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(54) MILLABLE FRACTURE BALLS COMPOSED OF METAL

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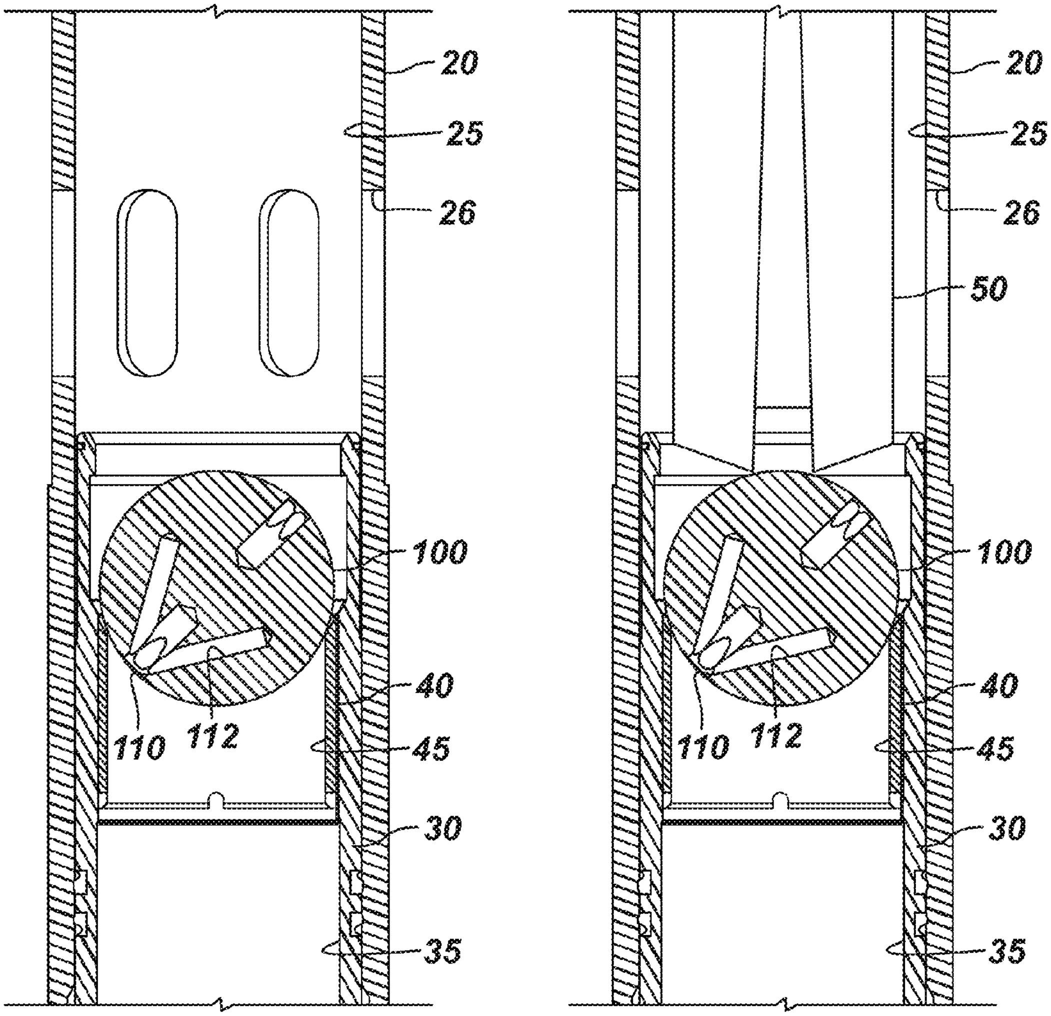
CPC ***E21B 33/1204*** (2013.01)
USPC **166/193**; 29/592; 29/899

(57) **ABSTRACT**

A ball is used for engaging in a downhole seat and can be milled out after use. The ball has a spherical body with an outer surface. An interior of the spherical body is composed of a metallic material, such as aluminum. The spherical body has a plurality of holes formed therein. The holes extend from at least one common vertex point on the outer surface of the spherical body and extend at angles partially into the interior of the spherical body.



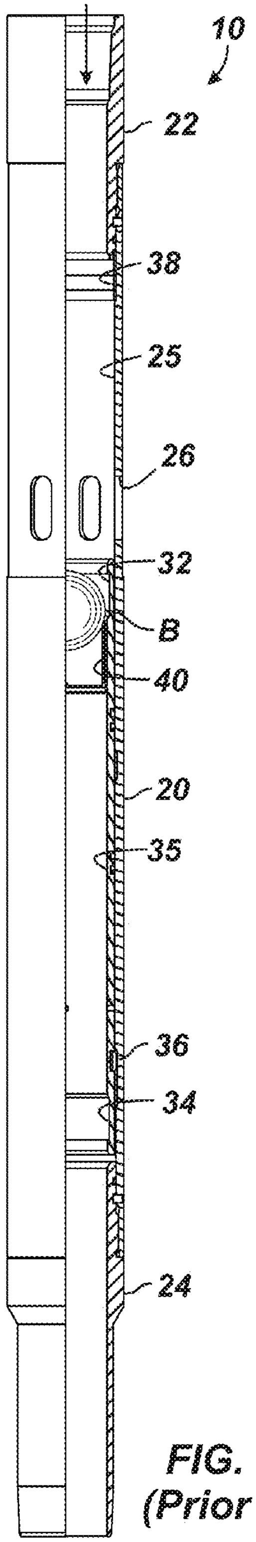


FIG. 1A
(Prior Art)

