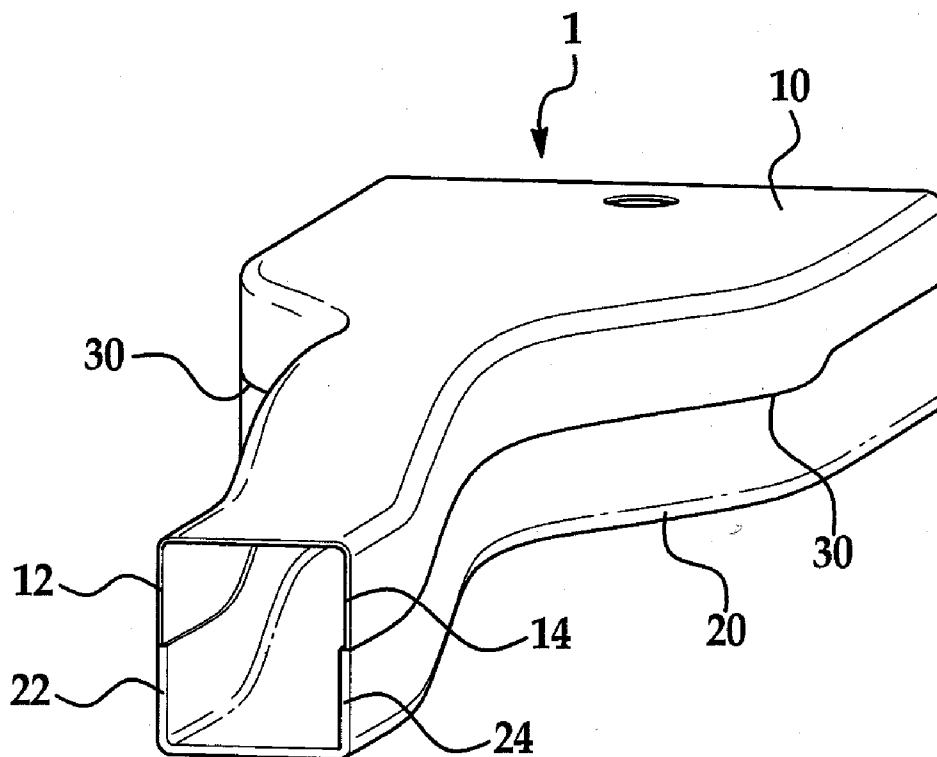




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(19) **United States**(12) **Patent Application Publication**
Gruber(10) **Pub. No.: US 2013/0337285 A1**(43) **Pub. Date: Dec. 19, 2013**(54) **BUTT JOINTED CLOSED SECTION
HOLLOW STRUCTURAL ELEMENT**(52) **U.S. Cl.**
USPC 428/595(76) Inventor: **Rudolf Gruber**, Uxbridge (CA)(21) Appl. No.: **13/525,337**(22) Filed: **Jun. 17, 2012****Publication Classification**(51) **Int. Cl.**
B62D 21/00 (2006.01)
B32B 1/00 (2006.01)(57) **ABSTRACT**

A vehicular structural member is provided from a closed section hollow element that utilizes a conventional clamshell configuration but eliminates the overlapped joint of the prior art. It has been proven that for large volume applications such as those dictated by the automotive industry, sheet metal press forming is the most cost-effective method of manufacturing structural components. The present disclosure eliminates the redundant material associated with overlapping or flange type joints in clamshell closed section hollow elements thereby reducing weight and cost.



