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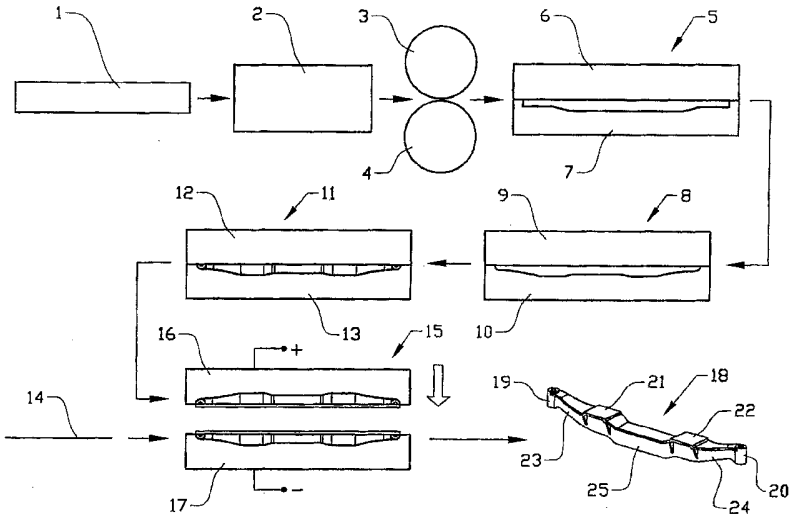
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(54) Title: METHOD FOR MANUFACTURING HOLLOW CONSTRUCTION ELEMENTS



(57) Abstract: The invention relates to a method for manufacturing a hollow elongate construction element, in which a first blank and a second blank (1, 14) are conveyed through a furnace (2) for heating to working temperature and are conveyed between rolls (3, 4) with profiled surfaces for preshaping in one or more steps. The blanks are each conveyed through a forging press with a number of interacting die cushions, the blank being worked in a number of steps (5, 8, 11) to form halves of an in the main finished product, having a cross section essentially in the form of a U-profile with a predetermined varying height, width and material thickness along its length. The second blank (14) constitutes in the main a copy of the first blank (1). In a final step (15), the blanks are joined together to form a composite hollow construction element (18). The invention also relates to a construction element produced according to the method.

WO 2004/108326 A1

METHOD FOR MANUFACTURING HOLLOW CONSTRUCTION ELEMENTS

TECHNICAL FIELD

The invention relates to a method for manufacturing hollow composite construction elements, preferably intended for use in vehicles, and a construction element manufactured according to the method.

BACKGROUND ART

There are requirements in many areas today for products which are weight-optimized while retaining function and strength. This applies in particular to forged products, which can be heavy and difficult to optimize owing to limitations of the tools used in manufacture.

An example is front axle beams for heavy-duty vehicles. These beams are typically forged as an I-profile where the web, or the core, in the beam cross section has little influence on the torsional stiffness. With strength calculations, it is possible to demonstrate that a tubular cross section, with the material moved as far radially outward as possible, is optimal for such a construction. This applies in particular to what is known as the swan-neck on the front axle beam, between its central part and a kingpin support. With conventional forging technology, however, it is difficult to achieve such a solution. EP-A2-0 059 038 discloses a front axle beam forged lying in a conventional way, that is to say that the blank lies with its final vertical plane (after mounting) in the horizontal plane during working. The specification describes how a blank is preshaped by rolling and is then moved between a number of presses, which forge all or parts of the blank into the desired shape. The disadvantage of the solution is, as indicated above, that the web of the beam is mostly centrally located, which has little influence on the torsional stiffness.

An alternative solution emerges from EP-A1-0 015 648, which describes forging of a rectangular, hollow front axle beam starting from a tubular blank. While it is possible with this method to obtain a beam with greater torsional stiffness, it also gives rise to a number of problems. In order to produce the tapering ends of the beam, these have to be drawn through a die. Although the material is, seen radially, distributed further out from the center of the beam, the possibility of controlling the material thickness is very limited. This also applies to the other parts of the beam, because the starting material is a tube with constant material thickness. Moreover, a great deal of machining of the beam ends is required in order to produce kingpin supports, and separate attachments for air bellows, for example, have to be mounted.

Another solution emerges from US-A-6 122 948, which specification discloses a hydroformed front axle beam. In this case too, the starting point is a tubular blank, which is first bent into the desired basic shape and is then hydroformed into its final shape. The disadvantage of this solution is that, as in the example above, it is not possible to control the distribution of the material along the length of the profile. The profile also has to be provided with a number of separate mountings, not only for the air bellows but also for the holders for the kingpins. These have to be attached by welding, for example, which gives the beam an inherent corrosion-sensitive weakening.

Finally, it is also possible to cast hollow frame axle beams, which emerges from JP-A-11-011105. For reasons associated with the casting process, however, there is a limitation with regard to maximum and minimum material thickness, and there are requirements for reinforcing ribs, complicated casting cores and the like in order to permit casting of such an advanced profile. In addition, there are further limitations as far as the material choice possible in practice is concerned, and financial consequences for the unit price of the axle beams owing to the greatly increased costs a casting process would involve.

The majority of the problems mentioned above are solved by the manufacturing method according to the invention, which method results in a considerably greater possibility of accurately controlling the distribution of material around and along a forged profile.

DISCLOSURE OF INVENTION

The invention relates to a method for manufacturing a hollow, elongate construction element, in accordance with claim 1 and its subordinate claims, and a construction element according to claim 12 produced using the method.