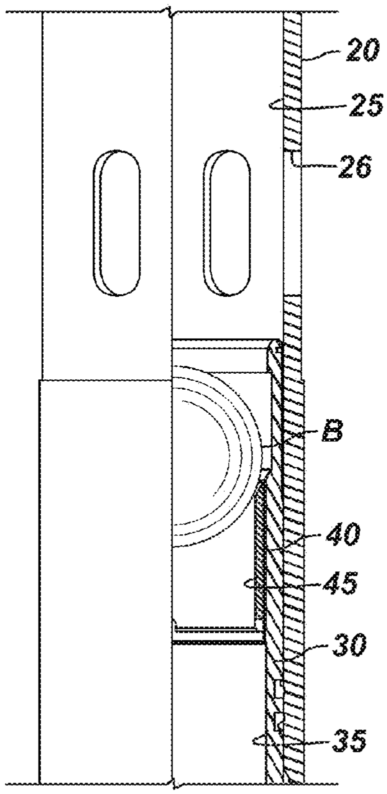


FIG. 1B
(Prior Art)

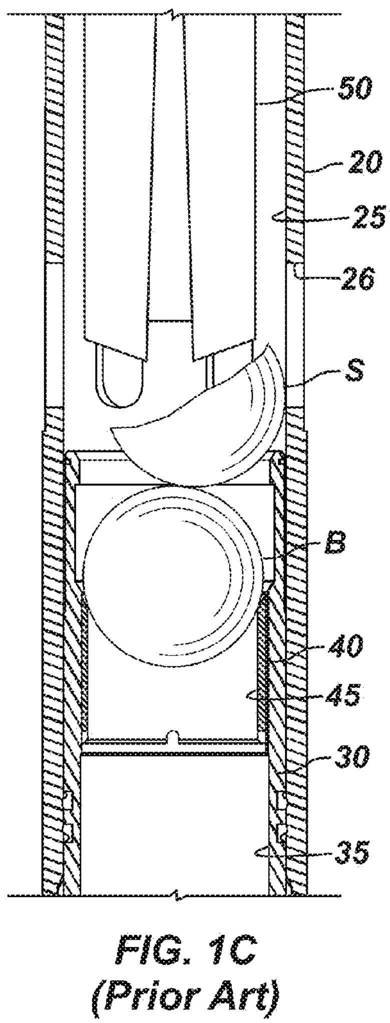


FIG. 1C
(Prior Art)

