-forming stand in the row of roll-forming stands of the roll-forming machine needs individual, precisely controllable drive means for the necessary continuously varying transverse position of the profiling means of the particular profiling stand.

[0015] Now, it is the object of the present invention to provide a process for manufacturing a finished metal beam with a width and/or height varying in its lengthwise direction that is highly economical and needs less complicated equipment than the prior art process. Along with that the object of the present invention is further directed to a corresponding manufacturing stand to perform such a process.

[0016] Above mentioned object is achieved by a process comprising the features of claim 1.

[0017] The above mentioned object is further achieved by a manufacturing stand comprising the features of claim 17,

[0018] Modifications, improvements or specifications of the method and the manufacturing stand may be obtained from the respective dependent claims.

[0019] The steps of the inventive manufacturing process are the following:

- a) receiving a semi-finished metal beam from a preceding manufacturing step,
- b) fixedly positioning the semi-finished metal beam with a fixing portion thereof that extends over about the complete length of the semi-finished metal beam in a counter die of a manufacturing stand so that at least one semi-shaped portion that also extends over about the complete length of the semi-finished metal beam adjacent to the fixed portion thereof is free to be deformed relative to the counter die,
- c) moving the counter die with the fixed semi-finished metal beam in the lengthwise direction relative to a profiling machine with at least one profiling means and/or vice versa,
- d) in the course of the relative movement in the lengthwise direction in step c) and by the profiling means of the profiling machine, bending the semi-shaped portion towards a contoured buttress face of the counter die extending in the lengthwise direction, the contour of the buttress face conforming to the shape of this portion of the finished metal beam that finally results in the varying measure of the finished metal beam in this dimension,
- e) removing the metal beam from the counter die, and
- f) optionally, moving the metal beam to the next manufacturing step.

[0020] The term "finished metal beam" means a product that is finished with regard to the described process step. This does not exclude the possibility that the metal beam is subject to further manufacturing process steps like trimming, heat treatment, surface treatment, addi-

tional cutting, boring, riveting or of course stacking, packing, binding or the like.

[0021] The term "extending over about the complete length" means that a small length difference is of no importance. Moreover, a smaller length of the semi-finished metal beam than the available length for fixing in the counter die is no problem to the inventive process, while a much greater length means at least that there is no buttress face available for the part of the beam extending lengthwise beyond the counter die.

[0022] The inventive process shows a combination of a die forming process with a profiling, in particular a roll-forming process. For this the relative movement of the counter die and the profiling machine in the lengthwise direction is important, whereas for the basic idea of the process it is not important which part of the manufacturing stand is the moving part and which is the stationary one, or if both parts are moving relative to each other. However, in practice it has been proven to be an interesting option to move the profiling machine relative to the stationary counter die.

[0023] Whereas all types of profiling machines with all kinds of profiling means are generally available for the present process it has been revealed that a particularly useful machine is a roll-forming machine with profiling rolls as profiling means.

[0024] Whereas generally one profiling stand with one profiling means is the minimum requirement for the inventive process, in general it is advisable to have a stepwise bending of the semi-shaped portion towards its final shape by means of a row of profiling stands where the contour of their profiling means is changing stepwise from stand to stand.

[0025] Whereas usually the metal beam removed from the counter die will be immediately transferred to the next manufacturing step, the inventive process covers as well the option that the metal beam is stacked intermediately before being processed in the next manufacturing step later,

[0026] An important aspect of the invention is that the profiling means of the profiling stands need no independent controllable drive means for transverse movement. What they need is some kind of biasing towards the contoured buttress face of the counter die. This biasing force should be controllable to a specific value, and usually the profiling means should be positioned at a particular location in the transverse direction. The first profiling means in the row of profiling stands applies the slightest change of shape of the semi-shaped portion and leaves the semi-shaped portion of the semi-finished metal beam still at a considerable distance from the buttress face. This distance will be defined by the position of the profiling means relative to the buttress face. In the successive following stands the actual surface of the profiling means is positioned closer and closer to the buttress face with the surface of the last profiling means pressing the sheet metal actually onto the buttress face itself.

[0027] The semi-shaped portion adjacent to the fixed

portion of the semi-finished metal beam may still have the original flat form of the initially used sheet or strip material. However, it is advantageous that the semi-shaped portion has already been formed in a continuous profiling step where width and height of the product are not varying in the lengthwise direction to a shape that is already prepared in the best possible way for the die forming process step that forms the essential part of the invention.

[0028] For example, if the semi-shaped portion shall form a flange to a U-shaped finished metal beam of varying width the semi-shaped portion should in the preceding manufacturing step already be bent upwardly from the fixing portion with a rather smooth curvature. Starting from this shape of the semi-shaped portion, the work to be performed by the profiling machine is reduced to the essential final die forming of the final shape of the metal beam.

[0029] Biasing is preferably done hydraulically or hydro-pneumatically, because this allows the best definition of the biasing force. However, a biasing force may be applied by mechanical spring means as well. Biasing towards the counter die is a directional indication only. Of course there may be a substantial gap between the profiling phase of the profiling means on the one hand and the buttress face on the counter die on the other hand, e. g. in the first profiling stand of the profiling machine. A defined biasing force here is mainly important for the bending angle and position of the semi-shaped portion of the metal beam.

[0030] In order to free the finished metal beam from the profiling means of the profiling machine it is advisable that at the end of the process those profiling means are returned to a rest position which is remote from the contoured buttress face of the counter die. Then the counter die may be opened so that the finished metal beam may be removed from the counter die and transported to the next manufacturing position.

[0031] In general it is possible to use the counter die with the fixing portion of the semi-finished metal beam in cooperation with two generally parallel operating profiling machines to form two semi-shaped portions on two buttress faces simultaneously.