The method comprises the following steps:

(a) a first blank is conveyed through a furnace for heating to working temperature,

(b) the first blank is conveyed between a pair of rolls with profiled surfaces, the blank being preshaped in one or more steps to form an intermediate product with a predetermined profile along its longitudinal extent,

(c) the first blank is supplied to a forging press with a number of interacting die cushions, the blank being worked in a number of steps to form a first half of an in the main finished product, having a cross section essentially in the form of a U-profile with a predetermined varying height, width and material thickness along its length,

(d) a second blank is conveyed through a furnace for heating to working temperature,

(e) the second blank is conveyed between a pair of rolls with profiled surfaces, the blank being preshaped in one or more steps to form an intermediate product with a predetermined profile along its longitudinal

extent,

(f) the second blank is supplied to a forging press with a number of interacting die cushions, the blank being worked in a number of steps to form a second half of an in the main finished product, having a cross section essentially in the form of a U-profile with a predetermined varying height, width and material thickness along its length, the second blank in the main being a copy of the first blank,

(g) the first blank and the second blank are joined together in a final step, at least along their respective edges, to form a composite hollow construction element.

In contrast to known art, the first blank and the second blank are forged horizontally, that is to say during working the main horizontal dividing plane of the blank coincides in the main with the vertical plane in which the construction element is intended to be mounted.

The starting material can be, for example, a round, square or rectangular blank which is cut to the desired length, after which it is heated in a furnace to a working temperature suitable for the material. When use is made of, for example, air-hardening, microalloyed steel, the blank is heated to 1250-1300°C, preferably to 1280°C. In a first step, the blank is provided with a suitable cross section with the aid of a pair of rotating rolls, which can be profiled. The rolled blank is then moved to a forging press for working into final shape.

The forging operation comprises a first step in which a pair of first interacting die cushions shape the material in the first blank so that during working it is provided with a predetermined varying height in a vertical plane along its longitudinal extent, the blank being provided with its main basic shape in this plane. The blank is then moved to a new forging press, or is worked by a new die cushion, which performs a second step in which a pair of second

interacting die cushions shape the material in the first blank so that it is provided with a predetermined varying thickness along one or more of the side surfaces, bottom surface and upper edge surfaces of the profile along its longitudinal extent. This second step is repeated one or more times in further forging presses or further die cushions, successive die cushions shaping the blank until it has been provided with its final shape. In this way, it is possible to redistribute the material of the blank both in its cross section and along its longitudinal extent. By suitable design of the die cushions, the blank can be shaped freely as far as the forging process allows along both its inner and its outer periphery.

In order to produce a closed profile, the first blank must be joined together with a second blank. The second blank consists of the same starting material as the first blank. The second blank is preshaped and finally shaped in the same way as the first blank in a separate forging operation in the same press, or in a separate press, into in the main the same profile as the first blank relative to the dividing plane of the die cushions. An especially advantageous embodiment is to form both the blanks with identical profiles in the same press tool, one blank then being turned so that the edges of the blanks in the dividing plane can be placed against one another.

Before the first blank and the second blank are joined together to form a united construction element, further heating of at least the outer edges of each blank takes place. According to a preferred embodiment, the joining-together takes place by flash butt welding. Flash butt welding is a process intended to produce a butt weld with the same strength as in a corresponding forged blank. This is suitably effected by the blanks being clamped firmly in contact with one another and pressed together in a controlled way while a welding current is applied in order to melt the material in the join between them.

According to an alternative embodiment, joining-together can take place by

the joining edges of the first blank and the second blank being heated by an induction coil, after which they are placed between a pair of interacting die cushions in a press and joined together by forge welding. Alternatively, the joining edges of the first blank and the second blank can be heated simultaneously with the aid of a means for heating introduced between the first blank and the second blank. The blanks are held between a pair of interacting die cushions in a press, after which they are joined together by forge welding. Said means for heating can consist of induction elements, gas flames or the like.

In a final operation, trimming of what is known as flash along the joined-together edges of the profile is effected. This can take place either in the same pressing operation as for the joining-together of the first blank and the second blank, or by separate trimming of the outer edges of the composite profile. The profile is thus provided with a predetermined varying height along its entire longitudinal extent, seen in the plane in which the construction element is intended to be mounted.

The end result is an elongate construction element with a hollow closed cross-sectional profile. The element comprises a first portion with a cross section essentially in the form of a U-profile which has a predetermined varying width, height and material thickness along its length, and a second portion which has an in the main identical U-profile. The two U-profiles are turned with the open parts of each profile facing one another and are joined together at least along the edge surfaces of each U-profile. The term "edge surfaces" or "joining surfaces" comprises all the surfaces where the U-profiles make contact with one another in or close to the dividing plane. Examples of such surfaces are the outer peripheral delimiting surface of each profile, and other surfaces where the edge surfaces of a U-profile are united to form a surface or where surfaces separate from the edge surfaces are located in or close to the dividing plane.

The assembled U-profiles have an essentially vertical dividing plane with regard to the main plane in which the construction element is intended to be used. The mutually facing edge surfaces of the U-profiles are in the main located in this plane. It is also possible to provide the respective edge surfaces with interacting projections and cutouts. Such projections and cutouts contribute both to simplified positioning of the U-profiles relative to one another when they are to be joined together and to the strength of the composite construction element after joining-together.

The embodiments indicated above afford considerably greater possibilities for optimizing the material thickness of the construction element compared with known art. On the one hand, the material can be distributed so that the greatest thickness is obtained where the loads on the construction element are greatest, and, on the other hand, material can be moved toward the periphery of the construction element, which increases its torsional stiffness. A hollow profile of this kind moreover provides a great saving of weight compared with a corresponding product forged in a conventional way.

In order further to increase the strength, the construction element can be made from an air-hardening, microalloyed steel. The product therefore does not need to be hardened or heat-treated in another way after joining-together of the two portions. It is of course possible to use steel of another grade, but further heat-treatment or other aftertreatment, which increases costs, may then be necessary in order to achieve the desired strength.

A construction element which it is suitable to manufacture in this way is a front axle beam. By using the method above, it is possible to manufacture such a beam with a 30% lower weight than a conventionally forged beam (see, for example, EP-A2-0 059 038 above).