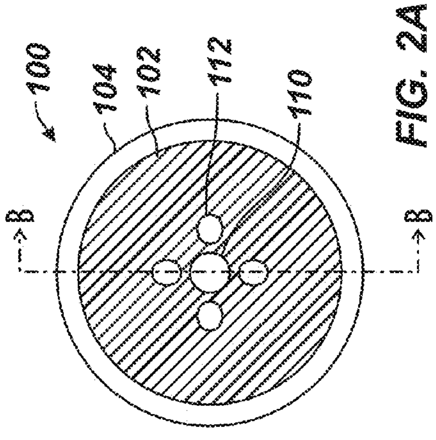


FIG. 2A

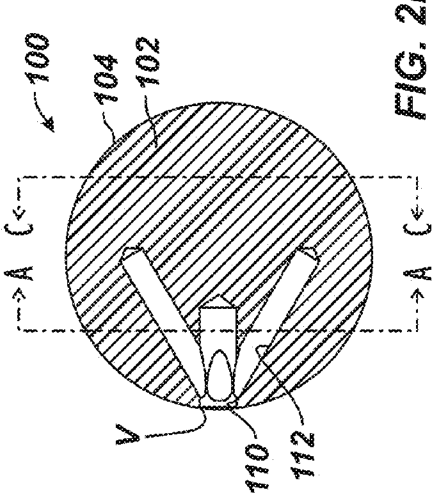


FIG. 2B

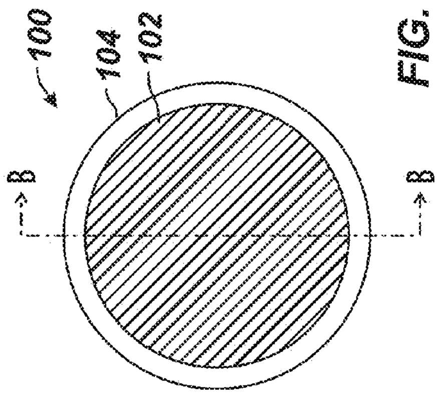


FIG. 2C

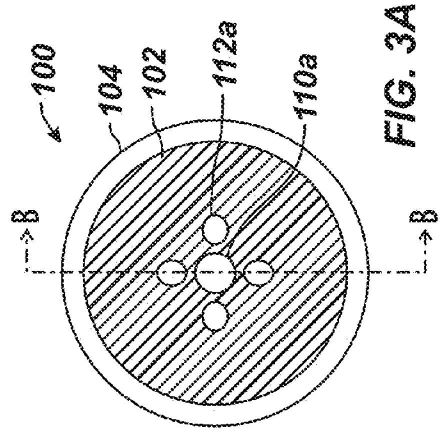


FIG. 3A

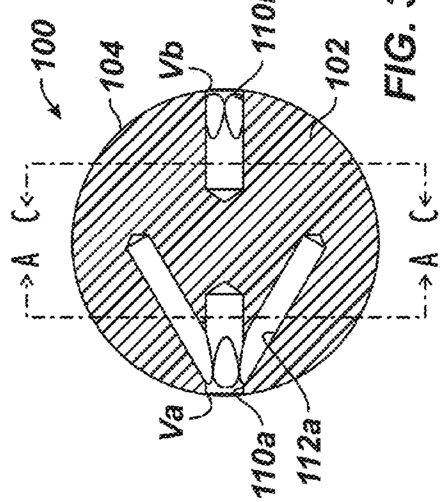


FIG. 3B

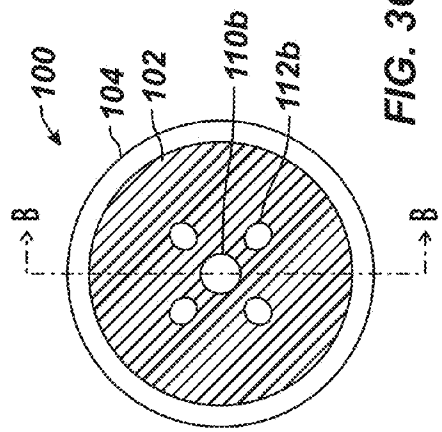


FIG. 3C

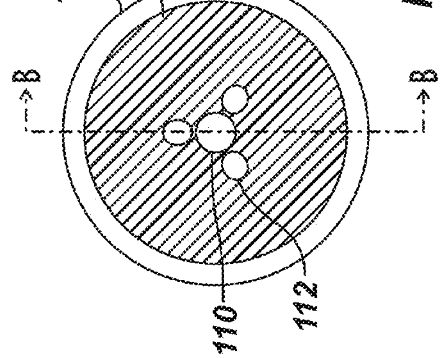


FIG. 4A

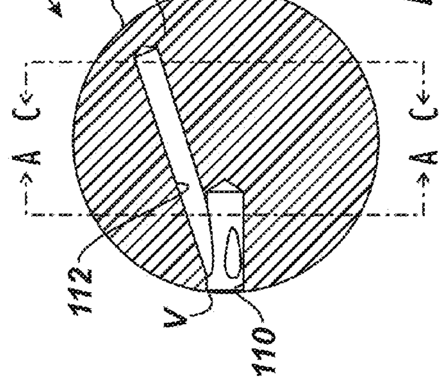


FIG. 4B

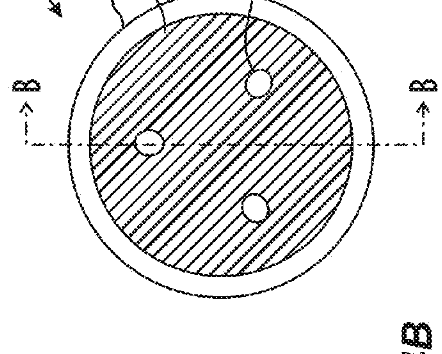


FIG. 4C

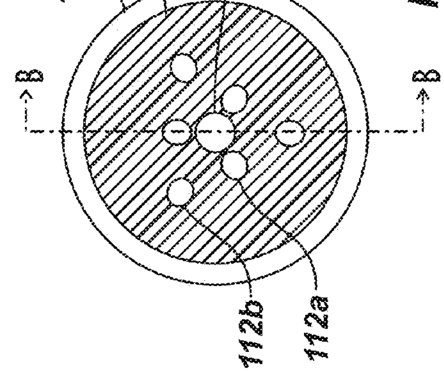


FIG. 5A

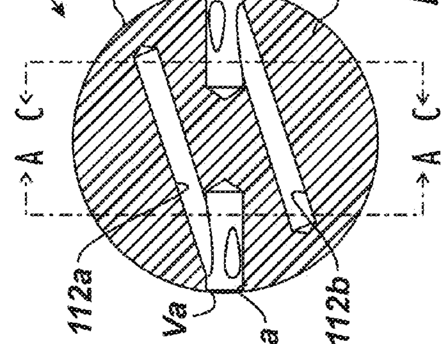


FIG. 5B

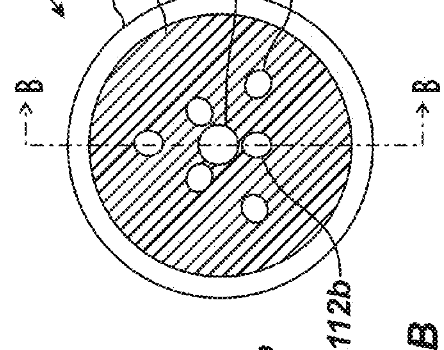


FIG. 5C

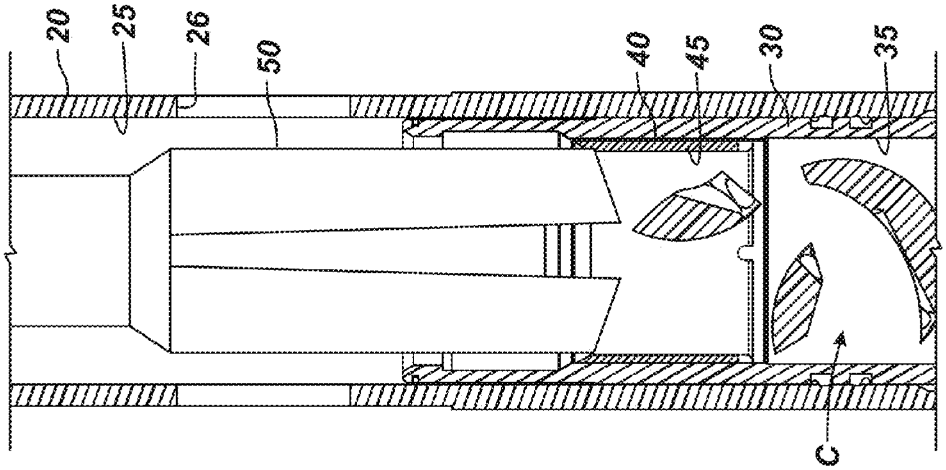


FIG. 6C

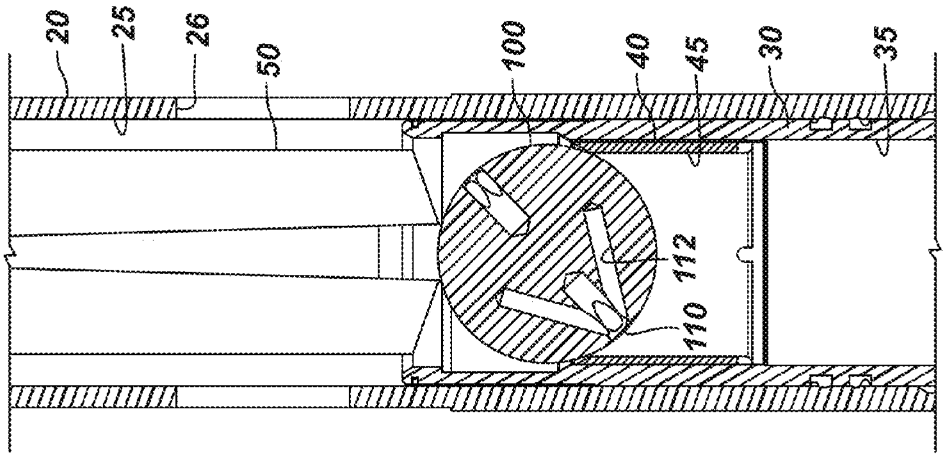


FIG. 6B

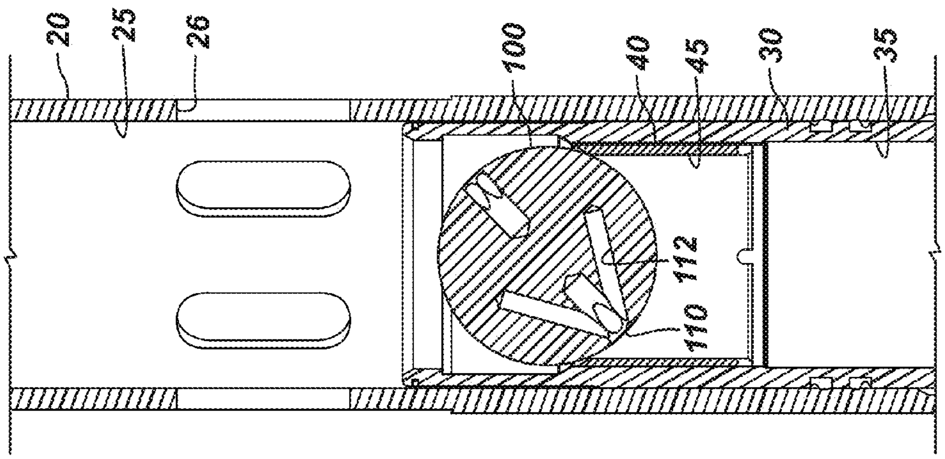


FIG. 6A

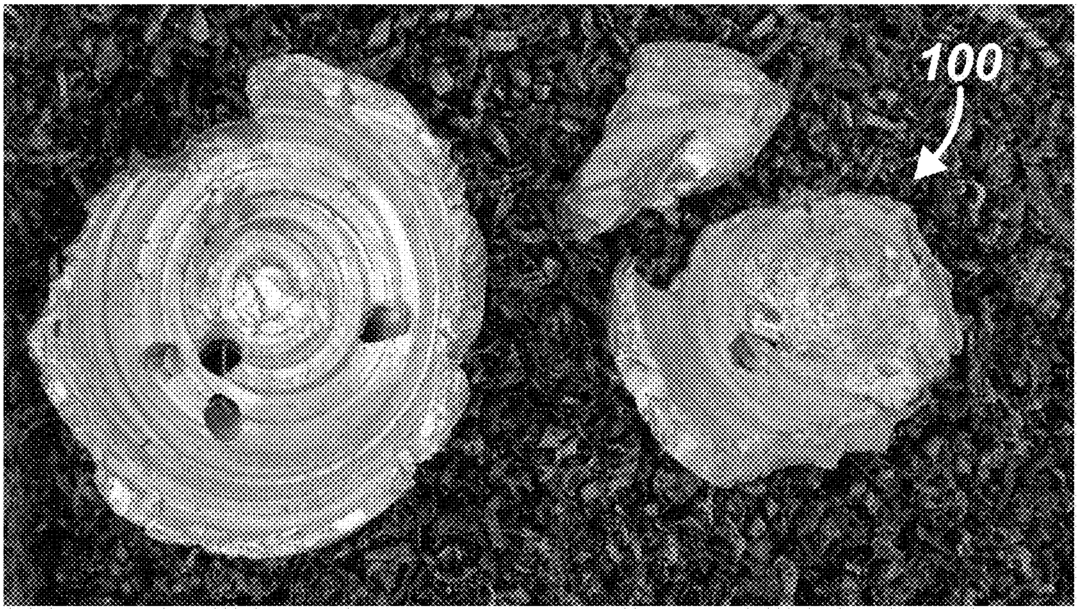


FIG. 7

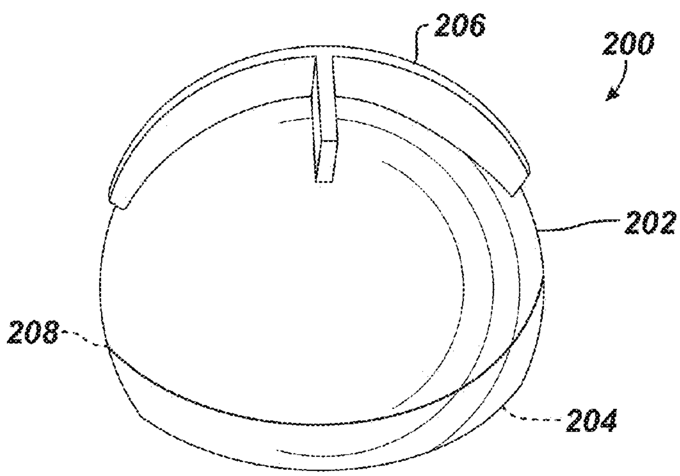


FIG. 8

MILLABLE FRACTURE BALLS COMPOSED OF METAL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of the U.S. Prov. Appl. 61/774,729, filed 8 Mar. 2013, which is incorporated herein by reference.

BACKGROUND OF THE DISCLOSURE

[0002] In a staged fracturing operation, multiple zones of a formation need to be isolated sequentially for treatment. To achieve this, operators install a fracturing assembly down the wellbore, which typically has a top liner packer, open hole packers isolating the wellbore into zones, various sliding sleeves, and a wellbore isolation valve. When the zones do not need to be closed after opening, operators may use single shot sliding sleeves for the fracturing treatment. These types of sleeves are usually ball-actuated and lock open once actuated. Another type of sleeve is also ball-actuated, but can be shifted closed after opening.