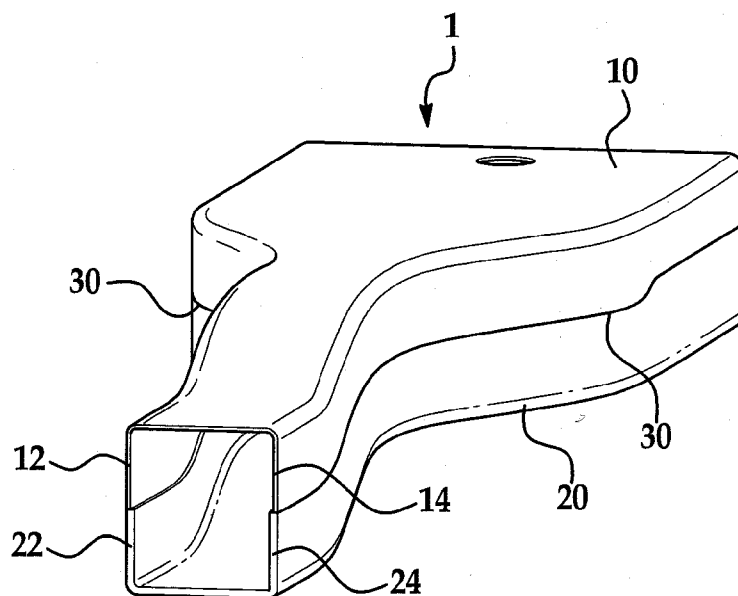


FIG. 1

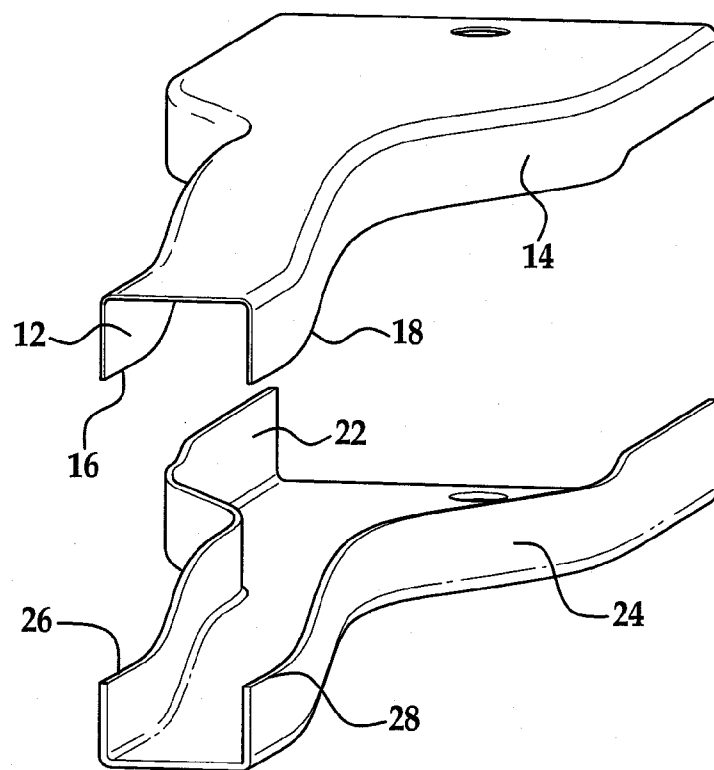


FIG. 2

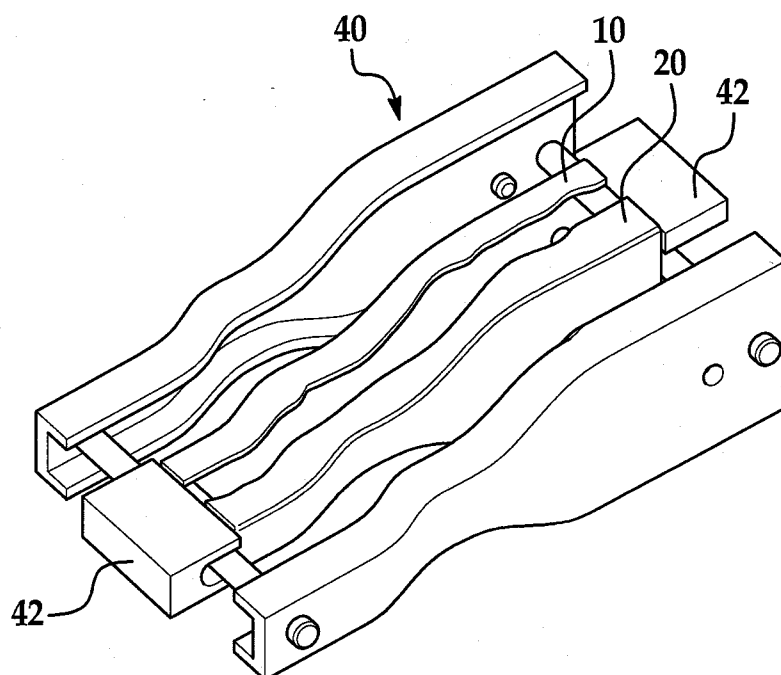


FIG. 3

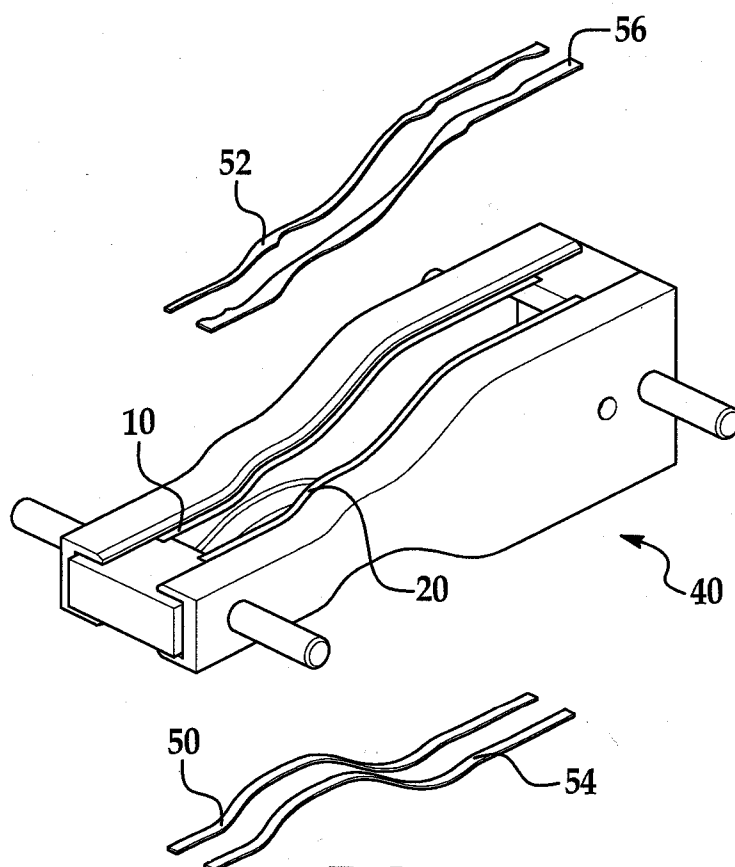


FIG. 4

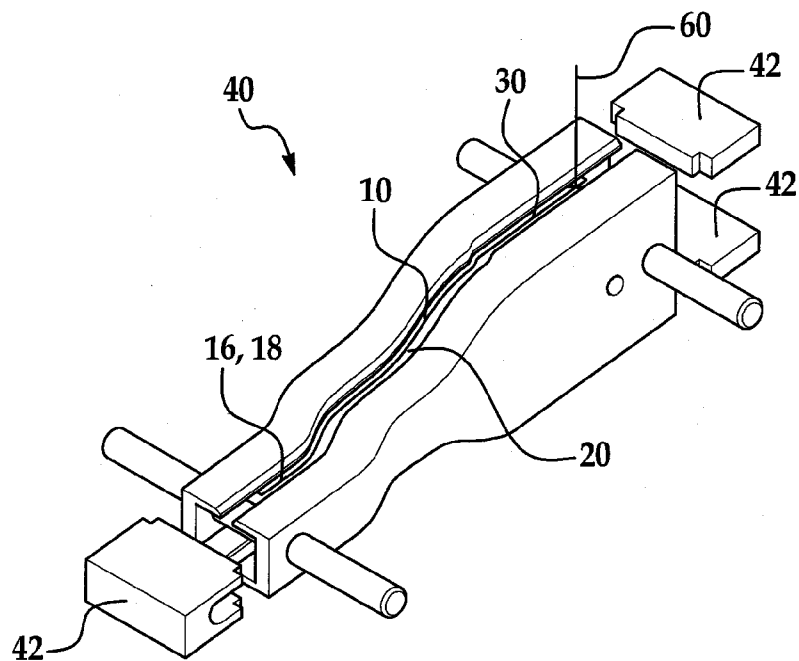


FIG. 5

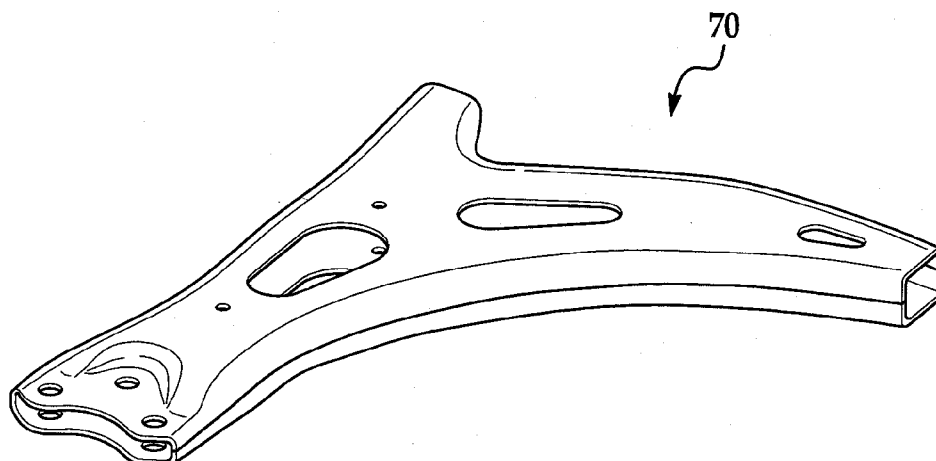


FIG. 6

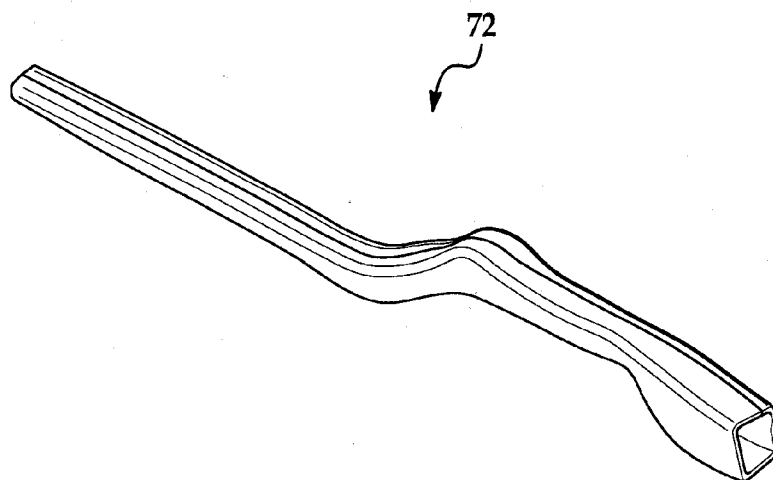


FIG. 7

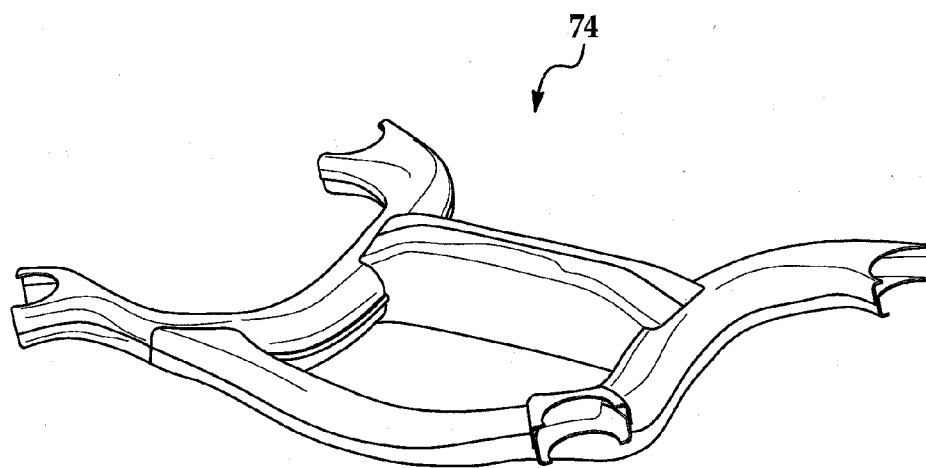


FIG. 8

BUTT JOINTED CLOSED SECTION HOLLOW STRUCTURAL ELEMENT

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims priority to PCT Application No. PCT/IB2010/055898 filed Dec. 10, 2010 and to US provisional patent application no. 61/287662 filed Dec. 17, 2009.

BACKGROUND

[0002] It would be advantageous to create a vehicular structural member such as a motor compartment rail, suspension control arm or suspension subframe beam from a closed section hollow element that utilizes a conventional clamshell configuration but eliminates the overlapped joint