WHAT IS CLAIMED IS:

1. A casing bit, comprising:

a mandrel; and

a bit body bonded to the mandrel, the bit body having an inner surface and an outer surface opposite the inner surface, the bit body consisting essentially of a matrix material of crystalline tungsten and a binder material.

2. The casing bit of claim 1 wherein the bit body includes at least one blade.

3. The casing bit of claim 2 wherein the blade includes a plurality of cutters, each cutter being bonded to the blade.

4. The casing bit of claim 3 wherein each cutter is a polycrystalline diamond cutter.

5. The casing bit of claim 3 wherein each cutter comprises a diamond table mounted to a substrate of a first material.

6. The casing bit of claim 5 further including a cap mounted to the substrate of the first material, wherein the cap at least partially overlies, but is not attached to, the diamond table.

7. The casing bit of claim 6 wherein the cap is made of or tipped with tungsten carbide.

8. The casing bit of claim 1 further including a plurality of blind openings formed in either the inner surface or the outer surface.

9. The casing bit of claim 1 wherein the binder material comprises brass.

10. The casing bit of claim 19 wherein the binder material comprises a nickel-brass alloy.

11. The casing bit of claim 1 wherein the inner surface includes a plurality of non-axisymmetric regions defined by raised portions of the inner surface.

12. The casing bit of claim 11 wherein the raised portions comprise a raised boss structure or a raised land structure.

13. The casing bit of claim 12 wherein the inner surface is configured such that during a drill out operation, drill out forces on the inner surface are first received by the raised boss structure or the raised land structure.

14. A casing end tool, comprising:

a tool body bonded to a mandrel, the tool body including a face portion having an inner surface, the face portion comprising a crystalline tungsten matrix material.

15. The tool of claim 14 wherein the tool body includes a plurality of blades.

16. The tool of claim 14 wherein the inner surface includes a plurality of non-axisymmetric regions defined by raised portions of the inner surface.

17. The tool of claim 16 wherein the raised portions comprise a raised boss structure or a raised land structure.

18. The tool of claim 17 wherein the inner surface is configured such that during a drill out operation, drill out forces on the inner surface are first received by the raised boss structure or the raised land structure.

19. The tool of claim 14 wherein the tool is one of a casing bit or a casing reamer.

CLAIMS

1. A casing end tool, comprising:

a bowl-like body defined by a wall having an outer convex surface and an inner concave surface on an opposite side of said wall from the outer convex surface, the bowl-like body having a center axis, the inner concave surface being non-axisymmetric with respect to the center axis and the outer convex surface being axisymmetric with respect to the center axis.

2. The tool of claim 1 wherein the non-axisymmetric inner concave surface is defined by a plurality of spaced apart regions of the wall having a thickness greater than a thickness of regions of the wall between said spaced apart regions.

3. The tool of claim 2 further including a plurality of blades on the outer convex surface of the wall, wherein the spaced apart regions on the inner concave surface are positioned opposite locations of junkslots formed between pairs of blades.

4. The tool of claim 2 further including a plurality of ports formed through the wall, wherein the spaced apart regions with greater thickness surround each port on the inner concave surface.

5. The tool of claim 4 further including a port sleeve for each port, the port sleeve extending above the surrounding spaced apart region.

6. The tool of claim 2 wherein the spaced apart regions comprise a raised boss structure or a raised land structure on the inner concave surface.

7. The tool of claim 1 wherein the non-axisymmetric inner concave surface is defined by a plurality of channel regions formed in the wall.

8. The tool of claim 7 further including a plurality of blades on the outer convex surface of the wall, wherein the channel regions on the inner concave surface are positioned opposite locations of the blades.

9. The tool of claim 1 further including a plurality of blades on the outer convex surface of the wall separated by junkslots, each blade supporting a plurality of cutter elements, and further including a channel formed between adjacent ones of the cutter elements and extending between junkslots.

10. The tool of claim 1 further including an inner collar ring defining a bit guide.

11. The tool of claim 1 wherein the wall of the bowl-like body comprises:

a cylindrical sidewall portion having a bottom end; and

a face wall portion attached to the cylindrical sidewall portion at the bottom end.

12. The tool of claim 11 wherein the face wall portion is attached to the cylindrical sidewall portion using a threaded coupling at the bottom end.

13. The tool of claim 12 wherein the face portion comprises a plurality of pieces clamped together by engagement with the threaded coupling in a first rotation direction opposite a second rotation direction for a cutting operation of the tool.

14. The tool of claim 1 wherein the tool is one of a casing bit or a casing reamer.

15. The tool of claim 1 further including a plurality of blades on the outer convex surface of the wall, each blade supporting a plurality of cutter elements, and each cutter element comprising a diamond table mounted to a substrate of a first material.

16. The tool of claim 15 further including an additional substrate of a second material different than the first material, wherein the additional substrate is mounted to an end of the cutter opposite the diamond table.

17. The tool of claim 1 further comprising a cutting structure arranged on a face of the tool which is force balanced to less than about 10%.

18. The tool of claim 1 further comprising a cutting structure arranged on a face of the tool which is force balanced to less than about 5%.