[0003] Initially, operators run the fracturing assembly in the wellbore with all of the sliding sleeves closed and with the wellbore isolation valve open. Operators then deploy a setting ball to close the wellbore isolation valve. This seals off the tubing string of the assembly so the packers can be hydraulically set. At this point, operators rig up fracturing surface equipment and pump fluid down the wellbore to open a pressure actuated sleeve so a first zone can be treated.

[0004] As the operation continues, operates drop successively larger balls down the tubing string and pump fluid to treat the separate zones in stages. When a dropped ball meets its matching seat in a sliding sleeve, the pumped fluid forced against the seated ball shifts the sleeve open. In turn, the seated ball diverts the pumped fluid into the adjacent zone and prevents the fluid from passing to lower zones. By dropping successively increasing sized balls to actuate corresponding sleeves, operators can accurately treat each zone up the wellbore.

[0005] FIG. **1**A shows an example of a sliding sleeve **10** for a multi-zone fracturing system in partial cross-section in an opened state. This sliding sleeve **10** is similar to Weatherford's ZoneSelect MultiShift fracturing sliding sleeve and can be placed between isolation packers in a multi-zone completion. The sliding sleeve **10** includes a housing **20** defining a bore **25** and having upper and lower subs **22** and **24**. An inner sleeve or insert **30** can be moved within the housing's bore **25** to open or close fluid flow through the housing's flow ports **26** based on the inner sleeve **30**'s position.

[0006] When initially run downhole, the inner sleeve **30** positions in the housing **20** in a closed state. A breakable retainer **38** initially holds the inner sleeve **30** toward the upper sub **22**, and a locking ring or dog **36** on the sleeve **30** fits into an annular slot within the housing **20**. Outer seals on the inner sleeve **30** engage the housing **20**'s inner wall above and below the flow ports **26** to seal them off.

[0007] The inner sleeve **30** defines a bore **35** having a seat **40** fixed therein. When an appropriately sized ball lands on the seat **40**, the sliding sleeve **10** can be opened when tubing pressure is applied against the seated ball **40** to move the inner sleeve **30** open. To open the sliding sleeve **10** in a fracturing operation once the appropriate amount of proppant has been pumped into a lower formation's zone, for example, operators drop an appropriately sized ball B downhole and pump the ball B until it reaches the landing seat **40** disposed in the inner sleeve **30**.

[0008] Once the ball B is seated, built up pressure forces against the inner sleeve **30** in the housing **20**, shearing the breakable retainer **38** and freeing the lock ring or dog **36** from the housing's annular slot so the inner sleeve **30** can slide downward. As it slides, the inner sleeve **30** uncovers the flow ports **26** so flow can be diverted to the surrounding formation. The shear values required to open the sliding sleeves **10** can range generally from 1,000 to 4,000 psi (6.9 to 27.6 MPa).

[0009] Once the sleeve **10** is open, operators can then pump proppant at high pressure down the tubing string to the open sleeve **10**. The proppant and high pressure fluid flows out of the open flow ports **26** as the seated ball B prevents fluid and proppant from communicating further down the tubing string. The pressures used in the fracturing operation can reach as high as 15,000-psi.

[0010] After the fracturing job, the well is typically flowed clean, and the ball B is floated to the surface. Then, the ball seat **40** (and the ball B if remaining) is milled out. The ball seat **40** can be constructed from cast iron to facilitate milling, and the ball B can be composed of aluminum or a non-metallic material, such as a composite. Once milling is complete, the inner sleeve **30** can be closed or opened with a standard "B" shifting tool on the tool profiles **32** and **34** in the inner sleeve **30** so the sliding sleeve **10** can then function like any conventional sliding sleeve shifting with a "B" tool. The ability to selectively open and close the sliding sleeve **10** enables operators to isolate the particular section of the assembly.

[0011] When aluminum balls B are used, more sliding sleeves **10** can be used downhole for the various stages because the aluminum balls B can have a close tolerance relative to the inner diameter for the seats **40**. For example, forty different increments can be used for sliding sleeves **10** having solid seats **40** used to engage aluminum balls B. However, an aluminum ball B engaged in a seat **40** can be significantly deformed when high pressure is applied against it. Any variations in pressuring up and down that allow the aluminum ball B to seat and to then float the ball B may alter the shape of the ball B, compromising its seating ability or its ability to float to the surface after use.

[0012] Additionally, aluminum balls B if left downhole can be particularly difficult to mill out of the sliding sleeve **10** due to their tendency of rotating during the milling operation. For example, FIG. **1**C shows a mill **50** inserted into a sliding sleeve's housing **20** after milling a ball B from an uphole sliding sleeve. Operators use the mill **50** to mill through all the balls B and seats **40** to gain full tubing access.

[0013] One problem with using aluminum balls B can be the long mill up times required per zone. For instance, milling just one frac stage when a solid aluminum ball is used can take up to an hour. During mill up, larger aluminum balls B push through the seats as a large quarter segment S of the ball. This segment S travels down to the next seat **40** and contacts the next ball B, as shown in FIG. **1**C. When the mill **50** reaches this sliding sleeve, the aluminum segment S and the existing ball B tend to spin on each other and do not allow the mill **50** to grab and mill up the components quickly. As are result, milling the seats **40** and aluminum balls B can be longer than desired, which delays operators' ability to put the well in production.

[0014] Using non-metal balls may avoid the problem of longer milling times because the non-metal balls break apart easier during mill up. Yet, as noted previously, these non-metal balls may not hold the desired operating pressures and may not provide as many stages as can be obtained with the minimized aluminum ball and seat engagement.

[0015] The subject matter of the present disclosure is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth above.

SUMMARY OF THE DISCLOSURE

[0016] A plug is used for engaging in a downhole seat and is milled out after use. The plug has a body with an outer surface and an interior. The plug can be a ball, and the body can be spherical. Additionally, the plug's body can be composed of a metallic material, such as aluminum.

