during HIPping is generally uniform, certain regions of the canister, such as corners, are under greater stress and highly localized strain. If, for example, the interior volume of a HIPping canister is not completely filled with metallurgical powder in a corner region where an endplate transitions into the body portion of the canister, the degree of localized strain in the region can be severe and may cause weld failure and resultant incomplete densification of the metallurgical powder.

[0035] FIG. 3 is a representation of calculated stress levels (in units of Pascals) experienced during HIPping for a region of a metallurgical powder-filed cylindrical HIPping canister including a conventional flat top endplate. FIG. 3 shows that the corner region of the flat endplate, where the endplate mates with a circular end of the body portion of the canister, experiences high stress levels and highly localized strain. The figure further shows that the high stresses experienced by the corner region are transferred to areas in the corner of the billet formed in the canister during HIPping. The stresses to which the corners of the consolidated billet are subjected during HIPping may produce a billet that fractures during upset forging or other post-consolidation processing.

[0036] An aspect of the present disclosure is directed to a HIPping canister endplate design that may reduce the stress concentration in the corner regions of the HIPping canister as the canister deforms during HIPping. Figure 4A is a schematic representation of a cross-section through the center of a circular endplate 210 according to a non-limiting embodiment of the present disclosure. Endplate 210 comprises an outer face 212 and an inner face 214. The inner face 214 forms a region of the internal surface of the HIPping canister to which the endplate 210 is secured. The outer face 214 forms a region of the exterior surface of the HIPping canister. Endplate 210 also comprises central region 216, which in certain non-limiting embodiments has a generally uniform thickness *(i.e.,* in the embodiment, the distance between the outer face 212 and the inner face 214 is generally uniform in the central region 216). In certain non-limiting embodiments, the uniform thickness of the central region 216 may be in a range of about 0.64 centimeters (0.25 inches) to about 2.54 centimeters (1 inch), or about 1.27 centimeters (0.5 inches). In certain non-limiting embodiments, the diameter of the central region 216, as measured along the outer face

212, may be in a range of about 0.64 centimeters (0.25 inches) to about 2.54 centimeters (1 inch), or about 1.27 centimeters (0.5 inches). In certain non-limiting embodiment, the central region 216 may include a bore through the endplate 210, passing between the outer face 212 and the inner face 214 and allowing access into the interior volume of the HIPping canister.

[0037] Still referring FIG. 4A, endplate 210 further includes a main region 218 extending radially from the central region 216 and terminating in a corner 220 that extends entirely about the circular periphery 222 of the circular endplate 210. In certain non-limiting embodiments, the diameter of the outer face 212 of the endplate 210 may be in a range of about 2.54 centimeters (1 inch) to about 76.20 centimeters (30 inches), or in a range of about 12.70 centimeters (5 inches) to about 63.50 centimeters (25 inches), or about 52.32 centimeters (20.6 inches). As shown in FIG. 4A, a thickness of the endplate 210 increases from the central region 216 through the main region to the corner 220. The increasing thickness of the endplate 210 in the main region 218 as the distance from the center of the endplate 210 increases defines a taper angle θ. In certain non-limiting embodiments of endplate 210, the taper angle may be in a range of about 3° to about 15°, or about 5° to about 10°, or about 8°. In the non-limiting embodiment of endplate 210 shown in FIG. 4A, the outer face 212 is substantially planar and the taper angle is formed by a downward sloping of the inner face 214 away from the outer face 212 in the direction of the periphery 222.

[0038] Referring now to FIGs. 4A and 48, the corner 220 includes a peripheral lip 224 having a shape configured to mate with a circular face of a cylindrical body portion (not shown) of the HIPping canister. The corner 220 includes a radiused inner surface region 226 by which the main region 218 smoothly transitions *(i.e.,* transitions without sharp edges or corners) into the peripheral lip 224. In certain non-limiting embodiments of endplate 210, the radiused inner surface region 226 may have a circular cross-section having a radius in a range of about 1.27 centimeters (0.5 inches) to about 7.62 centimeters (3.0 inches), or about 5.08 centimeters (2.0 inches). It will be understood, however, that the radius of the inner surface region 226 will generally depend on the size of the HIPping canister. The radiused inner surface region 226 of the corner 220 acts to spread the stress that occurs in the corner region over the endplate and to the vertical wall of the canister, as shown in FIG. 5 and as discussed further hereinbelow. Otherwise, the

consolidated billet may include a sharp corner having high residual stresses. The portion of a HIP billet end face including a sharp comer must be machined away prior to forging or other processing of the billet, resulting in the waste of expensive alloy material.