As mentioned above, it is possible to optimize the manufacturing method so that the greatest material thickness of the front axle beam is found adjacent

to mounting points and areas which are to be loaded by external forces and torques. The method also makes it possible to adapt the cross section of the front axle beam in such a way that it has essentially the same outer contours in both vertical and horizontal planes as a conventionally forged solid beam. By virtue of providing the outer contours of the beam with the same shape, and also the same offset (height of the kingpin supports relative to the mounting points of the resilient elements in the vertical direction) and drop (height of the upper central point of the beam relative to the mounting points of the resilient elements in the vertical direction) as a standard beam for a given vehicle, it can be used without modifications having to be made in existing vehicles. It is also possible to retain existing mounting points and mechanical interfaces for kingpin supports, springs and the like.

DESCRIPTION OF FIGURES

The invention will emerge in greater detail from the following description of a preferred embodiment, shown as an example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a diagrammatic representation of the steps comprised by a preferred embodiment of the method according to the invention.

Figure 2 shows a perspective view of two shaped blanks before final joining-together to form a front axle beam, according to a preferred embodiment.

Figure 3 shows a front axle beam comprising two blanks according to Figure 2 after joining-together.

Figure 4 illustrates a flash butt welding machine for joining two blanks together to form a front axle beam, according to a preferred embodiment.

Figure 5 illustrates a flash butt welding machine according to Figure 4 after joining-together of a front axle beam.

PREFERRED EMBODIMENTS

Figure 1 shows a preferred embodiment of the method according to the invention, which method comprises a number of steps for manufacturing a composite hollow construction element, in this case a front axle beam for heavy-duty vehicles.

A first blank 1, which has been cut to a predetermined length, is conveyed through an induction furnace 2 where it is heated to working temperature. When use is made of, for example, air-hardening, microalloyed steel, the blank is heated to 1250-1300°C, preferably to 1280°C. When the correct temperature has been reached, the blank is conveyed through a pair of profiled rolls 3, 4 which are profiled so as to provide the blank 1 with a suitable starting cross section along its longitudinal extent. By suitable design of the respective profiles of the rolls 3, 4, an intermediate product is obtained, the cross section and material thickness of which vary along the length of the blank in a way which at least partly corresponds to the finished product, or a rough approximation of its final U-profile. At this stage, the blank 1 is still essentially straight, at least along the peripheral edges, with a number of depressions along the central part.

In the next step, the preshaped blank is moved to a first forging press 5, with upper and lower interacting die cushions 6, 7. In this forging press 5, the shaping of the blank 1 is started, its cross section being provided with a more marked U-profile in certain predetermined areas where great torsional resistance is desirable. Examples of such areas are what are known as the swan-necks 23, 24 at the outer ends of the front axle beam, which swan-necks connect a pair of kingpin supports 19, 20 to the central portion 25 of the beam. In other areas, where great bending resistance is desirable, transverse ribs are retained between the opposite vertical sides of the profile. Examples of such areas are mounting points 21, 22 for the resilient elements (not shown) which are placed between the chassis of the vehicle and the

front axle beam. Such resilient elements can consist of, for example, air bellows. In addition to the shaping of the cross section of the blank 1, deformation in the horizontal direction and the vertical direction is also started, in order to give the beam the desired width and, respectively, vertical height, also called drop, along its longitudinal extent. Seen in the dividing plane of the die cushions, this shaping gives the blank a varying height measured in a vertical plane and also a varying distance from a horizontal plane through the outer ends of the blank 1. Relative to said dividing plane, the greatest vertical height of the finished beam and its greatest distance from the horizontal plane coincide with the portions of the beam for mounting resilient elements. The horizontal dividing plane of the die cushions will in this connection coincide with a vertical plane through a composite hollow front axle beam in the position in which the beam is intended to be used.

In the following step, the blank is moved to a second and third forging press 8, 11 with respective upper and lower die cushions 9, 10; 12, 13. When the blank leaves the third forging press 11, it has been provided with its final shape and is ready to be joined together with a second blank 14 to form a composite hollow beam.

For the sake of clarity, the forging process above is described and illustrated as a number of press tools placed one after another. It is of course possible to shape the blanks in one and the same forging press, only the die cushions then being moved between each working step. The invention per se is not limited to one of these forging processes.

The number of steps required in order to obtain the desired shape of the blank can of course be varied within the scope of the invention, as the number is directly dependent on the properties of the starting material and the degree of deformation desired.

The second blank 14 can originate from the same starting material as the first

blank. The second blank is preshaped and finally shaped in the same way as the first blank 1 in a separate forging operation and, if appropriate, in a separate press into in the main the same profile as the first blank relative to the dividing plane of the die cushions.

According to a preferred embodiment, two identical blanks are manufactured, one blank then being turned toward the other so that their opposite edges are placed against one another when the joining-together operation takes place. In this way, both the blanks can be shaped in the same press tool, which results in a reduced manufacturing cost.

In order to join the first blank 1 and the second blank 14 together, they are conveyed into a flash butt welding machine 15 with interacting fixtures or die cushions 16, 17, the two blanks 1, 14 being positioned in their respective fixtures 16, 17. Before working and joining-together can take place, the first blank 1 and the second blank 14 are brought into contact with one another along their respective edge surfaces.

The blanks are clamped firmly in contact with one another and are then pressed together in a controlled way while a welding current from a current source, such as a welding transformer, is applied in order to melt a controlled quantity of material in the join between the edges of the blanks. The molten material will be pressed out of the join and forms a flash, a corresponding reduction of the width of the blanks taking place at the same time. This will be described in greater detail in connection with Figures 4 and 5. In order that the composite construction element will have the desired width, the edge surfaces of the blanks 1, 14 therefore have to be forged to a slightly greater dimension in a direction at right angles to the dividing plane of the die cushions. The flash can be removed directly by interacting tools in the fixtures 16, 17 or in subsequent machining. Any oxides and other impurities on the edge surfaces will be pressed out of the join together with the melt during the process, which produces a homogeneous joint with the same

strength and other properties as the forged blanks. The result is a composite elongate construction element in the form of a hollow front axle beam.