of the prior art. It has been proven that for large volume applications such as those dictated by the automotive industry. Sheet metal press forming is the most cost-effective method of manufacturing structural components. Almost every vehicle currently produced utilizes a body structure and selected subframes constructed almost entirely from either aluminum or steel stampings manufactured using press forming techniques. Wherever closed section hollow elements are required they are generally constructed from two press formed open section sheet metal components, creating a clamshell configuration using either an overlapping section to facilitate a suitable fillet type weld joint or a outstanding flange to provide a double material spot weld joint. The primary aim of the present disclosure is to eliminate the redundant material associated with overlapping or flange type joints in clamshell closed section hollow elements.

[0003] The most efficient type of weld joint is a butt arrangement where the two components being structurally joined meet along a tangent interface at their open edges so that there is no overlapping of material. This butt joint can then be welded using MIG, TIG, Arc, Laser or similar means creating a continuous structural attachment of the two components. The quality of this welded butt joint is extremely sensitive to the gap between the two components and the differential thickness of the materials of the two components. The differential thickness can be controlled by correct specification during the design process. The gap between the two components is dependent on manufacturing process capability. When the two components are constructed from stamped sheet metal using press formed techniques the open edges cannot be developed to interface with a zero gap due to limitations in the process. It is for this reason that press formed clamshell configurations use either an overlapping section to facilitate a suitable fillet type weld joint or an outstanding flange to provide a double material spot weld joint.

SUMMARY

[0004] The most effective process for continuous structural attachment of two metal components is laser welding as laser welding imparts significantly less heat than other welding techniques. Laser welding also generally does not require filler material and has significantly faster application speed. However, laser welding requires even tighter tolerances on butt joint gaps than other welding techniques and so is generally only applied to overlapping material configurations. A closed section hollow element constructed from two press

formed open section sheet metal components configured as a clamshell with structural attachment created by laser welding of a butt joint at the interface between the components would offer a significant weight and cost advantage over the configurations of the prior art.