[0032] In the prior art discussed above (US-A-4,558,577) profiling is performed on a semi-finished metal beam that already has a width varying in its lengthwise direction. However, from a practical standpoint it is easier to process a planar strip of metal with a constant width and to adjust the cross section of the finished metal beam by trimming of its lengthwise extending edge or edges. It is obvious that the inventive manufacturing process will lead to at least some and minor wrinkles or other upsetting deformations in the metal sheet material of the metal beam leaving the counter die. However, tests have shown that it is possible to flatten those wrinkles or other upsetting deformations in the next or a further manufacturing step without impairing the impact properties of the finished metal beam.

[0033] As said above it is generally interesting to use the claimed process with steel sheet or strip material. However also light metal sheet or strip material, in particular an aluminum alloy material or even a magnesium alloy material may be manufactured with the same process steps.

[0034] As far as the manufacturing stand used in the above explained manufacturing process is concerned, it is obvious that such manufacturing stand needs appropriate modifications.

[0035] A manufacturing stand usable for the inventive manufacturing process (claim 17) comprises a counter die that extends over about the complete length of the elongated metal beam, wherein the counter die is openable in a fixing section to receive a fixing portion of a semi-finished metal beam and re-closable to fixedly position said fixing portion in the fixing section, wherein said counter die comprises a contoured buttress face extending in the lengthwise direction more or less adjacent to the fixing section of the counter die, a profiling machine aligned in parallel to the counter die along the buttress face thereof, said profiling machine comprising at least one profiling means, said profiling means transversally movable relative to the buttress face and being adapted to bend a semi-shaped portion of the semi-finished metal beam that also extends over about the complete length of the semi-finished metal beam towards the buttress face of the counter die, wherein either the profiling machine is stationary and the counter die is movable in the lengthwise direction relative to the profiling machine and/or, preferably, the counter die is stationary and the profiling machine is movable in the lengthwise direction relative to the counter die, wherein in the course of the relative movement in the lengthwise direction bending of the semi-shaped portion of the semi-finished metal beam towards the buttress face of the counter die is performed,

[0036] The term "adjacent" means that the contoured buttress face shall be positioned relative to the fixing section at the appropriate usually small distance so that the semi-shaped portion of the semi-finished metal beam can be formed onto the contoured buttress face without too much of a free space in between.

[0037] In the preferred embodiment of the manufacturing stand it is provided that the movable part of the stand, namely the counter die or, preferably, the profiling machine is positioned on a transport track extending in the lengthwise direction, and drive means are provided at the transport track for moving the movable part back and forth along the transport track.

[0038] Preferred embodiments of the drive means on the transport track are the subject matter of claim 19.

[0039] As far as the transverse movement of the profiling means, namely the rolls or rollers of the profiling stands are concerned, each profiling stand should be provided with at least one transverse drive means along with at least one biasing means to establish the biasing force in the transverse direction mentioned above.

[0040] Now, hereafter a preferred embodiment of a

manufacturing stand according to the invention is explained with reference to the drawings. Along with that a number of alternative shapes of semi-finished and finished metal beams are described and the manufacturing process is explained in detail. In the drawings

- Fig. 1 shows a schematic top plan view of a manufacturing stand according to a preferred embodiment of the invention,
- Fig. 2a, b, c shows three successive profiling stands of the manufacturing stand according to Fig. 1,
- Fig. 3a, b, c shows schematic representations of a semi-finished metal beam before it is positioned in the counter die (3a), thereafter fixedly positioned in the counter die (3b), and the varying width of the finished metal beam following application of the inventive manufacturing process (3c),
- Fig. 4 shows a schematic representation of the basic concept for a two-side die forming process,
- Fig. 5 shows a schematic representation of a further version of the invention for a semi-finished metal beam with two laterally distant fixing portions with the semi-shaped portion in between for a simultaneous width and depth variation.

[0041] The invention is related to a process and a manufacturing stand for manufacturing of an elongated metal beam 1 used as a vehicle body component. An example of such a metal beam is displayed in Fig. 3c. The important point with such an elongated metal beam 1 is that the finished metal beam 1 has a width and/or height that varies in its lengthwise direction. Fig. 3c shows that the width varies from the front end to a much wider rear end.

[0042] Fig. 3a shows the cross section of an example of a semi-finished metal beam 2 as it may be received from a preceding manufacturing step. Fig. 3a shows that this semi-finished metal beam 2 has already been processed from a planar strip of metal, in particular steel, to have a kind of asymmetric U-profile. Fig. 3a shows a bottom 2a, a straight right leg 2b with a straight flange 2c and a curved left leg 2d of this U-profile.

[0043] In the present embodiment the semi-finished metal beam 2 is formed by continuous or by-the-piece roll-forming from a planar strip of metal with a constant width and with a height of this U-profile that is constant in its lengthwise direction. However, light metal may be used, too.

[0044] The manufacturing stand in Fig. 1, 2 and 3b used for the inventive process is provided with a counter die 3 that extends over about the complete length of the

semi-finished metal beam 2. However, it is possible that the counter die 3 might have free spaces or interruptions along its length or its height. This depends upon the exact shape of the metal beam 1 that shall be reached.

[0045] The counter die 3 is openable in a fixing section 4. In fact the counter die 3 has an upper part 4a and a lower part 4b of the fixing section 4. By means of a lifting drive 5 indicated schematically in Fig. 1 the upper part 4a of the fixing section 4 may be lifted to open the fixing section 4 so that a fixing portion 2a of the semi-finished metal beam 2 can be received between the upper part 4a and the lower part 4b. In the present embodiment the bottom 2a explained along with Fig. 3a is identical with the fixing portion 2a of the semi-finished metal beam 2.

[0046] After re-closing the counter die 3 to fixedly position the fixing portion 2a therein, the counter die 3 is ready for the further process steps. This position can be seen in Fig. 3b.

[0047] Fig. 3b shows that one semi-shaped portion 2d, namely here the curved left leg 2d of the U-profile, also extends over about the complete length of the semi-finished metal beam 2 adjacent to its fixing portion 2a so that it is free to be deformed relative to the counter die 3.