19. The tool of claim 1 further including a plurality of blind openings formed in the inner concave surface.

20. The tool of claim 1 wherein the bowl-like body is made of one or more materials selected from the group consisting of: austemperized ductile iron, zinc alloy, titanium, aluminum, steel, crystalline tungsten, graded tungsten carbide and crystalline tungsten, copper or brass.

21. The tool of claim 20 wherein the bowl-like body of austemperized ductile iron or of steel comprises nitrided austemperized ductile iron or nitrided steel.

22. The tool of claim 1 wherein the bowl-like body is made of a material whose hardness is graded from less hard closer to the inner concave surface to more hard closer to the outer convex surface.

23. The tool of claim 1 further including a plurality of blades on the outer convex surface of the wall extending to a gage region of the tool, the gage regions of the blades having a width which narrows in a direction extending towards a rear of the tool.

24. The tool of claim 1 further including a float valve.

25. The tool of claim 1 further including a frangible bypass port.

26. A casing end tool comprising:

a bowl-like body defined by a wall having an outer convex surface and an inner concave surface opposite of the outer convex surface, the bowl-like body having a center axis, the inner concave surface being non-axisymmetric with respect to the center axis and the outer convex surface being axisymmetric with respect to the center axis; and

a plurality of cutter elements, each cutter element comprising a diamond table mounted to a substrate, and a cap mounted to the substrate, wherein the cap at least partially overlies, but is not attached to, the diamond table.

27. The tool of claim 26 wherein the cap is made of or tipped with tungsten carbide.

28. The tool of claim 26 wherein the cap is made of tungsten carbide and tipped with cubic boron nitride.

29. A casing end tool, comprising:

a bowl-like body including an inner plenum and being defined by a wall having an outer convex surface and an inner concave surface opposite of the outer convex surface, the bowl-like body having a center axis, the inner concave surface including a plurality of non-axisymmetric regions defined by spaced apart portions of

the wall having a thickness greater than a thickness of regions of the wall between said spaced apart portions.

30. The tool of claim 29 further including a plurality of blades on the outer convex surface of the wall, wherein the spaced apart portions on the inner concave surface are positioned opposite locations of junkslots formed between pairs of blades.

31. The tool of claim 29 wherein the spaced apart portions comprise a raised boss structure or a raised land structure on the inner concave surface.

32. The tool of claim 29 further including a plurality of blades on the outer convex surface of the wall separated by junkslots, each blade supporting a plurality of cutter elements, and further including a channel formed between adjacent ones of the cutter elements and extending between junkslots.

33. The tool of claim 29 wherein the wall of the bowl-like body comprises:

a cylindrical sidewall portion having a bottom end; and

a face wall portion attached to the cylindrical sidewall portion at the bottom end.

34. The tool of claim 33 wherein the face wall portion is attached to the cylindrical sidewall portion using a threaded coupling at the bottom end.

35. The tool of claim 34 wherein the face portion comprises a plurality of pieces clamped together by engagement with the threaded coupling in a first rotation direction opposite a second rotation direction for a cutting operation of the tool.

36. The tool of claim 29 wherein the bowl-like body is made of a material whose hardness is graded from less hard closer to the inner concave surface to more hard closer to the outer convex surface.

37. The tool of claim 29 further including a plurality of blades on the outer convex surface of the wall extending to a gage region of the tool, the gage regions of the blades having a width which narrows in a direction extending towards a rear of the tool.

38. The tool of claim 29 further including a float valve.

39. The tool of claim 29 further including a frangible bypass port.

40. A casing end tool, comprising:

a bowl-like body including an inner plenum and being defined by a wall having an outer convex surface and an inner concave surface opposite of the outer convex surface, the bowl-like body having a center axis, the inner concave surface being a non-axisymmetric inner concave surface and including a plurality of channel regions formed in the wall; and

a plurality of blades on the outer convex surface of the wall, wherein the channel regions on the inner concave surface are positioned opposite locations of the blades.

41. The tool of claim 40 further including a channel formed in an outer surface of at least one of the plurality of blades at a position between adjacent ones of the cutter elements.

42. The tool of claim 40 wherein the wall of the bowl-like body comprises:

a cylindrical sidewall portion having a bottom end; and

a face wall portion attached to the cylindrical sidewall portion at the bottom end.

43. A casing end tool comprising:

a bowl-like body including an inner plenum and being defined by a wall having an outer convex surface and an inner concave surface opposite of the outer convex surface, the bowl-like body having a center axis;

wherein the wall of the bowl-like body comprises:

a cylindrical sidewall portion having a bottom end; and

a face wall portion attached to the cylindrical sidewall portion at the bottom end;

wherein the face wall portion is attached to the cylindrical sidewall portion using a threaded coupling at the bottom end.

44. The tool of claim 43 wherein the face portion comprises a plurality of pieces clamped together by engagement with the threaded coupling in a first rotation direction opposite a second rotation direction for a cutting operation of the tool.

45. The tool of claim 40 wherein the bowl-like body is made of a material whose hardness is graded from less hard closer to the inner concave surface to more hard closer to the outer convex surface.

46. The tool of claim 40 further including a plurality of blades on the outer convex surface of the wall extending to a gage region of the tool, the gage regions of the blades having a width which narrows in a direction extending towards a rear of the tool.

47. The tool of claim 40 further including a float valve.

48. The tool of claim 40 further including a frangible bypass port