BALL SEAT FOR A WELL FRACTURING APPARATUS AND METHOD OF MAKING AND USING SAME

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ABSTRACT

Device and an apparatus incorporating the device for use in wellbore fracturing applications. The device is a ball seat that allows for use of a smaller difference in ball size versus the size of an opening in the ball seat. The ball seat is constructed of metallic material and polymeric material.
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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit under 35 U.S.C. §119(e) of U.S. Provisional Application Ser. No. 61/539,513, filed Sep. 27, 2011, entitled “Ball Seat for a Well Fracturing System and Method of Making Same” which is hereby expressly incorporated herein in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present disclosure relates to a ball seat for a fracturing apparatus. More specifically, the ball seat is made of metal and rubber. The present disclosure also includes the fracturing apparatus that includes the ball seat and a method of making the ball seat.

[0004] 2. Description of the Related Art

[0005] Traditionally, ball seats have been made of metal and the frac balls used to block flow through the ball seat have a diameter that is about 62 thousandths of an inch bigger than the internal diameter of the hole running through the ball seat. The need for the 62 thousandths of an inch overlap limits the number of production zones in a horizontally-drilled well. Accordingly, there is a need for a fracturing system that can provide more production zones in a horizontally-drilled well.

SUMMARY

[0006] Various embodiments disclosed herein are generally directed to a device and apparatus for use in wellbore fracturing operations.

[0007] In accordance with some embodiments, a ball seat is disclosed. The ball seat having a ball side, a back side, and an inner diameter defining an opening in the ball seat, and an outside diameter. The ball seat is constructed of a metallic material and polymeric material.

[0008] In accordance with another embodiment, the disclosure is directed toward a downhole tool that includes the ball seat device. This tool includes a slotted body having at least one opening in an outer wall of the slotted body. The tool also includes a sleeve slidably disposed within the slotted body, the sleeve blocking the at least one opening in the slotted body. As stated above, the tool includes the ball seat, which is disposed within the sleeve. Finally, the tool includes a ball having a diameter to engage the ball seat wherein, when the ball engages the ball seat under fluid pressure, the force from the fluid applied to the ball and ball seat is transferred to the sleeve and the sleeve slides within the slotted body to unblock the opening in the slotted body and permit fluid to flow therethrough.

[0009] These and other features and advantages which may characterize various embodiments can be understood in view of the following detailed discussion and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 provides an elevation view of one embodiment of a wellbore fracturing apparatus constructed in accordance with the present invention.

[0011] FIG. 2 provides an elevation view of another embodiment of the wellbore fracturing apparatus constructed in accordance with the present invention.

[0012] FIG. 3 provides an elevation view of yet another embodiment of the wellbore fracturing apparatus constructed in accordance with the present invention.

[0013] FIGS. 4A-4D provide perspective views of a ball seat constructed in accordance with the present invention.

[0014] FIG. 5A provides a perspective view of a portion of the ball seat constructed in accordance with the present invention.

[0015] FIG. 5B provides a perspective view of another embodiment of the ball seat constructed in accordance with the present invention.

[0016] FIG. 6A provides an elevation view of a sleeve constructed in accordance with the present invention.

[0017] FIG. 6B provides a perspective view of the sleeve constructed in accordance with the present invention.

DETAILED DESCRIPTION

[0018] The present disclosure relates to a ball seat for a fracturing apparatus that allows for more a multi-stage or multi-area zones in a fracturing system (or production system). The disclosure also relates to a method of using and making the ball seat.

[0019] Referring now to FIG. 1, shown therein is a downhole wellbore fracturing apparatus (or tool) 10. The apparatus 10 can include typical elements of fracturing tools, such as side adapters, bottom adapter, packers, etc. The fracturing tool disclosed herein further includes at least one slotted body 12, at least one ball seat 14, at least one ball 16 (frac ball) and at least one opening sleeve 18. It should be understood and appreciated that the fracturing apparatus can include any device known in the art for inclusion in producing or fracturing oil and gas wells.

[0020] In one embodiment, the slotted body 12 has at least one opening 20 to ultimately allow fluid to flow from within the tool 10 and outside of the tool 10 and to the casing/formation. It should be understood and appreciated that the slotted body 12 can have multiple openings disposed therein for fluid to escape. The sleeve 18 is disposed within the slotted body 12 and blocks the at least one opening 20 to prevent fluid from escaping the tool 10. The sleeve 18 can be secured within the slotted body 12 by any means known in the art, such as shear pins or screws. The ball seat 14 is disposed within the sleeve 18. In one embodiment, the ball seat 14 is fractionally disposed within the sleeve 18.