[0048] The counter die 3 needs a form that can be used for die forming of the semi-shaped portion 2d of the semi-finished metal beam 2. Insofar the counter die 3 comprises a contoured buttress face 6 extending in the lengthwise direction more or less adjacent to the fixing section 4 of the counter die 3 over about the complete length of the semi-finished metal beam 2.

[0049] The manufacturing stand further comprises a profiling machine 7 aligned in parallel to the counter die 3 along the buttress face 6 thereof, said profiling machine 7 comprising at least one profiling means 7b, said profiling means 7b being transversally movable relative to the buttress face 6 and being adapted to bend a semi-shaped portion 2d of the semi-finished metal beam 2 that also extends over about the complete length of the semi-finished metal beam 2 towards the buttress face 6 of the counter die 3.

[0050] In order to perform this process step the counter die 3 with the fixed semi-finished metal beam 2 is moved in the lengthwise direction relative to the profiling machine 7 and/or vice versa. It is preferred, however, and explained in the present embodiment in detail (see Fig. 1) that the profiling machine 7 is the movable part whereas the counter die 3 is the stationary part of the manufacturing stand.

[0051] Fig. 1 shows in its top plan view that the contoured buttress face 6 of the counter die 3 in this embodiment is a face that varies its position in the lengthwise direction in one direction only. Of course it is possible to have a varying width and/or height first in one transverse direction and further down the buttress face 6 in the opposite transverse direction.

[0052] In the course of the relative movement in the lengthwise direction and by the profiling means 7b of the profiling machine 7 the semi-shaped portion 2d is bent

towards the contoured buttress face 6 on the counter die 3. The contour of the buttress face 6 conforms to the shape of this portion that the finished metal beam 1 shall have in the final state, this shape finally resulting in the varying measure of the finished metal beam 1 in this dimension.

[0053] Having die formed the semi-shaped portion 2d of the semi-finished metal beam 2 into its final shape the metal beam 2 may be removed from the counter die 3 to proceed to the next manufacturing step or steps.

[0054] Due to the varying width of the bottom 2a of the semi-finished metal beam 2 it is clear that at first the upstanding leg of the finished metal beam 1 in Fig. 3c would have a different height. Fig. 3c therefore shows the finished metal beam 1 insofar as in a next or further manufacturing step the free lengthwise extending edge on the left leg 2d of the metal beam 1 has already been trimmed to its straight course and the same height as the right leg 2b.

[0055] Figs. 1 and 2 show that in the preferred embodiment of the process and the manufacturing stand a roll-forming machine 7 is used as a profiling machine with at least one profiling roll 7b as profiling means. In fact the rolls or rollers of the profiling means 7b have a stepwise changing contour. The profiling machine 7 in the present embodiment comprises a row of six profiling stands 7a each provided with a contoured profiling roll 7b as profiling means. Fig. 2a shows the first profiling stand 7a which is the profiling stand 7a farthest to the right in Fig. 1. Fig. 2b shows an intermediate profiling stand 7a, whereas Fig. 2c shows the final profiling stand 7a at the left end of the row of profiling stands 7a in Fig. 1. It can be easily seen that the contour of the profiling rolls 7b is changing stepwise from stand to stand towards the final shape of the semi-shaped portion 2d of the semi-finished metal beam 2.

[0056] Fig. 1 and 2 show a preferred embodiment of the invention in that the counter die 3 is the stationary part of the manufacturing stand whereas the profiling machine 7 moves back and forth along the buttress face 6 of the counter die 3.

[0057] In the disclosed and preferred embodiment where the profiling machine 7 is the movable part of the stand the profiling machine 7 is positioned on a transport track 8 extending in the lengthwise direction and drive means 9 are provided at the transport track 8 for moving the profiling machine 7 back and forth along the transport track 8.

[0058] In this specific embodiment it is provided that the drive means 9 comprises a drive motor 9a at one end of the track 8, a driving belt 9b or chain extending from the drive motor 9a towards the opposite end of the track 8, and a belt or chain tensioning device 9c at the opposite end of the track 8. The movable part 7 of the stand is attached to the carrying run of the driving belt 9b or chain.

[0059] On the one hand it is possible that instead of the profiling machine 7 the counter die 3 is movable or that both parts are movable relative to each other. On

the other hand the transport track 8 and drive means 9 can be constructed differently in a way appropriate under the specific circumstances.

[0060] Moreover, Figs. 1 and 2 disclose a further constructional aspect of the inventive manufacturing stand in that each profiling stand 7a of the profiling machine 7 is provided with a transverse drive means 10 for driving the corresponding profiling means 7b between a forward operating position and a remote rest position, and a biasing means 11, preferably a hydraulic or hydro-pneumatic biasing means, for biasing the profiling means 7b towards the counter die 3 or the semi-shaped portion 2d of the semi-finished metal beam 2 respectively. In the present embodiment, due to the scale of Fig. 1, it is difficult to differ between the transverse drive means 10 and the biasing means 11. However, the biasing means 11 are provided to bias the profiling means 7b, preferably hydraulically or hydro-pneumatically, towards the semi-shaped portion 2d or the buttress face 6 of the counter die 3 respectively with a defined biasing force. Preferably the biasing force established by the biasing means 11 is controlled by a control system.

[0061] Whereas hydraulically or hydro-pneumatically biasing means 11 are preferable for this task, it is in general possible to use mechanical biasing means like mechanical compression springs or the like.

[0062] The transverse drive means 10 are in the present embodiment not active in establishing the biasing force. They are used only for returning the profiling means 7b to a rest position remote from the contoured buttress face 6 of the counter die 3 as soon as the process steps c/d are finished. Then the finished metal beam 1 is free to be removed from the re-opened counter die 3. The transverse drive means 10 might be a hydraulic drive, an electric spindle drive or the like.

[0063] Whereas Fig. 3 shows an embodiment of the invention where the varying width of the finished metal beam 1 is provided by a varying position of the left leg 2d only, it may be equally possible to vary the height of the metal beam 1 or vary both sides of the metal beam 1. Fig. 4b shows a height-variation and Fig. 4a shows a two-sided width-variation of the semi-finished metal beam 2.