[0017] The body has a plurality of holes formed therein. In particular, the holes extend from at least one common vertex point on the outer surface of the body and extend at angles partially into the interior of the body. The at least one common vertex point can be at least one tap hole defined in the outer surface of the body, and the plurality of holes can be a plurality of angled holes formed at an angle into the interior from the at least one tap hole. At least a portion of the holes can have a filler material disposed therein.

[0018] In one implementation, common vertex points disposed on opposing sides of the body can be used. In this case, the holes include a first set of angled holes formed at an angle into the interior from one of the common vertex points on one of the opposing sides. Additionally, the holes include a second set of angled holes formed at an angle into the interior from the other of the common vertex points on the other of the opposing sides. The first and second sets of angled holes can be offset from one another.

[0019] Manufacturing the plug involves forming the body with the outer surface and the interior. The holes are formed in the body by extending the holes from at least one common vertex point on the outer surface of the body and extending the holes at angles partially into the interior of the body.

[0020] To extend the holes from the at least one common vertex point on the outer surface of the body, the method can involve forming at least one tap hole in the outer surface of the body and forming a plurality of angled holes formed at an angle into the interior from the at least one tap hole. In one implementation, tap holes can be formed on opposing sides of the body. In this way, a first set of angled holes can be formed at an angle into the interior from one of the tap holes, and a second set of angled holes can be formed at an angle into the interior from the other tap hole. These first and second sets of angled holes can be offset from one another.

[0021] The foregoing summary is not intended to summarize each potential embodiment or every aspect of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] FIG. **1**A illustrates a sliding sleeve having a ball engaged with a seat to open the sliding sleeve according to the prior art.

[0023] FIG. **1**B illustrates a close up view of the sliding sleeve in FIG. **1**B.

[0024] FIG. **1**C illustrates a close up view of a mill entering the sliding sleeve of FIG. **1**B.

[0025] FIGS. **2**A-**2**C illustrate cross-sectional views of a first embodiment of a metallic ball according to the present disclosure for actuating a sliding sleeve.

[0026] FIGS. **3**A-**3**C illustrate cross-sectional views of a second embodiment of a metallic ball according to the present disclosure for actuating a sliding sleeve.

[0027] FIGS. **4**A-**4**C illustrate cross-sectional views of a third embodiment of a metallic ball according to the present disclosure for actuating a sliding sleeve.

[0028] FIGS. **5**A-**5**C illustrate cross-sectional views of a fourth embodiment of a metallic ball according to the present disclosure for actuating a sliding sleeve.

[0029] FIGS. **6**A-**6**C illustrates a detailed view of a mill entering a sliding sleeve having the metallic ball of FIGS. **3**A-**3**C.

[0030] FIG. **7** illustrates segments or shards remaining after milling a ball according to the present disclosure.

[0031] FIG. **8** illustrates yet another embodiment of a metallic ball for actuating a sleeve and facilitating mill out according to the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0032] Fracture balls composed of metal, and particularly aluminum, have material removed from the ball's interior. The removal of the material can be done in various ways. In general, holes can drilled to a specified depth in the ball, but the holes do not create a through-hole in the ball, as this would compromise the sealing ability of the ball. Instead, the holes create voids (not through-holes) and allow the ball to stay intact during fracturing operations. The holes in the ball also allow the ball to break up easier during milling operations.

[0033] As noted in the background of the present disclosure, mill out of a solid metal (aluminum) ball may cause a large segment of the ball to push through the seat before being fully milled. The partially milled segment then travels to the next ball/seat below it. The segment and ball then tend spin when the mill reaches them, which increases the mill up times. However, the disclosed ball having the partial hole(s) defined therein tends to break up into smaller pieces that allow the mill to grab them when it travels to the lower seat. Although the partial hole(s) may be beneficial for milling, the ball must still be capable of properly seating on the ball seat and preventing leakage and must be able to withstand the increased pressures of the fracture operations.

[0034] FIGS. **2**A-**2**C illustrate cross-sectional views of a first embodiment of a ball **100** according to the present disclosure for actuating a sliding sleeve. The ball **100** has a solid, spherical body **102** composed of a metallic material, including, but not limited to, aluminum, aluminum alloy, steel, brass, aluminum bronze, a metallic nanostructure material, cast iron, etc. The metallic material is preferably one that can be floated to the surface and can be milled if necessary. Of course, the ball **100** can be composed of any suitable material, even ceramics, plastics, composite materials, phenolics, Torlon, Peek, thermoplastics, or the like.

[0035] Voids, spaces, or holes are defined in the body **102** to facilitate milling of the ball **100** when disposed in a ball seat of a tool, such as a sliding sleeve. Because the ball **100** has the purposes of sealingly engaging the ball seat in the sliding sleeve, the ball **100** preferably is configured to maintain or produce a sufficient seal with the ball seat when seated therein. Therefore, the voids, spaces, or holes do not pass entirely through the body **102**. Instead, as shown in FIGS.

2A-**2**C, a tap hole **110** is drilled in one side of the ball's body **102**. The depth of this tap hole **110** is preferably less than half the diameter of the ball **100**, although it could be deeper in a given implementation.

[0036] Drilled off at angles from the tap hole **110** are a plurality of angled holes **112**—four such angled holes **112** are shown in the ball **100** of FIGS. **2**A-**2**C. The tap hole **110**, although it may provide a desired void in the ball's body **102**, is used primarily to provide a common vertex point V near the surface **104** of the ball **100** from which to form the angled holes **112**. In this way, the multiple angled holes **112** do not tap multiple points on the ball's outer surface **104**, which could compromise the sealing capability of the ball **100** when seated.

[0037] All the same, the tap hole **110** can be left unplugged and act as a suitable void. Alternatively, the tap hole **110** can plugged with material, such as epoxy, resin, solder, plastic, rubber, the same metal material as the body **102**, other type of metal than the body **102**, or the like. The angled holes **112** can even be filled at least partially with filler material that can be readily milled.