According to an alternative embodiment, it is also possible to heat the interacting edges of the two blanks 1, 14 separately before they are joined together by forge welding along all the surfaces where the first blank and the second blank are in contact with one another. Heating of the two blanks can also be effected with the aid of gas flames or the like. In connection with the first blank and the second blank being forge-welded together, trimming and removal of superfluous material (what is known as flash) around the edges of the workpiece can be carried out. According to another alternative embodiment, it is also possible to weld the two blanks 1, 14 together.

When the shaping of the front axle beam is complete, it undergoes final machining, mounting holes for the resilient elements being drilled and the kingpin support holders being machined to their final shape and tolerance.

Figure 2 shows the first blank 1 and the second blank 14 as they appear after final shaping, when they are ready to be joined together. The figure shows a view of the front axle beam from an angle obliquely upward, the varying horizontal and vertical extent of the first blank 1 along its length being visible. In this connection, the inner cavities 30, 30', 31, 31' and 32 of the first blank 1, its transverse reinforcing ribs 33, 33', 34, 34' and its kingpin support holders 19, 20 emerge clearly. In this embodiment, the all-round edge surfaces 35 of the first blank 1 shown have an essentially uniform thickness along large parts of its length, but it is of course possible to vary its thickness along the longitudinal extent of the beam, for example by shaping it with a greater material thickness in areas which will be subjected to greater loading after mounting in a vehicle. This is suitably brought about in connection with the forging operations for the blank concerned. The second blank 14 shows the outer contours of the front axle beam. In this connection, the swan-necks 23, 24 of the front axle beam, which connect the kingpin supports 19, 20 to

the central portion 25 of the beam, are visible.

Figure 3 shows a finished front axle beam which has been trimmed to a predetermined width along its peripheral edge. Moreover, the kingpin supports 19, 20 have been machined and provided with through-holes 27, 28 for mounting kingpins, and holes have been drilled for attachment elements at the mounting points 21, 22 for a pair of air bellows (not shown) between the front axle beam and the chassis of the vehicle.

This preferred embodiment shows a front axle beam composed of a pair of in the main symmetrical blanks 1, 14, the vertical dividing plane X of the front axle beam running through the join in the center of the front axle beam. The finished front axle beam will have the same outer dimensions as a conventionally forged front axle beam, for which reason it can be mounted in an existing vehicle without any modifications of the vehicle having to be made.

Alternative embodiments with a dividing plane displaced from the vertical plane of symmetry of the front axle beam are of course also possible.

Figure 4 illustrates diagrammatically a flash butt welding machine 40 before the first blank 1 and the second blank 14 are joined together. The flash butt welding machine 40 comprises a first fixture 41 for the first blank 1 and a second fixture 42 for the second blank 14. The second fixture 42 is displaceable toward the rigidly mounted first fixture 41 along a guide 43. As indicated in the figure, each blank has a predetermined protrusion a_1 from the front end surface of the respective fixture 41, 42. The pushing movement is preferably brought about by a hydraulic cylinder 44, or alternatively by corresponding mechanical means.

Figure 5 illustrates diagrammatically how the first blank 1 and the second blank 14 are joined together in the flash butt welding machine 40. In a first

step, the blanks are clamped firmly in contact with one another by the second fixture 42 being displaced by the hydraulic cylinder 44. In this position, the distance between the mutually facing end surfaces of the fixtures 41, 42 is adapted so that the width b_1 of each blank in the horizontal direction before joining-together is slightly greater than the corresponding width b_2 of each blank in the joined-together front axle beam. The two blanks 1, 14 are then pressed together in a controlled way with the aid of the cylinder at the same time as a welding current from a current source 45, such as a welding transformer, is applied in order to melt a predetermined quantity of the material in the join between them. After the joining-together, both the blanks 1, 14 have a reduced second protrusion a_2, and a correspondingly reduced width b_2. That part of the edges which is heated to melting temperature thus corresponds to the difference in protrusion between said first protrusion a_1 and said second protrusion a_2. The reduction of the width of the blanks during the joining-together means that the molten material will be pressed out of the join and forms a flash, which can be removed directly by interacting tools in the fixtures 41, 42 or in subsequent machining.

The invention is not limited to the embodiments indicated above but can be applied to all types of construction element which can be manufactured with the aid of the method described above.

CLAIMS

1. A method for manufacturing a hollow, elongate construction element, characterized in that it comprises the following steps:

(a) a first blank (1) is conveyed through a furnace (2) for heating to working temperature,

(b) the first blank is conveyed between a pair of rolls (3, 4) with profiled surfaces, the blank being preshaped in one or more steps to form an intermediate product with a predetermined profile along its longitudinal extent,

(c) the first blank is supplied to a forging press with a number of interacting die cushions, the blank being worked in a number of steps (5, 8, 11) to form a first half of an in the main finished product, having a cross section essentially in the form of a U-profile with a predetermined varying height, width and material thickness along its length,

(d) a second blank (1) is conveyed through a furnace (2) for heating to working temperature,

(e) the second blank is conveyed between a pair of rolls (3, 4) with profiled surfaces, the blank being preshaped in one or more steps to form an intermediate product with a predetermined profile along its longitudinal extent,

(f) the second blank is supplied to a forging press with a number of interacting die cushions, the blank being worked in a number of steps (5, 8, 11) to form a second half of an in the main finished product, having a cross section essentially in the form of a U-profile with a predetermined varying height, width and material thickness along its

length, the second blank in the main being a copy of the first blank,

(g) the first blank (1) and the second blank (14) are joined together in a final step (15), at least along their respective edges, to form a composite hollow construction element (18).