[0064] To achieve a simultaneous shaping of two semi-shaped portions 2d it is preferable to have two parallel profiling machines 7 positioned in an appropriate relative position to two contoured buttress faces 6 of the counter die 3. In Fig. 4a only the counter die 3 is shown but not the left and right profiling machines 7.

[0065] For the embodiment of Fig. 3 it is provided that in the preceding manufacturing step a planar strip of metal is formed into a semi-finished metal beam 2 with the fixing portion 2a and an adjacent pre-shaped portion 2b having a constant width and/or height in the lengthwise direction, wherein the semi-finished metal beam 2 with its fixing portion 2a and the adjacent pre-shaped portion 2b is fixedly positioned in the counter die 3. The pre-shaped portion 2b was explained above in the term used

for the U-profile as straight right leg 2b.

[0066] In contrast to the embodiment of Fig. 3 the embodiment of Fig. 5 shows that the semi-finished metal beam 2 has two laterally distant fixing portions 2a with the semi-shaped portion 2d in between, wherein the two fixing portions 2a are fixedly positioned in the counter die 3. Here the contoured buttress face 6 of the counter die 3 has a wave-like contour which varies over the length of the semi-finished metal beam 2. This is indicated in dotted lines. The profiling machine 7 has correspondingly contoured profiling rolls 7b, one of which being indicated below the semi-shaped portion 2d in Fig. 5.

[0067] As explained before in connection with Fig. 3c it is possible and advisable in the next or a further manufacturing step that the free lengthwise extending edge or edges of the metal beam 2 be trimmed to their final course. Further, wrinkles or other upsetting deformations can not be prevented in the course of the inventive process. So it is advisable that in the next or a further manufacturing step wrinkles or other upsetting deformations in the metal sheet material of the metal beam 2 be flattened.

Claims

1. Process for manufacturing of an elongated metal beam (1) used as a vehicle body component, wherein the finished metal beam (1) has a width and/or height varying in its lengthwise direction, the process comprising the following steps;

- a) receiving a semi-finished metal beam (2) from a preceding manufacturing step,
- b) fixedly positioning the semi-finished metal beam (2) with a fixing portion (2a) thereof that extends over about the complete length of the semi-finished metal beam (2) in a counter die (3) of a manufacturing stand so that at least one semi-shaped portion (2d) that also extends over about the complete length of the semi-finished metal beam (2) adjacent to the fixing portion (2a) thereof is free to be deformed relative to the counter die (3),
- c) moving the counter die (3) with the fixed semi-finished metal beam (2) in the lengthwise direction relative to a profiling machine (7) with at least one profiling means (7b) and/or vice versa,
- d) in the course of the relative movement in the lengthwise direction in step c) and by the profiling means (7b) of the profiling machine (7), bending the semi-shaped portion (2d) towards a contoured buttress face (6) of the counter die (3) extending in the lengthwise direction, the contour of the buttress face (6) conforming to the shape of this portion, of the finished metal beam (1) that finally results in the varying measure of the finished metal beam (1) in this dimension,

sion,

e) removing the metal beam (2) from the counter die (3), and

f) optionally, moving the metal beam (2) to the next manufacturing step.

2. Process according to claim 1, **characterized in that** in step c) the profiling machine (7) is moved relative to the counter die (3) which remains stationary.
3. Process according to any one of the preceding claims, **characterized in that** a roll-forming machine (7) is used as profiling machine with at least one profiling roll (7b) as profiling means.
4. Process according to any one of the preceding claims, **characterized in that** in step c)/d) profiling is done by a row of profiling stands (7a), wherein the contour of their profiling means (7b) is changing stepwise from stand to stand towards the final shape of the semi-shaped portion (2d).
5. Process according to any one of the preceding claims, **characterized in that** in step c)/d) the profiling means (7b) are biased, preferably hydraulically or hydro-pneumatically, towards the counter die (3) with a defined biasing force, preferably a precisely controlled biasing force.
6. Process according to any one of the preceding claims, **characterized in that** at the end of step d) or in step e) the profiling means (7b) are returned to a position remote from the contoured buttress face (6) of the counter die (3).
7. Process according to any one of the preceding claims, **characterized in that** in step c) the counter die (3) is moved relative to two parallel profiling machines (7) positioned in an appropriate relative position to two contoured buttress faces (6) of the counter die (3).
8. Process according to claim 7, **characterized in that** the semi-finished metal beam (2) has two semi-shaped portions (2d) opposite to each other with the fixing portion (2a) in between and in step c) each semi-shaped portion (2d) is bent towards the adjacent buttress face (6) of the counter die (3) by the profiling machine (7) at this side of the counter die (3).
9. Process according to any one of the preceding claims, **characterized in that** in the preceding manufacturing step the semi-finished metal beam (2) is formed by continuous or by-the-piece roll-forming from a planar strip of metal with a constant width.

10. Process according to any one of claims 1 to 8, characterized in that

in the preceding manufacturing step the semi-finished metal beam (2) is formed by continuous or by-the-piece roll-forming from a planar strip of metal with a width of the strip that already varies in the lengthwise direction.

11. Process according to any one of the preceding claims, characterized in that

in the preceding manufacturing step a planar strip of metal is formed into a semi-finished metal beam (2) with the fixing portion (2a) and an adjacent pre-shaped portion (2b) having a constant width and/or height in the lengthwise direction.

12. Process according to any one of the preceding claims, characterized in that

the semi-finished metal beam (2) with its fixing portion (2a) and an adjacent pre-shaped portion (2b) or with two laterally distant fixing portions (2a) is fixedly positioned in the counter die (3).

13. Process according to any one of the preceding claims, characterized in that

in the next or a further manufacturing step the free lengthwise extending edge or edges of the metal beam (2) are trimmed to their final course.

14. Process according to any one of the preceding claims, characterized in that

in the next or a further manufacturing step wrinkles or other upsetting deformations in the metal sheet material of the metal beam (2) are flattened.