[0038] Each angled hole **112** can be angled at about 45-degrees from the centerline of the tap hole **110**, and the angled holes **112** may be offset at about 90-degrees from one another around the tap hole **110**. As with the tap hole **110**, the angled holes **112** may extend to less than the mid-section of the ball's body **102**, but this may vary for a given implementation. The ball **100** in FIG. **2**A-**2**C essentially defines holes **110**/**112** or voids in half the ball's body **102**.

[0039] For some exemplary dimensions for the ball **100** having a diameter of about 3-in., the tap hole **110** can be about ⅜-in. wide and can extend about ⅓ of the diameter (e.g., about 1-in.) of the body **102**. The angled holes can be about ¼-in. wide and can extend about 1.75-in. in length. Other sized balls **100** would have other dimensions, of course. In any event, balls **100** having a diameter of about 2-in. or greater would be best suited for the types of holes disclosed herein simply because balls with smaller diameters are already easier to mill.

[0040] FIGS. **3**A-**3**C illustrate cross-sectional views of a second embodiment of a ball **100** according to the present disclosure for actuating a sliding sleeve. This ball **100** is similar to that discussed previously, but tap holes **110***a-b* are defined in opposing sides of the ball's body **102**. Each tap hole **110***a-b* has a plurality of angled holes **112***a-b* in a manner similar to that discussed previously. Preferably as shown, the angled holes **112***a-b* are offset from one another around the axis defined by the tap holes **110***a-b* so that the opposing holes **112***a-b* do not meet with one another inside the body **102**. Because the tap holes **110***a-b* are offset 180-degrees on opposite sides, it is less likely that both will engage the edge of a seat when landed thereon.

[0041] As before, the tap holes **110***a-b* can primarily provide common vertices Va-Vb from which the opposing angled holes **112***a-b* can be formed so that multiple tap points do not need to be made in the ball's surface **104**. The ball **100** in FIG. **3**A-**3**C essentially defines holes **110***a-b*/**112***a-b* or voids throughout the interior of the entire ball's body **102**. If desired, the holes **110***a-b*/**112***a-b* can be left empty or can be filled with a filler material, such as an epoxy, resin, plastic, rubber, other type of metal than the body's metal, or the like.

[0042] FIGS. **4**A-**4**C illustrate cross-sectional views of a third embodiment of a metallic ball **100** according to the present disclosure for actuating a sliding sleeve. This ball **100** is similar to that discussed above with reference to FIGS. **2**A-**2**C in that a tap hole **110** and angled holes **114** are defined in one side of the ball **100**. Rather than having four angled holes as in the previous embodiment, this ball **100** has three angled holes **114** drilled at about every 120-degrees around the tap hole **110**.

[0043] In other differences illustrated, the angled holes **112** can be drilled at a shallower angle from the tap hole **110**. Additionally, the ends of the angled holes **112** can extend beyond the midpoint of the ball's body **102**. Thus, the angled holes **112** extend nearly to the opposing side of the ball's body **102**.

[0044] FIGS. **5**A-**5**C illustrate cross-sectional views of a fourth embodiment of a metallic ball **100** according to the present disclosure for actuating a sliding sleeve. This ball **100** has tap holes **110***a-b* and angled holes **112***a-b* similar to the ball **100** in FIGS. **4**A-**4**C and has two sets of such holes **110***a-b*/**112***a-b* on opposing sides of the ball **100** similar to the ball **100** in FIGS. **3**A-**3**C.

[0045] As can be seen from the various arrangements of holes in FIGS. **2**A through **5**C, the metallic ball **100** can have a plurality of holes (e.g., **112**) formed or drilled partially therein. Preferably, the holes **112** do not pass entirely through the ball's body **102** and do not intersect one another **102**. Instead, the holes **112** are made from one or more common vertices V near the surface **104** of the ball **100** and spread out from one another in different directions from the common vertex V. When the holes **112** are formed from two or more common vertices Va-Bb as in FIGS. **3**A-**3**C and **5**A-**5**C, the opposing holes **112***a-b* preferably pass between each other in a fit pattern.

[0046] In general, the ball **100** (if solid) would have about 10× the structural strength required to achieve its purposes downhole. Removing material with the holes **110**/**112** could reduce the structural strength to perhaps 2 to 3 times what is needed. In any event, a given ball **100** with the holes **110**/**112** is preferably capable of withstanding at least 7,000-psi, and more preferably 10,000-psi, without collapsing on itself. Of course, the different diameters of balls and seats used and the associated materials will govern any such variables.

[0047] FIGS. **6**A-**6**C illustrates a detailed view of a mill **50** entering a sliding sleeve having the ball **100** of FIGS. **3**A-**3**C. As shown in FIG. **6**A, the ball **100** is engaged in the seat **40**. The tap holes **110** and/or angled holes **112** of the ball **100** can be filled with filler material (not shown). After fracturing, the ball **100** may be deformed by the applied pressure in ways not specifically shown here. For example, an outer ring may form around the ball **100** where it engages the shoulder of the seat **40**, and the top of the ball **100** may be compressed outward. In any event, operators eventually run a milling tool **50** down the tubing string to mill out the ball **100** and seat **40**. In general, the mill **50** can use any suitable type of bit, such as a PCD type bit.

[0048] As shown in FIG. **6**B, the mill **50** engages the ball **100** and bears down against it. As the mill **50** rotates, the voids in the metal body **102** of the ball **100** allow the edges and teeth of the mill **50** to engage the ball **100** so that the mill **50** can bite, grab, break, and shave away the material of the ball **100** more readily than found with a solid metal ball. Notably, the voided ball **100** may have less of a tendency to rotate with the rotation of the mill **50**, which typically happens with a solid metal ball during milling operations. Also, if a portion of the ball **100** remains intact, the holes **110**/**112** can allow the portion to be split when the mill **50** applies weight because the holes **110/112** create fracture planes and points for grinding up the ball **100**.