[0039] With regard to an HIPping canister endplate according to the present disclosure, it will be understood, that the radiused inner surface region 226 need not have a circular cross-section and may have any cross-sectional shape that smoothly transitions from the main region 218 into the peripheral lip 224 and spreads out the stresses experienced in the corner 220 during HIPping. Non-limiting examples of other possible cross-sectional shapes for the curved inner surface region 226 include, for example, rounded and elliptical shapes.

[0040] In a non-limiting embodiment according to the present disclosure, the peripheral lip 224 of the endplate 210 includes a chamfer 228 that extends around the periphery of the endplate 210. The chamfer 228 is configured to accept a weld bead (not shown) securing the endplate 210 to the body portion (not shown) of the HIPping canister. In a non-limiting embodiment, the chamfer 228 comprises a chamfer width in a range ~~if~~of about 0.32 centimeters (0.125 inches) to about 0.64 centimeters (0.25 inches) and is angled relative to an axis of the endplate 210 so as to form a chamfer angle in a range of about 30° to about 60°, or about 45°.

[0041] In one non-limiting embodiment according to the present disclosure, the endplate 210 further comprises at least one fill stem 230. The at least one fill stem 230 is configured to allow powdered materials to be introduced into an interior volume of a HIPping canister to which the endplate 210 is secured. The fill stem 230 also allows gases to be removed from the interior volume of the HIPping canister prior to HIP consolidation. In a non-limiting embodiment, a single fill stem 230 is welded to the periphery of a bore formed through the central region 216 of the endplate 210. It will be understood that although a single fill stem 230 is shown in FIG. 4A in a central region of endplate 210, one or more fill stems can be located at other positions on the endplate, and a fill stem need not be included in a central position on the endplate. Each such fill stem should provide fluid communication with the interior volume of the HIPping canister to which the endplate is secured.

interior volume of the HIPping canister. In still another non-limiting embodiment, an endplate according to the present disclosure exhibits a surface roughness of about or no greater than 125 RMS (root mean square). Any technique useful for reducing surface roughness of the inner surfaces of the endplate may enhance powder filling and/or cleanliness of the interior volume of the canister.

[0051] Endplates constructed according to the present disclosure may be generally circular and configured to fit a cylindrical body portion of a HIPping canister. However, it will be understood that the endplates according to the present disclosure can be of any shape designed to fit the body portion of the HIPping canister to be provided. Regardless of overall shape, any such endplate embodiment according to the present disclosure will embody the tapered inner face and/or corner radiused inner surface features described herein.

[0052] Referring now to FIG. 6, another aspect of the present disclosure is directed to a canister for hot isostatic pressing a powdered material. FIG. 6 depicts a cross-section of a non-limiting embodiment of a HIPping canister 300 according the present disclosure. Canister 300 comprises a body portion 302, which may have, for example, a cylindrical shape or any other suitable shape. Canister 300 comprises a first endplate 304 constructed according to the present disclosure to include a tapered inner face and a corner including a radiused inner surface as described herein. Endplate 304 is welded to a circular first end 306 of the body portion 302. The endplate 304 may have, for example, the design of endplate 210 shown in FIGs. 4A and 4B, which is described above. Endplate 304 may include at least one lift lug 307 configured to expedite lifting and moving of the canister 300.