15. Process according to any one of the preceding claims, characterized in that

steel sheet or strip material is used for the metal beam (1).

16. Process according to any one of the claims 1 to 14, characterized in that

light metal sheet or strip material is used for the metal beam (1).

17. Manufacturing stand for use in a process for manufacturing of an elongated metal beam (1) used as a vehicle body component, wherein the finished metal beam (2) has a width and/or height varying in its lengthwise direction, the manufacturing stand comprising:

a counter die (3) that extends over about the complete length of the elongated metal beam (1),

wherein the counter die (3) is openable in a fixing section (4) to receive a fixing portion (2a) of a semi-

finished metal beam (1) and re-closable to fixedly position said fixing portion (2a) in the fixing section (4), wherein said counter die (3) comprises a contoured buttress face (6) extending in the lengthwise direction more or less adjacent to the fixing section (4) of the counter die (3),

a profiling machine (7) aligned in parallel to the counter die (3) along the buttress face (6) thereof, said profiling machine (7) comprising at least one profiling means (7b), said profiling means (7b) being transversally movable relative to the buttress face (6) and being adapted to bend a semi-shaped portion (2d) of the semi-finished metal beam (2) that also extends over about the complete length of the semi-finished metal beam (2) towards the buttress face (6) of the counter die (3),

wherein either the profiling machine (7) is stationary and the counter die (3) is movable in the lengthwise direction relative to the profiling machine (7) and/or, preferably, the counter die (3) is stationary and the profiling machine (7) is movable in the lengthwise direction relative to the counter die (3), wherein in the course of the relative movement in the lengthwise direction bending of the semi-shaped portion (2d) of the semi-finished metal beam (2) towards the buttress face (6) of the counter die (3) is performed.

18. Manufacturing stand according to claim 17, characterized in that

the movable part of the stand, namely the counter die (3) or, preferably, the profiling machine (7) is positioned on a transport track (8) extending in the lengthwise direction and

drive means (9) are provided at the transport track (8) for moving the movable part back and forth along the transport track (8),

19. Manufacturing stand according to claim 18, characterized in that

the drive means (9) comprises a drive motor (9a) at one end of the track (8), a driving belt (9b) or chain extending from the drive motor (9a) towards the opposite end of the track (8), and

a belt or chain tensioning device (9c) at the opposite end of the track (8),

wherein the movable part of the stand is attached to the carrying run of the driving belt (9b) or chain.

20. Manufacturing stand according to any one of the preceding product claims,

characterized in that

each profiling stand (7a) of the profiling machine (7) is provided with a transverse drive means (10) for driving the corresponding profiling means (7b) between a forward operating position and a remote rest position, and with a biasing means (11) preferably a hydraulic or hydro-pneumatic biasing means, for bi-

asing the profiling means (7b) towards the semi-shaped portion (2d) of the semi-finished metal beam (2) or towards the counter die (3) respectively.

Amended claims in accordance with Rule 137(2) EPC.

1. Process for manufacturing of an elongated metal beam (1) used as a vehicle body component, wherein the finished metal beam (1) has a width and/or height varying in its lengthwise direction, the process comprising the following steps:

a) receiving a semi-finished metal beam (2) from a preceding manufacturing step,

b) fixedly positioning the semi-finished metal beam (2) with a fixing portion (2a) thereof that extends over about the complete length of the semi-finished metal beam (2) in a counter die (3) of a manufacturing stand so that at least one semi-shaped portion (2d) that also extends over about the complete length of the semi-finished metal beam (2) adjacent to the fixing portion (2a) thereof is free to be deformed relative to the counter die (3),

c) moving the counter die (3) with the fixed semi-finished metal beam (2) in the lengthwise direction relative to a profiling machine (7) with at least one profiling means (7b) and/or vice versa, d) in the course of the relative movement in the lengthwise direction in step c) and by the profiling means (7b) of the profiling machine (7), bending the semi-shaped portion (2d) towards a contoured buttress face (6) of the counter die (3) extending in the lengthwise direction, the contour of the buttress face (6) conforming to the shape of this portion, of the finished metal beam (1) that finally results in the varying measure of the finished metal beam (1) in this dimension,

e) removing the metal beam (2) from the counter die (3), and

f) optionally, moving the metal beam (2) to the next manufacturing step,

characterized in that

in step b) the semi-finished metal beam (2) with its fixing portion (2a) or with two laterally distant fixing portions (2a) is fixedly positioned between an upper part (4a) and a lower part (4b) of a fixing section (4) of the counter die (3).

2. Process according to claim 1, **characterized in that**

in step c) the profiling machine (7) is moved relative to the counter die (3) which remains stationary.

3. Process according to any one of the preceding claims, **characterized in that**

a roll-forming machine (7) is used as profiling machine with at least one profiling roll (7b) as profiling means.

4. Process according to any one of the preceding claims, **characterized in that**

in step c)/d) profiling is done by a row of profiling stands (7a), wherein the contour of their profiling means (7b) is changing stepwise from stand to stand towards the final shape of the semi-shaped portion (2d).

5. Process according to any one of the preceding claims, **characterized in that**

in step c)/d) the profiling means (7b) are biased, preferably hydraulically or hydro-pneumatically, towards the counter die (3) with a defined biasing force, preferably a precisely controlled biasing force.

6. Process according to any one of the preceding claims, **characterized in that**

at the end of step d) or in step e) the profiling means (7b) are returned to a position remote from the contoured buttress face (6) of the counter die (3).

7. Process according to any one of the preceding claims, **characterized in that**

in step c) the counter die (3) is moved relative to two parallel profiling machines (7) positioned in an appropriate relative position to two contoured buttress faces (6) of the counter die (3).

8. Process according to claim 7, **characterized in that**

the semi-finished metal beam (2) has two semi-shaped portions (2d) opposite to each other with the fixing portion (2a) in between and in step c) each semi-shaped portion (2d) is bent towards the adjacent buttress face (6) of the counter die (3) by the profiling machine (7) at this side of the counter die (3).