[0049] Finally, as shown in FIG. **6**C, the mill **50** can eventually grind and break up the ball into shavings (not shown) and possible chunks C that may then fall or be pushed through the seat **40**. Milling the aluminum ball B can take up to 10-min., depending of the motor, bit, flow rates, and weight on bit (WOB) used, as well as any environmental conditions.

[0050] Although these chunks C may pass to the next ball and seat downhole, their irregular shape and fragmented nature makes them easier to mill further when the mill **50** reaches the next ball and seat arrangement downhole. The chunks C and any exposed holes on the other ball create points of friction that can facilitate milling. As an example of what possible chunks C may be left of a metallic ball after milling and passing through a seat, FIG. **7** illustrates several chunks of an aluminum ball after being milled out at least partially.

[0051] Again, some of the ball remains as chunks during milling that can then pass through the seat before the mill **50** actually grinds the entire ball and seat during milling operations. Rather than producing a quarter segment of the ball B as encountered with a solid metal ball when milled, the voided ball **100** produces less uniform and less substantial chunks. One chunk is shown as being flat in shape and as defining remnants of the various holes (**112**) formed in the ball's body **102**. This makes this chunk more susceptible to further breaking and grinding during further milling stages. Other chunks are smaller pieces removed from the voided ball **100** during milling.

[0052] As an alternative to a spherical ball having holes to facilitate milling, a metallic ball **200** as shown in FIG. **8** can also engage in a seat of a sliding sleeve, yet facilitate mill out when needed. The ball **200** includes a fin or tail **206** on one end of the ball **200**, which would correspond to the top of the ball **200** when deployed. The base body **202** of the ball **200** is truncated, having a large portion **204** removed to below the sealing area **208** where the ball **200** would engage a seat's shoulder. The tail **206** keeps the ball **200** oriented properly. When milled, however, less of a spherical segment of the ball **200** would pass through the seat to the next ball, which can avoid some of the problems encountered during further milling stages.

[0053] Manufacture of the balls **100/200** disclosed herein can be performed in a number of ways depending on the type of material used. For example, the balls **110/200** can be formed by casting, machining, drilling, and a combination thereof. Any holes **110/112** in the balls **110** can be formed by casting, machining, drilling, and a combination thereof. These and other such manufacturing details will be appreciated by one skilled in the art having the benefit of the present disclosure.

[0054] The foregoing description of preferred and other embodiments is not intended to limit or restrict the scope or applicability of the inventive concepts conceived of by the Applicants. It will be appreciated with the benefit of the present disclosure that features described above in accordance with any embodiment or aspect of the disclosed subject matter can be utilized, either alone or in combination, with any other described feature, in any other embodiment or aspect of the disclosed subject matter.

[0055] In exchange for disclosing the inventive concepts contained herein, the Applicants desire all patent rights afforded by the appended claims. Therefore, it is intended that the appended claims include all modifications and alterations to the full extent that they come within the scope of the following claims or the equivalents thereof.

What is claimed is:

1. A plug for engaging in a downhole seat and being milled out after use, the plug comprising:

a body having an outer surface and an interior,

the body having a plurality of holes formed therein, the holes extending from at least one common vertex point on the outer surface of the body and extending at angles partially into the interior of the body.

2. The plug of claim **1**, wherein the plug is a ball, and wherein the body is spherical.

3. The plug of claim **1**, wherein the body is composed of a metallic material.

4. The plug of claim **3**, wherein the metallic material comprises aluminum.

5. The plug of claim **1**, wherein the at least one common vertex point comprises at least one tap hole defined in the outer surface of the body, and wherein the plurality of holes comprises a plurality of angled holes formed at angles into the interior from the at least one tap hole.

6. The plug of claim **1**, wherein the at least one common vertex point comprises common vertex points disposed on opposing sides of the body.

7. The plug of claim **6**, wherein the plurality of holes comprises:

a first set of angled holes formed at angles into the interior from one of the common vertex points on one of the opposing sides; and

a second set of angled holes formed at angles into the interior from the other of the common vertex points on the other of the opposing sides.

8. The plug of claim **7**, wherein the first and second sets of angled holes are offset from one another.

9. The plug of claim **1**, wherein at least a portion of the holes comprise a filler material disposed therein.

10. A method of manufacturing a plug for engaging in a downhole seat and being milled out after use, the method comprising:

forming a body having an outer surface and an interior,

forming a plurality of holes in the body by extending the holes from at least one common vertex point on the outer surface of the body and extending the holes at angles partially into the interior of the body.

11. The method of claim **10**, wherein the plug is a ball, and wherein the body is spherical.

12. The method of claim **10**, wherein the body is composed of a metallic material.

13. The method of claim **12**, wherein the metallic material comprises aluminum.

14. The method of claim **10**, wherein extending the holes from the at least one common vertex point on the outer surface of the body comprises forming at least one tap hole in the outer surface of the body,

15. The method of claim **14**, wherein extending the holes at angles partially into the interior of the spherical body comprises forming a plurality of angled holes formed at angles into the interior from the at least one tap hole.

16. The method of claim **10**, wherein extending the holes from the at least one common vertex point on the outer surface of the body comprises forming tap holes on opposing sides of the body.

17. The method of claim **16**, wherein extending the holes at angles partially into the interior of the body comprises:

forming a first set of angled holes at angles into the interior from one of the tap holes; and

forming a second set of angled holes at angles into the interior from the other tap hole.

18. The method of claim **17**, wherein the first and second sets of angled holes are offset from one another.

19. The method of claim **10**, further comprising filling at least a portion of the holes with a filler material.

20. A plug for engaging in a downhole seat and being milled out after use, the plug comprising:

a body having an outer surface,

a top end of the body having a fin disposed thereon, and

a bottom end of the body opposite the top end having a sealing area on the outer surface, the bottom end being truncated below the sealing area.

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