[0053] Referring now to FIGs. 4A, 4B, and 6, HIPping canister 300 includes endplate 304 which, with reference to FIGs. 4A and 4B, comprises an outer face 212, an inner face 214, and a central region 216. In a non-limiting embodiment, the central region 216 may have a uniform thickness. In specific non-limiting embodiments, the uniform thickness of the central region 216 may be in a range of about 0.64 centimeters (0.25 inches) to about 2.54 centimeters (1.00 inch), or about 1.27 centimeters (0.5 inches). In non-limiting embodiments, the diameter of the central region 216 may be in a range of about 0.64 centimeters (0.25 inches) to about 2.54 centimeters (1 inch), or about 1.27 centimeters (0.5 inches). In another

non-limiting embodiment, the central region 216 may define a bore in the endplate. In a non-limiting embodiment, the first endplate 304 may be circular in shape to mate with a circular end of a cylindrical body portion 302 of a HIPping canister 300. However, as discussed above, endplates according to the present disclosure may have any general shape suitable to mate with the shape of the particular body portion of the HIPping canister.

[0054] Still referring to the non-limiting embodiment of FIGs. 4A, 4B, and 6, first endplate 210, 304 further includes a main region 218 extending radially from the central region 216 and terminating in a corner 220 about a circular periphery 222 of the endplate. According to a non-limiting embodiment, the first endplate 304 may have a diameter in a range of about 2.54 centimeters (1.0 inch) to about 76.20 centimeters (30 inches), or in a range of about 12.70 centimeters (5 inches) to about 63.50 centimeters (25 inches), or about 52.32 centimeters (20.6 inches). The outer face 212 is substantially planar, but a thickness of the endplate 210 increases from the central region 216 to the corner 220 and thereby defines a taper angle 8. In non-limiting embodiments, the taper angle may be in a range of about 3° to about 15°, or in a range of about 5° to about 10°, or about 8°. The corner 220 includes a peripheral lip 224 configured to mate with a circular first end of the body portion 302. The corner 220 includes an inner surface 226 that is radiused so as to smoothly transition between the main region 218 and the peripheral lip 224. In non-limiting embodiments, the radiused portion is a circular radius of about 1.27 centimeters (0.5 inches) to about 7.62 centimeters (3.0 inches), or about 5.08 centimeters (2.0 inches).

[0055] In a non-limiting embodiment according to the present disclosure, the peripheral lip 224 of the endplate 210, 304 includes a chamfer 228. The chamfer 228 is configured to accept a weld bead 308 for welding the endplate 210, 304 to the body portion 302 of a hot isostatic pressing canister 300. In a non-limiting embodiment, the chamfer 228 may comprise a chamfer length in a range of about 0.32 centimeters (0.125 inches) to about 0.64 centimeters (0.25 inches), and a chamfer angle in a range of about 30° to about 60°, or about 45°.

[0056] In non-limiting embodiments, an endplate, fill stem, and canister body portion according the present disclosure consists of or comprises low carbon steel, mild steel, or stainless steel. In a specific embodiment, an endplate, fill stem, and canister body portion according to the present disclosure is fabricated from AISI T-304 stainless