[0021] FIG. 2 shows the tool 10 once the tool 10 has been actuated with fluid pressure. Fluid is pumped down into the tool 10 and forces the ball 16 up against the ball seat 14. The ball 16 will prevent the fluid from flowing through the ball seat 14. Once the fluid pressure reaches a certain level, the sleeve 18 is permitted to slide within the slotted body 12 until the sleeve 18 reaches a stop 22 disposed within the slotted body 12. The stop 22 can be something included as part of the slotted body 12, or it can be an end of another portion of the tool 10 to which the slotted body 12 attaches.

[0022] In another embodiment, FIG. 3 shows a fracturing system 25 including the fracturing tool 10 and a second fracturing tool 30. The second fracturing tool 30 is designed similar to the fracturing tool 10. Similar to the tool 10, the second fracturing tool 30 includes a second slotted body 32, second ball seat 34, a second ball 36 and a second opening
sleeve 38. In this embodiment, the second ball 36 and the second sleeve 38 are sized differently than the ball 16 and the opening sleeve 18.

[0023] When the fracturing system 25 is in use, fluid will flow in the direction dictated by the dotted line 40. The second ball seat 34 has an opening 44 disposed therein and is positioned within the second sleeve 38 and the ball seat 14 has an opening 42 disposed therein and is positioned within the sleeve 18. The second ball 36 is sized such that it will pass through the opening 42 of the ball seat 14 but not pass through the opening 44 of the second ball seat 34. The second ball 36 also has to be sized such that the second ball 36 will not pass through the second ball seat 34 even at extremely high pressures. Likewise, the ball 16 must be sized such that the ball 16 will not pass through the ball seat 14 even at extremely high pressures. It should be understood and appreciated that while only two fracturing tools 10 and 30 are shown in FIG. 3 and described herein, the fracturing system 25 can include any number of fracturing tools.

[0024] The ball seat 14 disclosed herein, and shown in more detail in FIGS. 4A-53, includes a metallic material portion 50 and an elastomeric (polymeric) material portion 52. The ball seat 14 has a ball side 54, a back side 56, an inner diameter portion 58 defining the opening 42 in the ball seat 14, and an outer diameter portion 60. In one embodiment, the ball seat 14 includes a plurality of metallic fins 62 and a plurality of polymeric fins 64 with a outer layer 66 of polymeric material extending around the outer diameter portion 60 of the ball seat 14. In a further embodiment, the metallic fins 62 and the polymeric fins 64 of the ball seat 14 are alternately disposed about the inner diameter portion 58 of the ball seat 14. In another embodiment, the circumference of the inner diameter portion 58 of the ball seat 14 is substantially equal linear parts metallic material and metal and rubber.

[0025] In one embodiment shown in FIGS. 4A-4D, the ball seat 14 is constructed with five (5) metallic fins 62 and five (5) polymeric fins 64. It should be understood and appreciated that the ball seat 14 can be constructed with any number of metallic fins 62 and polymeric fins 64.

[0026] The metallic material 50 of the ball seat 14 can be any metallic material, or combination of metallic materials, that can handle the operating conditions of a downhole wellbore environment. Similarly, the polymeric material of the ball seat 14 can be any polymeric material, such as rubber, that can handle the operating conditions of a downhole wellbore environment.

[0027] The ball side 54 of the ball seat 14 can have a first angled surface 68 to facilitate larger frac balls positioned to block fluid flow through the opening 42 of the ball seat 14. The first angled surface 68 slopes downward from the ball side 54 of the ball seat 14 toward the opening 42 of the ball seat 14. In another embodiment, the ball side 54 of the ball seat 14 can have a second angled surface 69 to facilitate smaller frac balls positioned to block fluid flow through the opening 42 of the ball seat 14. The second angled surface 69 slopes downward from where the first angled surface 68 ends toward the opening 42 of the ball seat 14. It should be understood and appreciated that the first and second angled surfaces 68 and 69 can be any angle such that they facilitate the ball positioning over the opening 42 of the ball seat 14.

[0028] The metallic material 50 and polymeric material 52 used to construct the ball seat 14 permits the use of a smaller difference in the diameter of the ball 16 versus the inner diameter 58 of the ball seat 14. The inner diameter 58 of the ball seat 14 can be less than about 62 thousandths of an inch smaller than the diameter of the ball 16. In one embodiment, the diameter of the frac ball 16 is about 40 thousandths of an inch larger than the diameter of the inner diameter 58 of the ball seat 14. The smaller difference in the opening 42 of the ball seat 14 and the ball 16 allows for more production zones to be used in the fracturing system over a predetermined length of wellbore.

[0029] In a further embodiment, the outer diameter portion 60 of the ball seat 14 decreases in diameter along its length as you travel from the ball side 54 of the ball seat 14 to the back side 56 of the ball seat 14, creating an angle of the outer diameter portion 60 of the ball seat 14. The angle can be any angle within the range of from about 0.1° to about 15°. In one embodiment, the angle is about 1°.