[0005] In an embodiment of the present disclosure, a closed section hollow element is constructed from an upper sheet metal stamped component with a generally open section manufactured using press forming techniques and configured with two primarily parallel downstanding interface flanges and a lower sheet metal stamped component with a generally open section manufactured using press forming techniques and configured with two primarily parallel upstanding interface flanges. After press forming the upper sheet metal stamped component and lower sheet metal stamped component are rigidly held in dimensional compliance by a purpose built fixture and the upstanding and downstanding interface flanges are complementarily trimmed using five-axis laser cutting. The fixture facilitates movement of the upper sheet metal stamped component and lower sheet metal stamped component into contact with each other along their entire interface with a zero gap while continuing to rigidly hold the components in dimensional compliance. The upper sheet metal stamped component and lower sheet metal stamped component are then structurally attached along the zero gap interface by a continuous laser butt weld while being rigidly held in the fixture. Because the components are rigidly held in dimensional compliance and the five axes trimming operation is undertaken in the same fixture the zero gap interface is absolutely maintained and a high quality laser welded joint with no redundant material overlap, very little heat effect and high processing speed is achieved. The result is a continuous hollow structural element of a variable cross section that has a high level of dimensional integrity because once the two sheet metal stamped components are structurally attached they hold each other in dimensional compliance once removed from the fixture thereby eliminating the effects of material springback and forming inaccuracies in the individual components.

[0006] In this manner, a highly efficient closed section hollow element is created that utilizes less material than structurally equivalent overlapped or flanged clamshell configurations thereby achieving a lower mass and lower cost solution. Additionally the closed section hollow element of the present disclosure can be constructed with cost effective press forming tools because highly accurate sheet metal stamped components are no longer required as the fixture provides the required dimensional tolerances during trimming and welding. An additional advantage of the closed section hollow element of the present disclosure is that its cross section area can be greatly varied along its length with far higher ratios than conventional closed section, non-overlapping joint arrangements produced by roll forming, blow forming or hydroforming.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of the inventive closed section hollow element;

[0008] FIG. 2 is an expanded perspective view of the inventive closed section hollow element;

[0009] FIG. 3 is a perspective view of the components of the inventive closed section hollow element partially installed in the purpose built fixture;

[0010] FIG. 4 is a perspective view of the purpose built fixture with the components of the inventive closed section hollow element fully installed and trimmed;

[0011] FIG. 5 is a perspective view of the purpose built fixture with the components of the inventive closed section hollow element fully installed during laser welding;

[0012] FIG. 6 is a perspective view of an application of the inventive closed section hollow element;

[0013] FIG. 7 is a perspective view of a further application of the inventive closed section hollow element;

[0014] FIG. 8 is a perspective view of another application of the inventive closed section hollow element.

DETAILED DESCRIPTION

[0015] Referring to FIGS. 1 and 2, a closed section hollow element (1) is substantially constructed from an upper sheet metal stamped component (10) and a lower sheet metal stamped component (20). Both of the sheet metal stamped components are manufactured by press forming a flat sheet of steel, aluminum or other suitable metal or alloy into a required open section shape which is dictated by the final application's structural and packaging requirements. The upper sheet metal stamped component (10) is configured with two primarily parallel downstanding interface flanges (12) (14). As shown in the non-limiting example of FIGS. 1 and 2, the lower sheet metal stamped component (20) is configured with two primarily parallel upstanding interface flanges (22) (24). The downstanding interface flanges (12)(14) of the upper sheet metal component (10) are five-axes laser trimmed after press forming to create highly accurate interface edges (16)(18). The upstanding interface flanges (22)(24) of the lower sheet metal component (20) are five-axes laser trimmed after press forming to create highly accurate interface edges (26)(28). The interface edges (16)(18)(26)(28) are complementarily trimmed via a five-axes laser during a single operation while the upper sheet metal stamped component (10) and a lower sheet metal stamped component (20) are rigidly held in dimensional compliance by a purpose built fixture. In this manner the interface edges (26)(28) of the upstanding interface flanges (22)(24) and the interface edges (16)(18) of the downstanding interface flanges (12)(14) are configured to tightly match with a zero gap. This zero gap interface (also referred to as "interface") facilitates a high quality laser welded butt joint (30) that structurally attaches the upper sheet metal stamped component (10) and a lower sheet metal stamped component (20) so as to create a continuous hollow structural element (1) of a variable cross section.