[0058] Now referring to the non-limiting schematic example shown in FIG. 8, still another aspect according to the present disclosure is directed to a hot isostatically pressed powder metal part or billet 500 manufactured according to non-limiting embodiments of methods according to the present disclosure. FIG. 8 depicts a cross-section of the billet 500 still encased in a deformed canister 502 according to the present disclosure. The billet 500 comprises at least one substantially flat end face 504. In non-limiting embodiments, the hot isostatically pressed powder metal billet 500 comprises a nickel-base superalloy. After removal of the canister 502 by machining and/or acid pickling, tor example, the billet 500 requires little or no further machining to present a flat end face 504 prior to upset forging or other processing of the billet. In another non-limiting embodiment, the hot isostatically pressed powder metal billet 500 comprises one of a Rolls Royce RR1000 alloy, an Alloy 10 alloy, and a low carbon ASTROLOY alloy, the compositions of which are known to those having ordinary skill in the metallurgy field. As is known in the art, RR1000 alloy has the following nominal composition, in percent by weight: 55 Ni, 14.5 Cr, 16.5 Co, 4.5 Mo, and balance Ni. Alloy 10 is disclosed in U.S. Patent No. 6,890,370, which is hereby incorporated by reference herein in its entirety. Alloy 10 alloy has the following compositional range, in percent by weight: 14.0-18.0 Co, 10.0-11.5 Cr, 3.45-4.15 Al, 3.60-4.20 Ti, 0.45-1.5 Ta, 1.4-2.0 Nb, 0.03-0.04 C, 0.01-0.025 B, 0.05-0.15 Zr, 2.0-3.0 Mo, 4.5 W+Re, and balance Ni. In a preferred embodiment, the ratio of Mo/(W+Re) for Alloy 10 is in the range of 0.25 to 0.5. In another embodiment, when Alloy 10 does not contain rhenium, the ratio of Mo/W is in the range of about 0.25 to about 0.5. As is known in the art, low carbon ASTROLOY alloy has the following composition, in percent by weight: 3.85-4.14 Al, 0.015-0.0235 B, 0.020-0.040 C, 14.0-16.0 Cr, 16.0-18.0 Co, 4.50-5.50 Mo, 52.6-58.3 Ni, and 3.35-3.65 Ti.

[0059] The examples that follow are intended to further describe certain non-limiting embodiments, without restricting the scope of the present invention. Persons having ordinary skill in the art will appreciate that variations of the following examples are possible within the scope of the invention, which is defined solely by the claims.

EXAMPLE 1

[0060] Two HIPping canister endplates were constructed according to the diagram in FIG. 9A and FIG. 9B. The endplates were machined from a 8.89 centimeter (3.5 inch) plate of AISI T-304 stainless steel. The endplates were substantially free of surface defects and had a surface roughness of 125 RMS. One of the endplates was machined to include a central bore with a diameter of 2.55 centimeters (1.002 inches). Each endplate weighed about 161 pounds.

EXAMPLE 2

[0061] A HIPping canister according to an embodiment of the present disclosure was made as follows. A 159.39 centimeter (62.75 inch) wide sheet of 1.27 centimeter (0.5 inch) thick AISI T-304 stainless steel was submerged arc welded to form a cylindrical canister body portion having an outside diameter of 61.67 centimeters (24.28 inches). All welds were made according to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The welded side seam was X-ray inspected to ensure integrity. Endplates from Example 1 were TIG welded to each end of the stainless steel cylinder to form a HIPping canister. A 2.54-centimeter (1-inch) diameter bore was provided in the center of one of the endplates, while the second endplate was solid and lacked a bore. A 33-centimeter (13-inch) long T-304 stainless steel tube having a 3.81 centimeter (1.5 inch) outside diameter and a 2.54 centimeter (1.0 inch) inside diameter was TIG welded to the periphery of the bore to provide a fill stem to allow powder to be introduced into, and air to be removed from, the interior volume of the HIPping canister.

EXAMPLE 3

[0062] The interior volume of the HIPping canister of Example 2 was thoroughly cleaned with abrasive cloth (flap wheel), rinsed with deionized water, and purged through the fill stem. The interior wall of the canister was then electropolished using an electrochemical process, rinsed with deionized water, and dried. After drying, the HIP canister was filled with 5471.5 pounds of RR1000 alloy powder. The powder-filled HIPping canister was placed into a out-gas furnace and evacuated to a pressure of less than 1 Torr, and the fill stem was crimped to hermetically seal the canister. The canister was then placed into a HIP furnace. The HIP furnace was pressurized with argon gas and heated according to the temperature-time plot of FIG. 10A and the

CLAIMS

What is claimed is:

1. An endplate of a hot isostatic pressing canister, the endplate comprising:
a central region; and
a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister;
wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle; and
wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip.

2. The endplate of claim 1, further comprising:
a substantially planar outer face; and
an inner face, wherein the taper angle is defined by an increasing distance between the outer face and the inner face in the main region as a distance from the central region increases.

3. The endplate of claim 2, wherein the peripheral lip comprises a chamfer configured to accept a weld bead for welding the endplate to a body portion of a hot isostatic pressing canister.