9. Process according to any one of the preceding claims, **characterized in that**

in the preceding manufacturing step the semi-finished metal beam (2) is formed by continuous or by-the-piece roll-forming from a planar strip of metal with a constant width.

10. Process according to any one of claims 1 to 8, **characterized in that**

in the preceding manufacturing step the semi-finished metal beam (2) is formed by continuous or by-the-piece roll-forming from a planar strip of metal with a width of the strip that already varies in the lengthwise direction.

11. Process according to any one of the preceding claims, **characterized in that**
in the preceding manufacturing step a planar strip of metal is formed into a semi-finished metal beam (2) with the fixing portion (2a) and an adjacent pre-shaped portion (2b) having a constant width and/or height in the lengthwise direction. 5
12. Process according to any one of the preceding claims, **characterized in that**
in the next or a further manufacturing step the free lengthwise extending edge or edges of the metal beam (2) are trimmed to their final course. 10
13. Process according to any one of the preceding claims, **characterized in that**
in the next or a further manufacturing step wrinkles or other upsetting deformations in the metal sheet material of the metal beam (2) are flattened. 15
20
14. Process according to any one of the preceding claims, **characterized in that** steel sheet or strip material is used for the metal beam (1). 25
15. Process according to any one of the claims 1 to 13, **characterized in that** light metal sheet or strip material is used for the metal beam (1). 30
16. Manufacturing stand for use in a process for manufacturing of an elongated metal beam (1) used as a vehicle body component, wherein the finished metal beam (2) has a width and/or height varying in its lengthwise direction,
the manufacturing stand comprising: 35
35
- a counter die (3) that extends over about the complete length of the elongated metal beam (1), wherein said counter die (3) comprises a contoured buttress face (6) extending in the lengthwise direction more or less adjacent to a fixing section (4) of the counter die (3), 40
40
- a profiling machine (7) aligned in parallel to the counter die (3) along the buttress face (6) thereof,
said profiling machine (7) comprising at least one profiling means (7b), said profiling means (7b) being transversally movable relative to the buttress face (6) and being adapted to bend a semi-shaped portion (2d) of the semi-finished metal beam (2) that also extends over about the complete length of the semi-finished metal beam (2) towards the buttress face (6) of the counter die (3), 45
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- wherein either the profiling machine (7) is stationary and the counter die (3) is movable in the lengthwise direction relative to the profiling machine (7) and/or the counter die (3) is stationary and the pro- 55

filing machine (7) is movable in the lengthwise direction relative to the counter die (3),
wherein in the course of the relative movement in the lengthwise direction bending of the semi-shaped portion (2d) of the semi-finished metal beam (2) towards the buttress face (6) of the counter die (3) is performed,

characterized in that

the counter die (3) is openable in the fixing section (4) to receive a fixing portion (2a) of a semi-finished metal beam (1) and re-closeable to fixedly position said fixing portion (2a) in the fixing section (4).