2. The method as claimed in claim 1, characterized in that both the first blank and the second blank are forged horizontally with regard to the main plane in which the construction element is intended to be used.

3. The method as claimed in claim 1 or 2, characterized in that the forging operation comprises a first step in which a pair of first interacting die cushions shape the material in the first blank so that it is provided with a predetermined varying height in a horizontal plane along its longitudinal extent, the blank being provided with its main basic shape in this plane.

4. The method as claimed in any one of claims 1-3, characterized in that the forging operation comprises a second step in which a pair of second interacting die cushions shape the material in the first blank so that it is provided with a predetermined varying thickness along one or more of the side surfaces, bottom surface and upper edge surfaces of the profile along its longitudinal extent.

5. The method as claimed in claim 4, characterized in that the second step of the forging operation is repeated one or more times in successive die cushions, until the first blank has been provided with its final shape.

6. The method as claimed in any one of claims 1-5, characterized in that the second blank is preshaped in a separate forging operation, in which it is shaped into an in the main identical profile which is turned relative to the U-profile of the first blank in the dividing plane of the die cushions.

7. The method as claimed in any one of claims 1-6, characterized in that the first blank and the second blank are joined together by flash butt welding.

8. The method as claimed in any one of claims 1-6, characterized in that the first blank and the second blank are heated in a pair of separate induction furnaces, after which they are placed between a pair of interacting die cushions in a press and joined together by forge welding.

9. The method as claimed in any one of claims 1-6, characterized in that the first blank and the second blank are heated simultaneously with the aid of means for heating introduced between the first blank and the second blank, which blanks are held between a pair of interacting die cushions in a press, after which they are joined together by forge welding.

10. The method as claimed in one of claims 8 and 9, characterized in that the heating is effected with the aid of induction elements, gas flame or the like.

11. The method as claimed in any one of the preceding claims, characterized in that two identical blanks are joined together.

12. The method as claimed in any one of the preceding claims, characterized in that trimming of flash along the joined-together edges of the profile is effected in the same operation as the joining-together of the first blank and the second blank, the profile being provided with a predetermined varying height along its longitudinal extent.

13. A hollow elongate construction element manufactured using the method as claimed in claim 1, characterized in that the construction element comprises a first portion with a cross section essentially in the form of a U-profile which has a predetermined varying width, height and material thickness along its length, and a second portion in the form of a U-profile which has an in the main identical profile which is turned relative to the U-profile of the first blank along a vertical dividing plane in the construction element and is joined together with the first portion at least along its edge surfaces.

14. The construction element as claimed in claim 13, characterized in that the construction element is made from a microalloyed steel.

15. The construction element as claimed in claim 13 or 14, characterized in that the construction element constitutes a front axle beam.

16. The construction element as claimed in claim 15, characterized in that the greatest material thickness of the front axle beam is found adjacent to mounting points and areas which are to be loaded by external forces and torques.

17. The construction element as claimed in claim 13 or 14, characterized in that the cross section of the front axle beam has essentially the same outer contours in both vertical and horizontal planes as a conventionally forged solid beam.