4. The endplate of claim 2, further comprising at least one fill stem, wherein the at least one fill stem is configured to enable fluid communication with an interior volume of a hot isostatic pressing canister when the endplate is secured to a body portion of the hot isostatic pressing canister.

5. The endplate of claim 4, wherein the endplate includes only a single fill stem.

6. The endplate of claim 2, wherein the endplate comprises at least one of a low carbon steel, a mild steel, and a stainless steel.

7. The endplate of claim 2, wherein at least a portion of the endplate comprises an electropolished finish.

8. The endplate of claim 2, wherein the endplate is configured to be secured to a cylindrical body portion of a hot isostatic pressing canister.

9. A canister for hot isostatic pressing a powdered material, the canister comprising:

a cylindrical body portion including a circular first end and a circular second end;

a first endplate welded to the circular first end of the cylindrical body portion, the first endplate comprising

a central region, and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with the body portion,

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle, and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip; and

a second endplate welded to the circular second end of the cylindrical body portion.

10. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate further comprises:

a substantially planar outer face; and

an inner face, wherein the taper angle is defined by an increasing distance between the outer face and the inner face in the main region as a distance from the central region increases.

11. The canister for hot isostatic pressing a powdered material of claim 9, wherein the peripheral lip of the first endplate further comprises a chamfer configured to accept a weld bead for welding the first endplate to the circular first end of the cylindrical body portion of the canister.

12. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate further comprises at least one fill stem, wherein the at least one fill stem is configured to enable fluid communication with an interior volume of the canister when the first endplate is welded to the circular first end of the cylindrical body portion of the canister.

13. The canister for hot isostatic pressing a powdered material of claim 12, wherein the first endplate includes only a single fill stem.

14. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate comprises at least one of a low carbon steel, mild steel, and a stainless steel.

15. The canister for hot isostatic pressing a powdered material of claim 9, wherein at least a portion of the first endplate comprises an electropolished finish.

16. The canister for hot isostatic pressing a powdered material of claim 9, wherein the second endplate comprises:

a central region; and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister;

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle; and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip.

17. A method for hot isostatic pressing a powdered material, the method comprising:

providing a canister for hot isostatic pressing, the canister comprising

a cylindrical body portion including a circular first end and a circular second end,

a first endplate welded to the circular first end of the cylindrical body portion, the first endplate comprising

a central region, and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister,

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle, and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip,

a fill stem attached to the first endplate, wherein the fill stem provides fluid communication with an interior volume of the canister, and

a second endplate welded to the circular second end of the cylindrical body portion;

disposing at least one metallurgical powder in the canister through the fill stem;

evacuating air from the canister through the fill stem;

crimping the fill stem to hermetically seal the canister; and

hot isostatically pressing the canister to provide a hot isostatic pressed billet.

18. The method of claim 17, wherein the first endplate of the canister further comprises:

a substantially planar outer face; and

an inner face, wherein the taper angle is defined by an increasing distance between the outer face and the inner face in the main region as a distance from the central region increases.

19. The method of claim 17, wherein the peripheral lip of the first endplate of the canister further comprises:

a chamfer configured to accept a weld bead for welding the first endplate to the circular first end of the cylindrical body portion of the canister.

20. The method of claim 17, wherein the metallurgical powder is a nickel-base superalloy powder.

21. The method of claim 17, wherein the metallurgical powder is one of a Rolls Royce RR1000 alloy powder, an Alloy 10 alloy powder, and a low carbon ASTROLOY alloy powder.

CLAIMS

1. An endplate of a hot isostatic pressing canister, the endplate comprising:

a central region; and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister; and

a substantially planar outer face;

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle; and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip.

2. The endplate of claim 1, further comprising:

an inner face, wherein the taper angle is defined by an increasing distance between the outer face and the inner face in the main region as a distance from the central region increases.

3. The endplate of claim 2, wherein the peripheral lip comprises a chamfer configured to accept a weld bead for welding the endplate to a body portion of a hot isostatic pressing canister.