[0030] The sleeve 18 of the tool 10 is shown in more detail in FIGS. 6A-6B. The sleeve 18 includes an inner portion 70, an outer portion 72, a seat portion 74 having an inner portion 76 and a back portion 78. The inner portion 76 of the seat portion 74 includes a lip portion 80 to receive the ball seat 14. In another embodiment, the inner portion 76 of the sleeve 18 is angled to match the angle of the outer diameter portion 60 of the ball seat 14. The lip portion 80 of the sleeve 18 separates the seat portion 74 of the sleeve 18 and the back portion 78 of the sleeve 18. The lip portion 80 ultimately prevents the ball seat 14 from sliding into the back portion 78 of the sleeve 18. The inner portion 70 has an upper portion 71 that can be sloped to match the slope of the outer diameter portion 60 of the ball seat 14.

[0031] The ball seat 14 is constructed by machining the metallic material 50 of the ball seat 14. In one embodiment, the metallic material 50 of the ball seat 14 is cast first, and then machined. Once the metallic portion 50 is machined, the elastomeric material 52 is bonded to the metallic portion 50 via heat and compression. Once the elastomeric material 52 is bonded to the metallic portion 50, the angle of the outside perimenter portion 60 of the ball seat 14 is cut. The first and second angled surfaces 68 and 69 of the ball side 54 of the ball seat 14 are also cut/machined into the ball seat 14. Further, the ball side 54 of the ball seat 14 is machined, and the desired opening 42 is cut into the ball seat 14.

[0032] From the above description, it is clear that the present disclosure is well adapted to carry out the objectives and to attain the advantages mentioned herein as well as those inherent in the disclosure. While present embodiments of the disclosure have been described, it will be understood that numerous changes may be made which will readily suggest themselves to those skilled in the art and which are accomplished within the spirit of the disclosure.

What is claimed is:
1. A device comprising:
a ball seat for a downhole tool having a ball side, a back side, and an inner diameter defining an opening in the ball seat, and an outer diameter, the ball seat constructed of a metallic material and a polymeric material.
2. The device of claim 1, wherein the ball seat is constructed of alternating fins of the metallic material and the polymeric material.
3. The device of claim 2, wherein the ball seat has a layer of polymeric material extending around an outer diameter portion of the ball seat.
4. The device of claim 1, wherein the ball seat further comprises a first angled surface in the ball side of the ball seat sloping downward from the ball side toward the opening of the ball seat.

5. The device of claim 4, wherein the ball seat further comprises a second angled surface in the ball side of the ball seat sloping downward from an end of the first angled surface toward the opening of the ball seat.

6. The device of claim 1, wherein the outside diameter of the ball seat slopes along its length from the ball side to the back side of the ball seat.

7. The device of claim 6, wherein the slope of the outside diameter is in a range of from about 1 degree to about 15 degrees.

8. The device of claim 7, wherein the slope is about 1 degree.

9. A downhole apparatus comprising:
   a slotted body having at least one opening in an outer wall of the slotted body;
   a sleeve slidably disposed within the slotted body, the sleeve blocking the at least one opening in the slotted body;
   a ball seat disposed within the sleeve, the ball seat having a ball side, a back side, and an inner diameter defining an opening in the ball seat, and an outside diameter wherein the ball seat is constructed of a metallic material and a polymeric material; and
   a ball having a diameter to engage the ball seat wherein when the ball engages the ball seat under fluid pressure, the force from the fluid applied to the ball and ball seat is transferred to the sleeve and the sleeve slides within the slotted body to unblock the opening in the slotted body and permit fluid to flow therethrough.

10. The apparatus of claim 9, wherein the ball seat has a layer of polymeric material extending around an outer diameter portion of the ball seat and the ball seat is constructed of alternating fins of the metallic material and the polymeric material.

11. The apparatus of claim 9, wherein the ball seat further comprises a first angled surface in the ball side of the ball seat sloping downward from the ball side toward the opening of the ball seat.

12. The apparatus of claim 11, wherein the ball seat further comprises a second angled surface in the ball side of the ball seat sloping downward from an end of the first angled surface toward the opening of the ball seat.

13. The apparatus of claim 9, wherein the outside diameter of the ball seat slopes along its length from the ball side to the back side of the ball seat, the slope of the outside diameter is in a range of from about 1 degree to about 15 degrees.

14. The apparatus of claim 13, wherein the slope is about 1 degree.

15. The apparatus of claim 13, wherein an inner portion of the sleeve is sloped to match the slope of the outside diameter of the ball seat.

16. The apparatus of claim 9, wherein the inner diameter of the ball is greater than about 62 thousandths of an inch larger than the inner diameter of the ball seat.

17. The apparatus of claim 16, wherein the inner diameter of the ball is in a range of greater than about 40 thousandths of an inch larger to about 62 thousandths of an inch larger than the inner diameter of the ball seat.

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