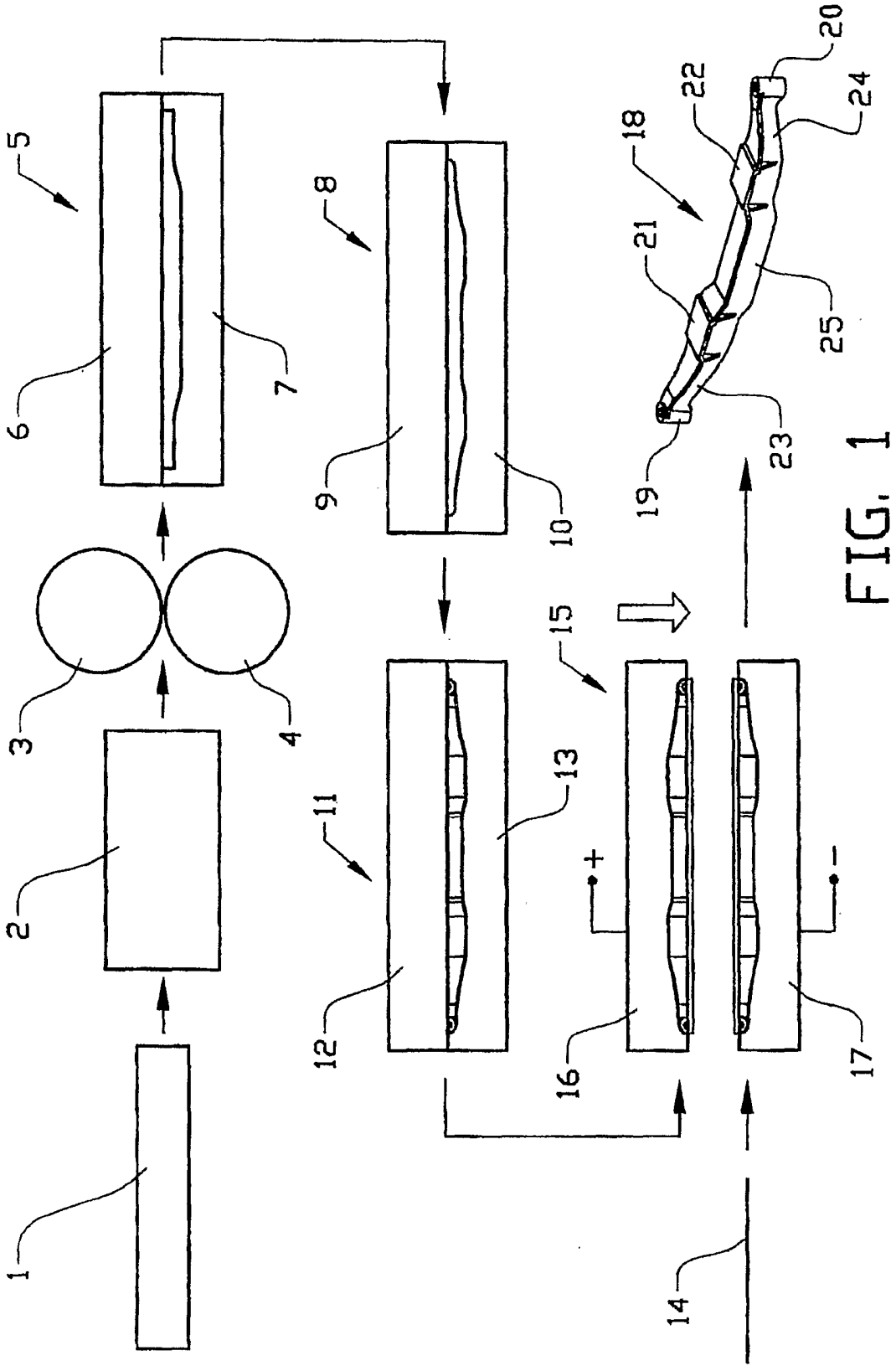


FIG. 1

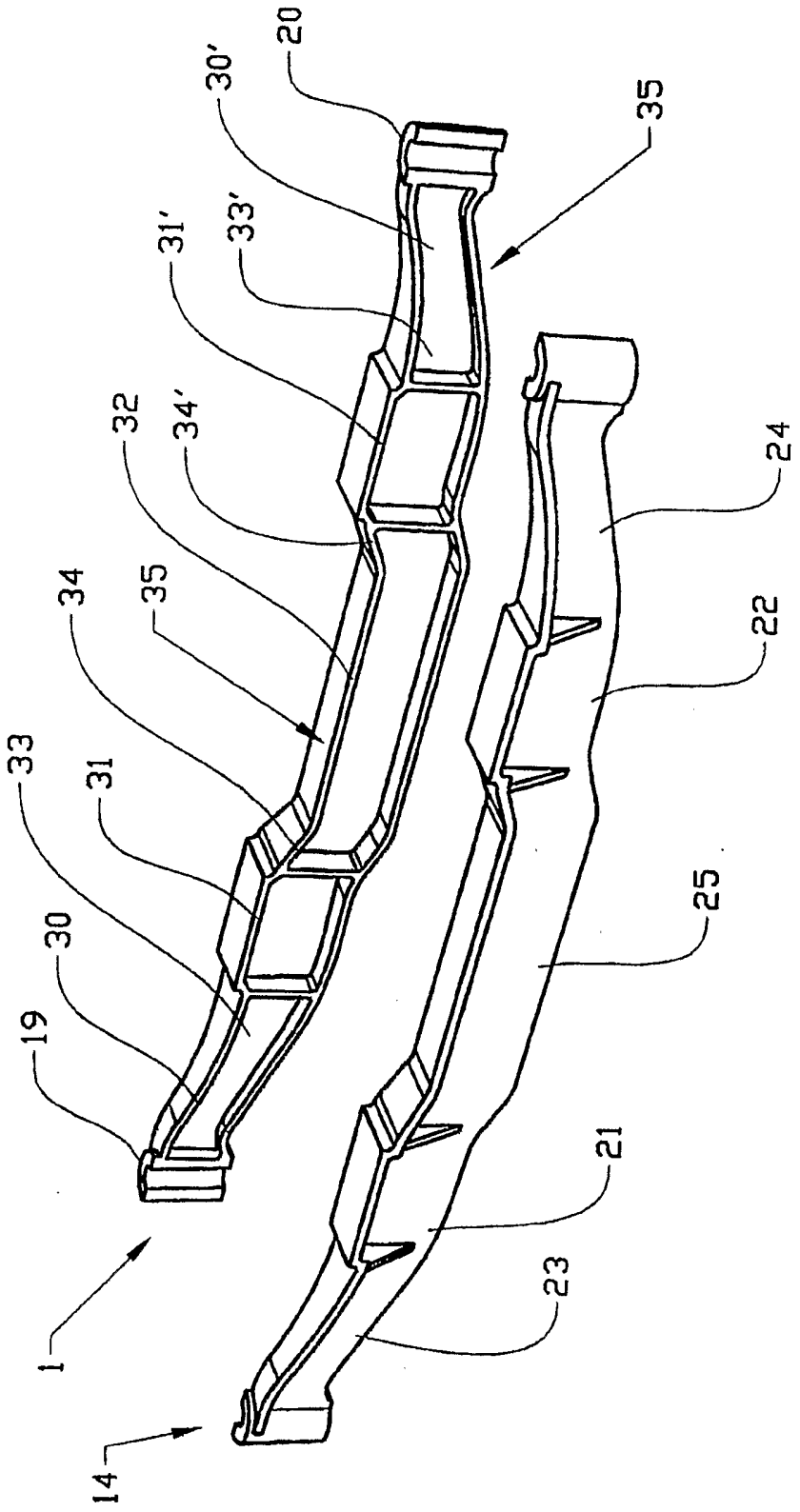


FIG. 2

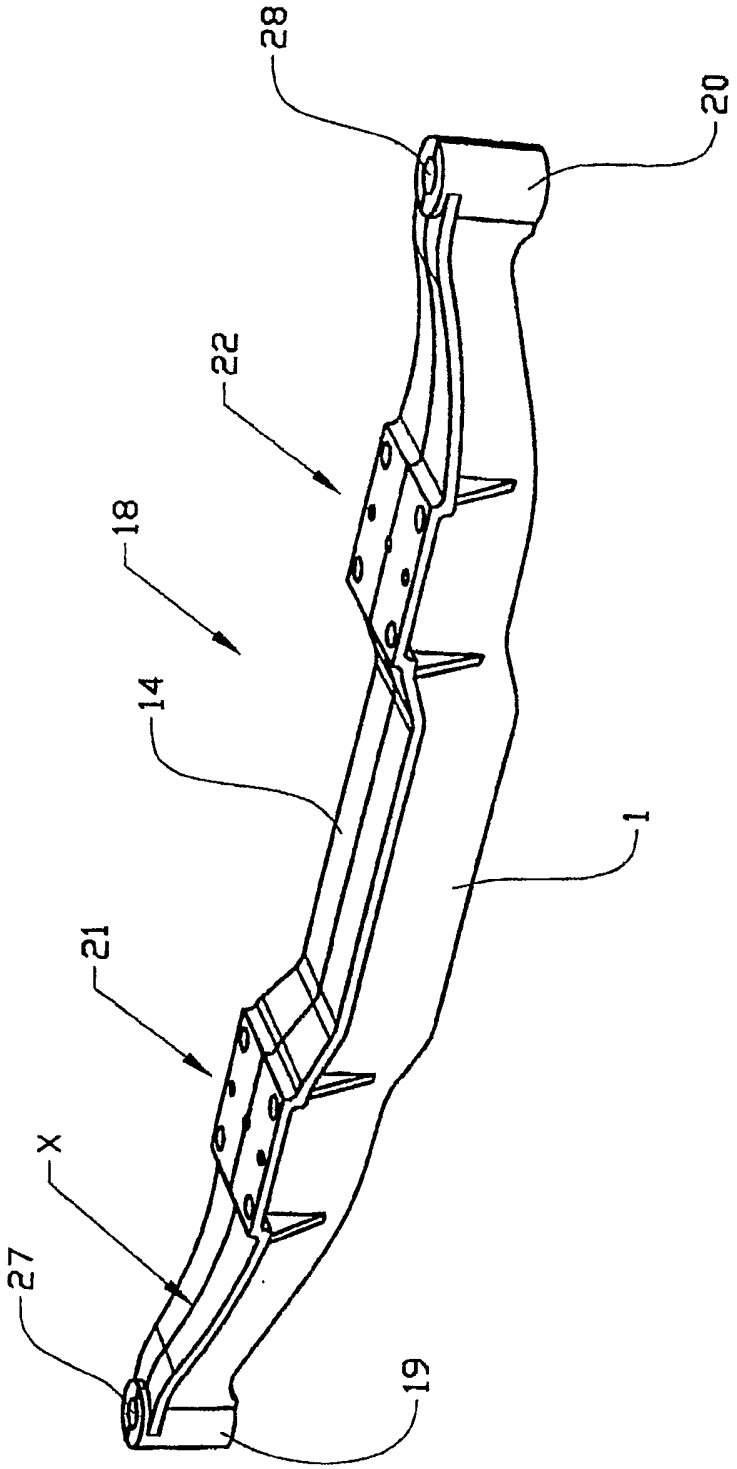


FIG. 3

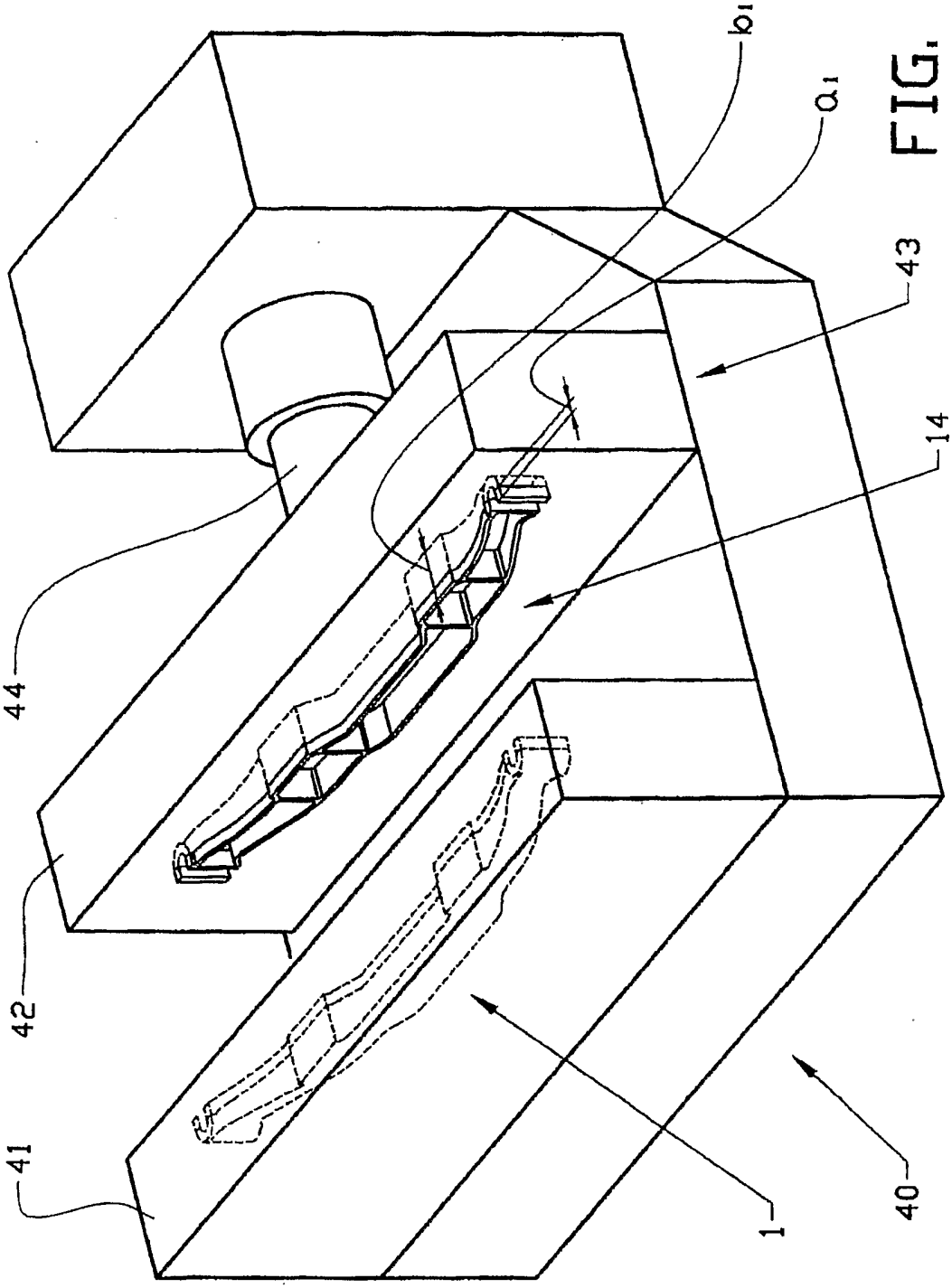
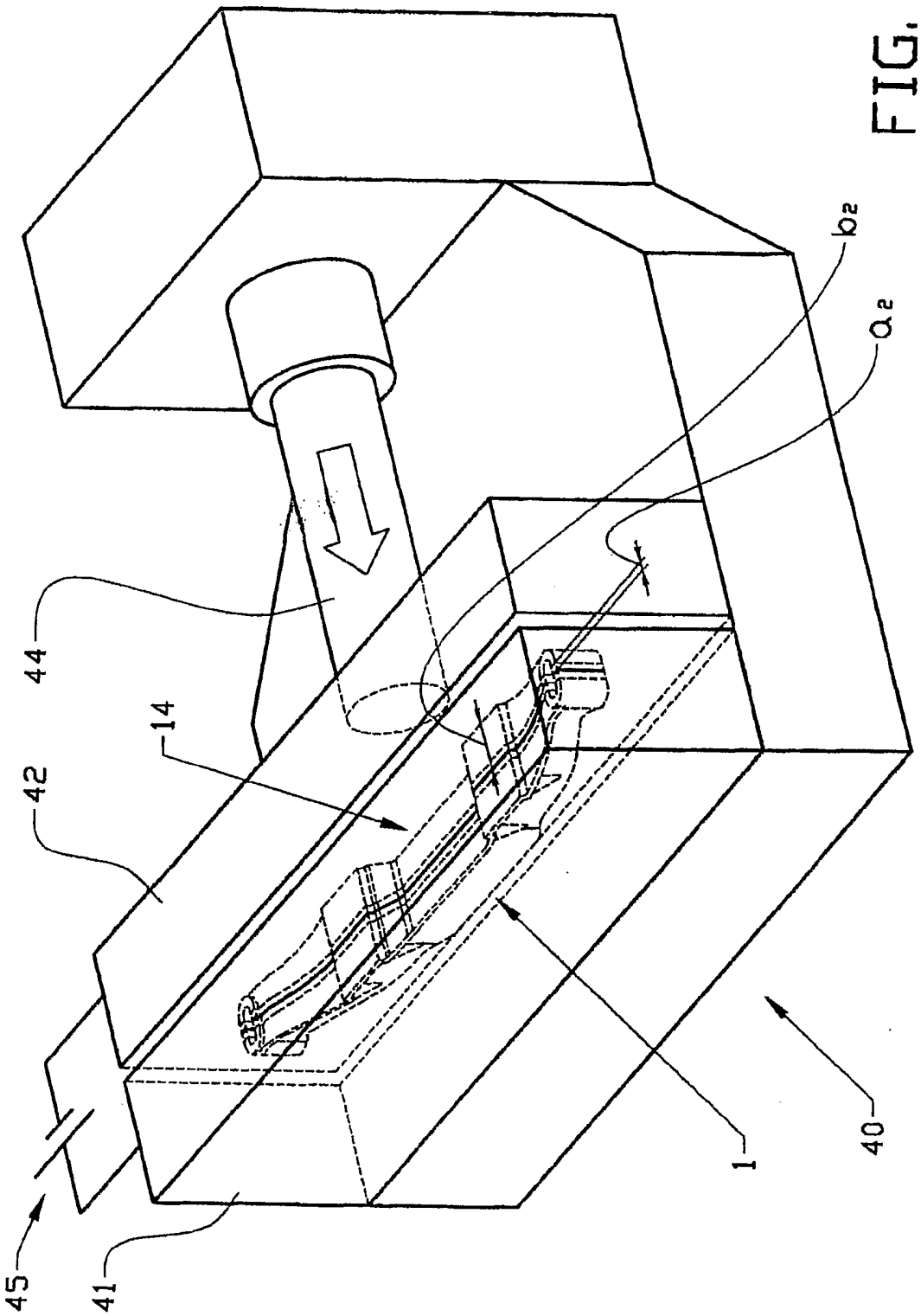


FIG. 4

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/000429

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B21K 1/06, B60B 35/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B21K, B60B, B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, PAJ, TXTE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02076652 A1 (VOLVO LASTVAGNAR AB), 3 October 2002 (03.10.2002), figures 1,2, abstract --	1-17
A	EP 0059038 A2 (THE SCOTTISH STAMPING AND ENGINEERING CO. LIMITED), 1 Sept 1982 (01.09.1982), abstract --	1-17
A	EP 0015648 A1 (LEAR SIEGLER, INC.), 17 Sept 1980 (17.09.1980), abstract --	1-17
A	US 6122948 A (DAVID G. MOSES), 26 Sept 2000 (26.09.2000), abstract --	1-17

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 Sept 2004	20 -09- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Kerstin Waczinska/MN Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/000429

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 199, no.904, 30 April 1999 (1999-04-30) & JP 11011105 A (HITACHI METALS LTD. et al) 19 January 1999 (1999-01-19) abstract -- --------	1-17

INTERNATIONAL SEARCH REPORT

Information on patent family members

31/07/2004

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PCT/SE 2004/000429

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