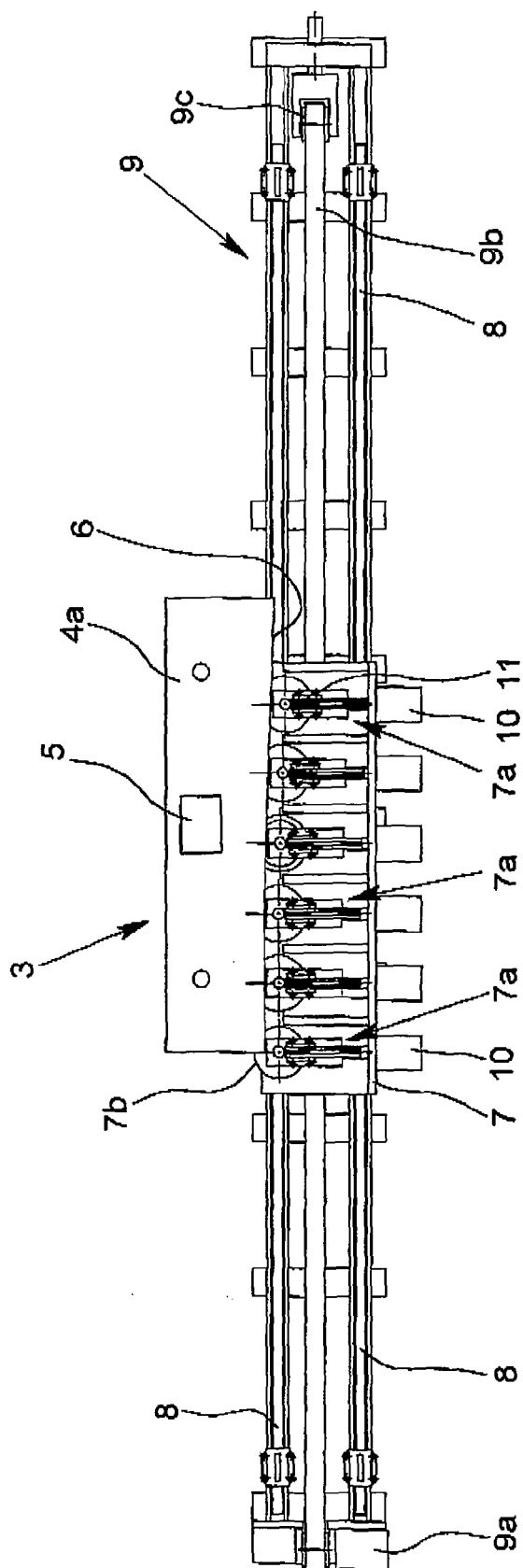


Fig. 1

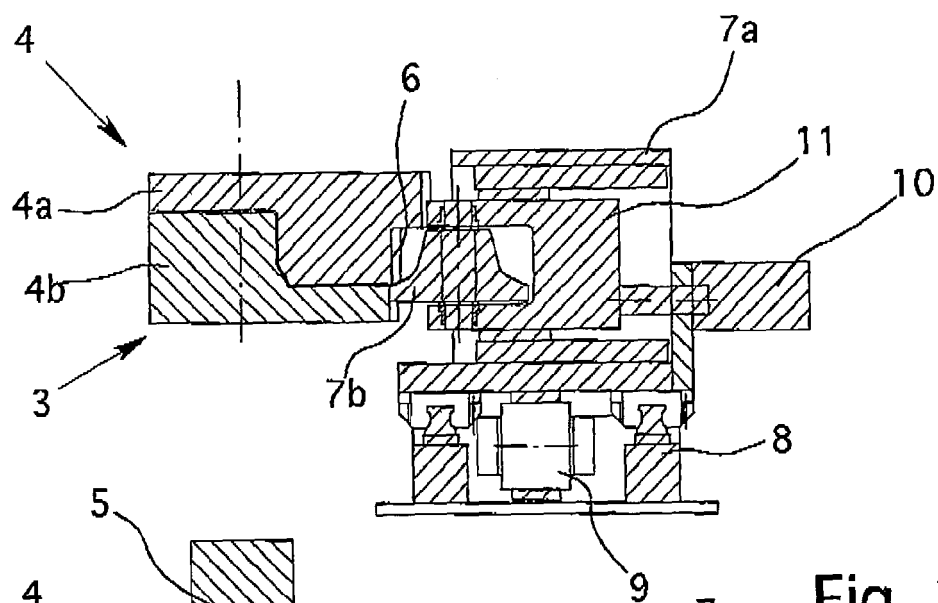


Fig. 2a

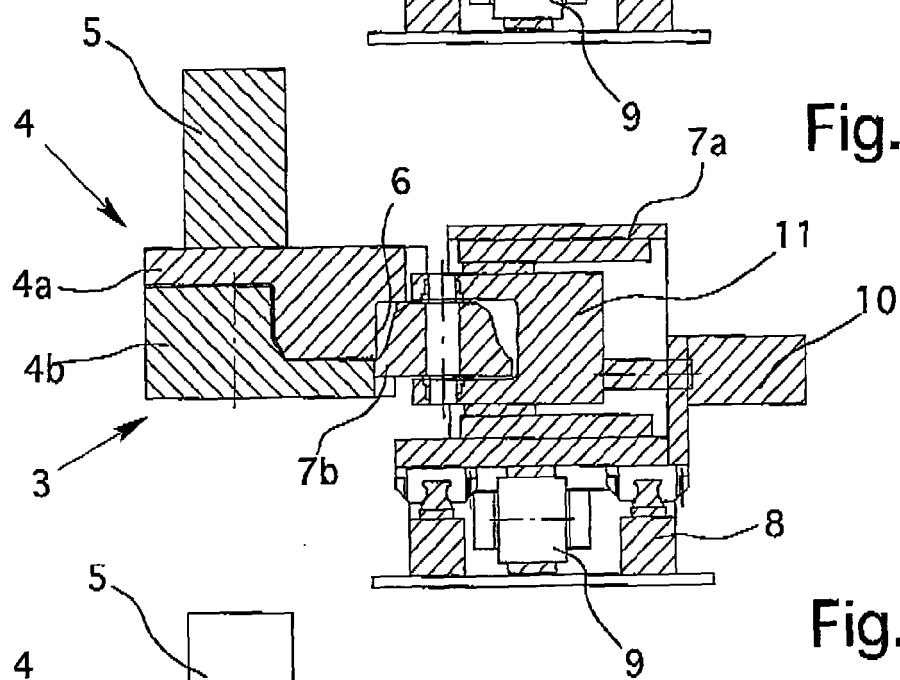


Fig. 2b

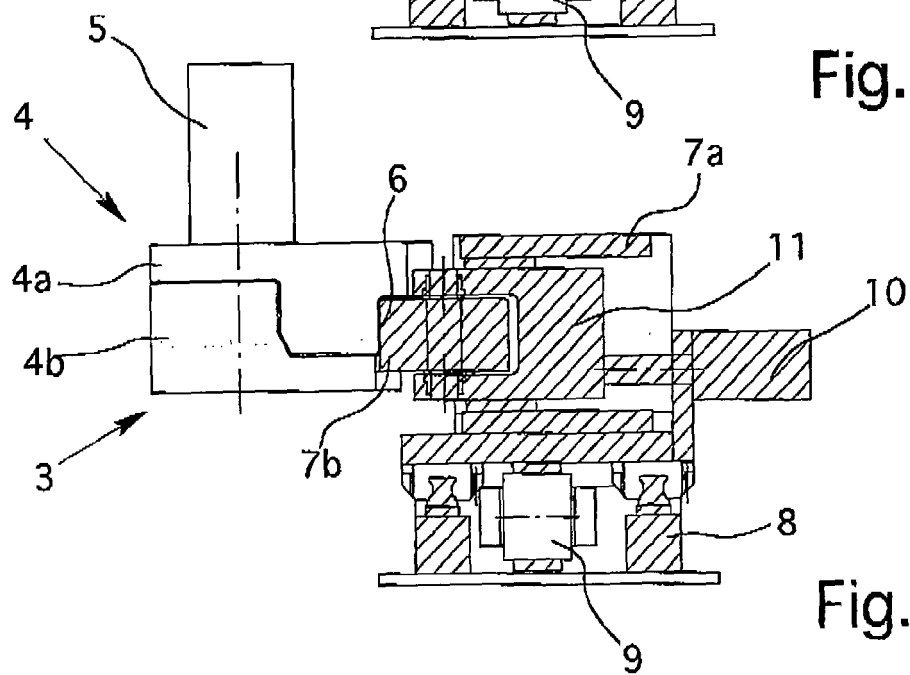


Fig. 2c

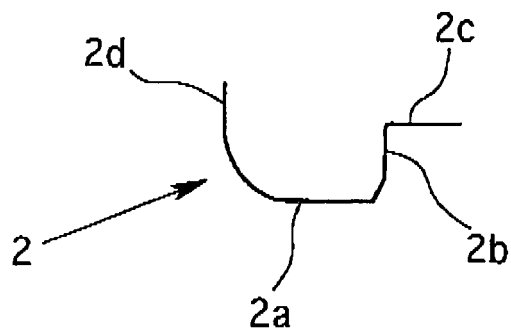


Fig. 3a

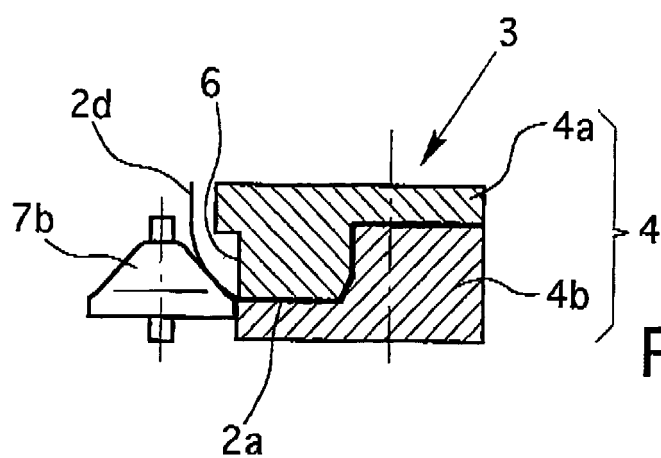


Fig. 3b

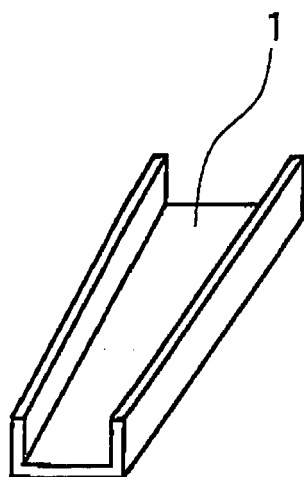


Fig. 3c

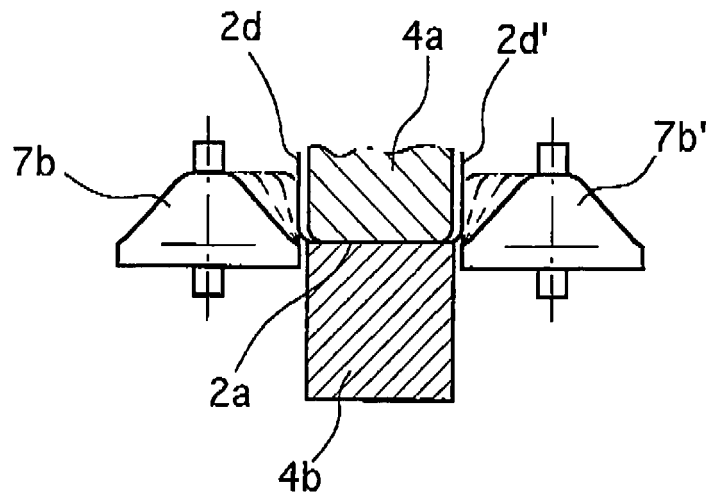


Fig. 4a



Fig. 4b

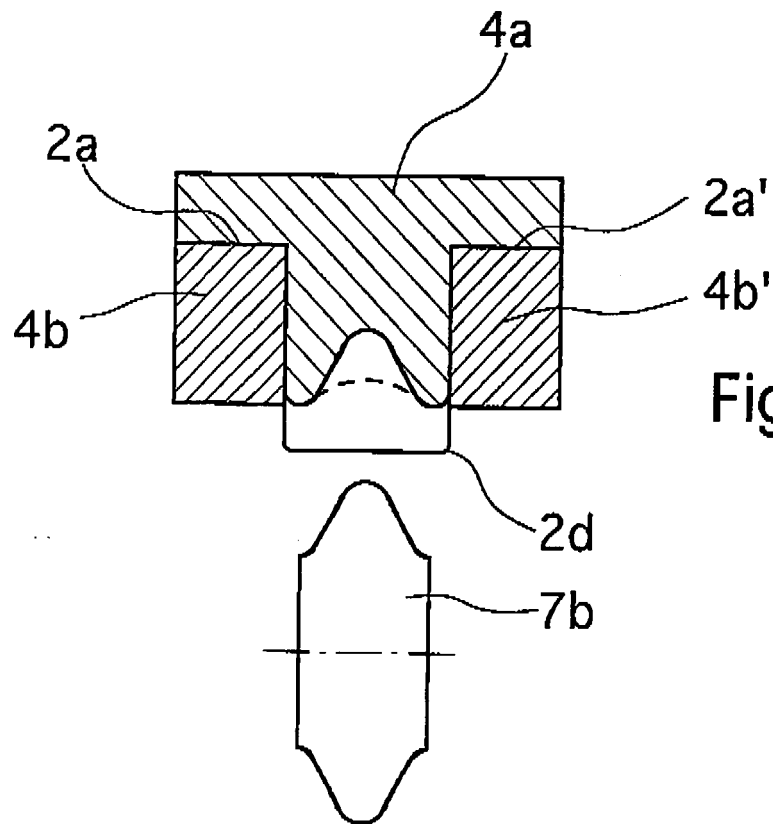


Fig. 5



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 06 01 3907

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 61 086031 A (TOYOTA MOTOR CORP) 1 May 1986 (1986-05-01) * abstract; figures *	1-3,5-20	INV. B21D5/08
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Y	JP 06 328145 A (CHUBU ENG KK) 29 November 1994 (1994-11-29) * abstract; figures *	4	
A	JP 62 134119 A (TOYOTA MOTOR CORP) 17 June 1987 (1987-06-17) * abstract; figures *	2,3,5-8, 17-20	
			TECHNICAL FIELDS SEARCHED (IPC)
			B21D E04C F16S B60J B62D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 November 2006	Examiner Knecht, Frank
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 06 01 3907

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28-11-2006

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