4. The endplate of claim 2, further comprising at least one fill stem, wherein the at least one fill stem is configured to enable fluid communication with an interior volume of a hot isostatic pressing canister when the endplate is secured to a body portion of the hot isostatic pressing canister.

5. The endplate of claim 4, wherein the endplate includes only a single fill stem.

6. The endplate of claim 2, wherein the endplate comprises at least one of a low carbon steel, a mild steel, and a stainless steel.

7. The endplate of claim 2, wherein at least a portion of the endplate comprises an electropolished finish.

8. The endplate of claim 2, wherein the endplate is configured to be secured to a cylindrical body portion of a hot isostatic pressing canister.

9. A canister for hot isostatic pressing a powdered material, the canister comprising: a cylindrical body portion including a circular first end and a circular second end; a first endplate welded to the circular first end of the cylindrical body portion, the first endplate comprising

a central region, and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with the body portion, and

a substantially planar outer face;

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle, and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip; and

a second endplate welded to the circular second end of the cylindrical body portion.

10. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate further comprises:

an inner face, wherein the taper angle is defined by an increasing distance between the outer face and the inner face in the main region as a distance from the central region increases.

11. The canister for hot isostatic pressing a powdered material of claim 9,

wherein the peripheral lip of the first endplate further comprises a chamfer configured to accept a weld bead for welding the first endplate to the circular first end of the cylindrical body portion of the canister.

12. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate further comprises at least one fill stem, wherein the at least one fill stem is configured to enable fluid communication with an interior volume of the canister when the first endplate is welded to the circular first end of the cylindrical body portion of the canister.

13. The canister for hot isostatic pressing a powdered material of claim 12, wherein the first endplate includes only a single fill stem.

14. The canister for hot isostatic pressing a powdered material of claim 9, wherein the first endplate comprises at least one of a low carbon steel, mild steel, and a stainless steel.

15. The canister for hot isostatic pressing a powdered material of claim 9, wherein at least a portion of the first endplate comprises an electropolished finish.

16. The canister for hot isostatic pressing a powdered material of claim 9, wherein the second endplate comprises:

a central region; and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister; and

a substantially planar outer face;

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle; and

wherein an inner surface of the corner includes a radiused portion by which the

main region smoothly transitions into the peripheral lip.

17. A method for hot isostatic pressing a powdered material, the method comprising:

providing a canister for hot isostatic pressing, the canister comprising

a cylindrical body portion including a circular first end and a circular second end,

a first endplate welded to the circular first end of the cylindrical body portion, the first endplate comprising

a central region, and

a main region extending radially from the central region and terminating in a corner about a periphery of the endplate, the corner including a peripheral lip configured to mate with a body portion of the canister,

wherein a thickness of the endplate increases from the central region to the corner and defines a taper angle, and

wherein an inner surface of the corner includes a radiused portion by which the main region smoothly transitions into the peripheral lip,

a fill stem attached to the first endplate, wherein the fill stem provides fluid communication with an interior volume of the canister, and

a second endplate welded to the circular second end of the cylindrical body portion;

disposing at least one metallurgical powder in the canister through the fill stem;

evacuating air from the canister through the fill stem;

crimping the fill stem to hermetically seal the canister; and

hot isostatically pressing the canister to provide a hot isostatic pressed billet.

18. The method of claim 17, wherein the first endplate of the canister further comprises:

a substantially planar outer face; and

an inner face, wherein the taper angle is defined by an increasing distance

between the outer face and the inner face in the main region as a distance from the central region increases.

19. The method of claim 17, wherein the peripheral lip of the first endplate of the canister further comprises:

a chamfer configured to accept a weld bead for welding the first endplate to the circular first end of the cylindrical body portion of the canister.

20. The method of claim 17, wherein the metallurgical powder is a nickel-base superalloy powder.

21.The method of claim 17, wherein the metallurgical powder is one of a Rolls Royce RR1000 alloy powder, an Alloy 10 alloy powder, and a low carbon ASTROLOY alloy powder.