

expansion. Before the sizing treatment, the thin-walled article is mounted on or surrounded by a mandrel that is formed of a material having a coefficient of thermal expansion that is significantly greater than that of the thin-walled article. When the thus assembled article and mandrel are heated to an elevated temperature, the mandrel expands at a faster rate than the thin-walled article, thereby exerting radially directed pressure on the article. The article and mandrel materials are selected such that within a preselected temperature range, the mandrel will expand to an external, or internal, cross-sectional dimension that corresponds to the desired internal, or external, cross-sectional dimension of the sized article.

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Summary of the Invention

~~The above-described problem of distortion in a welded duct assembly formed of a high strength, lightweight metal or alloy is solved to a large degree in accordance with this invention whereby there is provided a novel method for fabricating a welded metallic duct assembly. The fabrication process in accordance with this invention includes the steps of forming tubing from a flat form of a metal or alloy, annealing the tubing while applying radially directed pressure to a surface thereof, and then welding the tubing to an end of another similarly processed tube, a fitting, or a connector to form a duct assembly.~~

The annealing step is preferably carried out by mounting the tubing on a mandrel having a cross section that is slightly smaller than the inside dimension of the unannealed tubing and a coefficient of thermal expansion that is substantially greater than that of the metal or alloy used to form the tubing, whereby a tubing/mandrel combination is formed. The tubing/mandrel combination is heated in

ATTACHMENT

Proposed New Claims
Singapore Patent Application No. 9501676-2
CA-265 Singapore
CRS Holdings, Inc.

1. A process for fabricating a duct assembly comprising the steps of:
 - selecting a sheet of a metal or an alloy having a desired coefficient of thermal expansion;
 - forming said sheet into a tubular channel having a desired cross-sectional geometry by press-forming said sheet such that opposite edges of said sheet are brought into close proximity to each other;
 - welding the opposite edges of said sheet to close said channel and form a longitudinal seam thereon, thereby forming tubing from said channel;
 - annealing said tubing while applying radially directed pressure to a surface thereof for a time sufficient to substantially relieve residual stresses in said tubing; and then
 - circumferentially welding an end of said tubing to an article selected from the group consisting of a fitting, a tubular spacer, a connector, a flange, or similarly prepared tubing.
2. The process set forth in Claim 1 wherein the step of annealing said tubing comprises the steps of:
 - mounting the tubing on a mandrel having a cross section that is smaller and a coefficient of thermal expansion that is substantially greater than that of the metal or alloy used to form said tubing, whereby a tubing/mandrel combination is formed;
 - heating the tubing/mandrel combination to an elevated temperature sufficient to cause the mandrel to expand to a cross-sectional size that corresponds to a desired inside cross-sectional size for said tubing;
 - maintaining the tubing/mandrel combination at said elevated temperature for a time

sufficient to substantially relieve the residual stresses in said tubing; and then
cooling said tubing/mandrel combination to a temperature at which said tubing and
said mandrel can be readily separated.

3. The process according to Claim 2 wherein the step of heating the tubing/mandrel
combination comprises the steps of:

placing the tubing/mandrel combination in a pressure vessel and then closing and
sealing the pressure vessel;

evacuating the pressure vessel to remove atmospheric gases; and then
placing the pressure vessel in a heat treating furnace.

4. The process set forth in Claim 3 further comprising the step of backfilling the pressure
vessel with an inert gas after it has been evacuated.

5. The process set forth in any preceding claim wherein the step of circumferentially
welding the tubing to the article comprises the steps of:

aligning the end of said first tubing with an end of the article; and then

forming a circumferential weld between the tubing and the article to join them
together.

6. The process set forth in Claim 2, 3, or 4 wherein the tubing is formed of a titanium
alloy and the mandrel is formed of a stainless steel alloy.

7. The process set forth in Claim 6 wherein the tubing is circular in cross section.

8. A process for fabricating a duct assembly comprising the steps of:

forming first and second tubes from a thin-walled flat form of titanium or a titanium
alloy, each of said tubes being formed by selecting a sheet of titanium or titanium alloy

having a desired coefficient of thermal expansion, forming said sheet into a channel having a desired cross-sectional geometry by press-forming said sheet, said sheet being formed such that opposite edges of said sheet are brought into close proximity to each other, and welding the opposite edges of said sheet to close said channel and form a longitudinal seam thereon;

annealing said first and second tubes while applying radially directed pressure to a surface of each of said tubes for a time sufficient to substantially relieve stresses in said tubes; and then

circumferentially welding an end of said first tube to an end of said second tube.

9. The process set forth in Claim 8 wherein the step of annealing said tubes comprises the steps of:

mounting a tube on a mandrel having a cross-section that is smaller than, and a coefficient of thermal expansion that is greater than that of the titanium or titanium alloy used to form said tube, whereby a tube/mandrel combination is formed;

heating the tube/mandrel combination to an elevated temperature sufficient to cause the mandrel to expand to a cross-sectional size that corresponds to a desired inside cross-sectional size for said tube;

maintaining the tube/mandrel combination at said elevated temperature for a time sufficient to substantially relieve the residual stresses in said tube; and then

cooling said tube/mandrel combination to a temperature at which said tube and said mandrel can be readily separated.

10. The process according to Claim 9 wherein the step of heating the tube/mandrel combination comprises the steps of:

placing the tube/mandrel combination in a pressure vessel and then closing and sealing the pressure vessel;

evacuating the pressure vessel to remove atmospheric gases; and then

placing the pressure vessel in a heat treating furnace.

11. The process set forth in Claim 10 further comprising the step of backfilling the pressure vessel with an inert gas after it has been evacuated.

12. The process set forth in any one of Claims 8 to 11 wherein the step of welding the first and second tubes comprises the steps of:

aligning the end of said first tube with the end of said second tube to form a seam therebetween; and then

forming a circumferential weld around the tubes to join them together.

13. The process set forth in Claim 9, 10, or 11 wherein the tube/mandrel combination is heated to a temperature of about 1400-1450°F (760-790°C).

14. The process set forth in any one of Claims 8 to 13 wherein the channel has a circular cross-section.