[0016] FIG. 3 illustrates a non-limiting example of a purpose built fixture (40) configured to rigidly hold the upper sheet metal stamped component (10) and lower sheet metal stamped component (20) with the sheet metal stamped components shown prior to installation in the purpose built fixture (40) held at a predetermined distance by the spacer blocks (42). FIG. 4 illustrates the purpose built fixture (40) with the upper sheet metal stamped component (10) and lower sheet metal stamped component (20) fully installed in the fixture (40) and the interface edges (16)(18)(26)(28) having been complementarily trimmed via a five-axes laser. The scrap material (50)(52) that contains inaccurate formed edges (54) (56) is shown detached from the interface flanges (12)(14) (22)(24).

[0017] FIG. 5 illustrates the purpose built fixture (40) with the spacer blocks retracted (42) and the upper sheet metal stamped component (10) and lower sheet metal stamped com-

ponent (20) brought into contact with each other along their previously laser trimmed interface edges (16)(18)(26)(28) creating a zero gap condition. A laser beam (60) is illustrated completing a welded butt joint (30) along the entire zero gap interface so as to create a continuous hollow structural element (1) of a variable cross section.

[0018] FIG. 6 illustrates a non-limiting example of a vehicular suspension arm (70) configured as a closed section hollow element of a variable cross section constructed using the manufacturing technique previously described.

[0019] FIG. 7 illustrates a non-limiting example of a vehicular motor compartment rail (72) configured as a closed section hollow element of a variable cross section constructed using the manufacturing technique previously described.

[0020] FIG. 8 illustrates a non-limiting example of a vehicular suspension subframe (74) configured from four closed section hollow elements of variable cross section constructed using the manufacturing technique previously described.

What is claimed is:

1. A closed section hollow element formed from sheet metal comprising:

an upper sheet metal stamped component with a generally open section manufactured using press forming techniques and configured with two primarily parallel downstanding interface flanges;

a lower sheet metal stamped component with a generally open section manufactured using press forming techniques and configured with two primarily parallel upstanding interface flanges;

said upstanding and downstanding interface flanges being complementarily trimmed after press forming so as to contact each other along an interface between the upper sheet metal stamped component and the lower sheet metal stamped component, and said interface being operatively configured as a butt welded structural attachment joint between the upper sheet metal stamped component and lower sheet metal stamped component thereby creating a continuous hollow structural element of a variable cross section.

2. The closed section hollow element of claim 1 wherein the upstanding and downstanding interface flanges of the upper sheet metal stamped component and the lower sheet metal stamped component are complementarily trimmed using five-axes laser cutting.

3. The closed section hollow element of claim 1 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are structurally attached along the interface by a continuous laser butt weld.

4. The closed section hollow element of claim 2 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are rigidly held in dimensional compliance while the upstanding and downstanding interface flanges are complementarily trimmed using five-axes laser cutting.

5. The closed section hollow element of claim 3 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are rigidly held in dimensional compliance while being structurally attached along the interface by a continuous laser butt weld.

6. A closed section hollow element formed from sheet metal comprising:

an upper sheet metal stamped component with a substantially open section adapted to be manufactured using

press forming techniques, the upper sheet metal stamped component configured with two primarily parallel downstanding interface flanges;

a lower sheet metal stamped component with a generally open section manufactured using press forming techniques and configured with two primarily parallel upstanding interface flanges;

said upper sheet metal stamped component and said lower sheet metal stamped component being operatively configured to be rigidly held in dimensional compliance while the upstanding and downstanding interface flanges are complementarily trimmed using five-axes laser cutting after press forming so as to contact each other along their entire interface;

said upper sheet metal stamped component and said lower sheet metal stamped component being operatively configured to be rigidly held in dimensional compliance

while being structurally attached along the interface by a continuous laser butt weld thereby creating a continuous hollow structural element of a variable cross section.

7. The closed section hollow element of claim 6 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are operatively configured to function as a vehicular suspension arm.

8. The closed section hollow element of claim 6 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are operatively configured to function as a vehicular motor compartment rail.

9. The closed section hollow element of claim 6 wherein the upper sheet metal stamped component and the lower sheet metal stamped component are operatively configured to function as a beam for a vehicular suspension subframe.

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