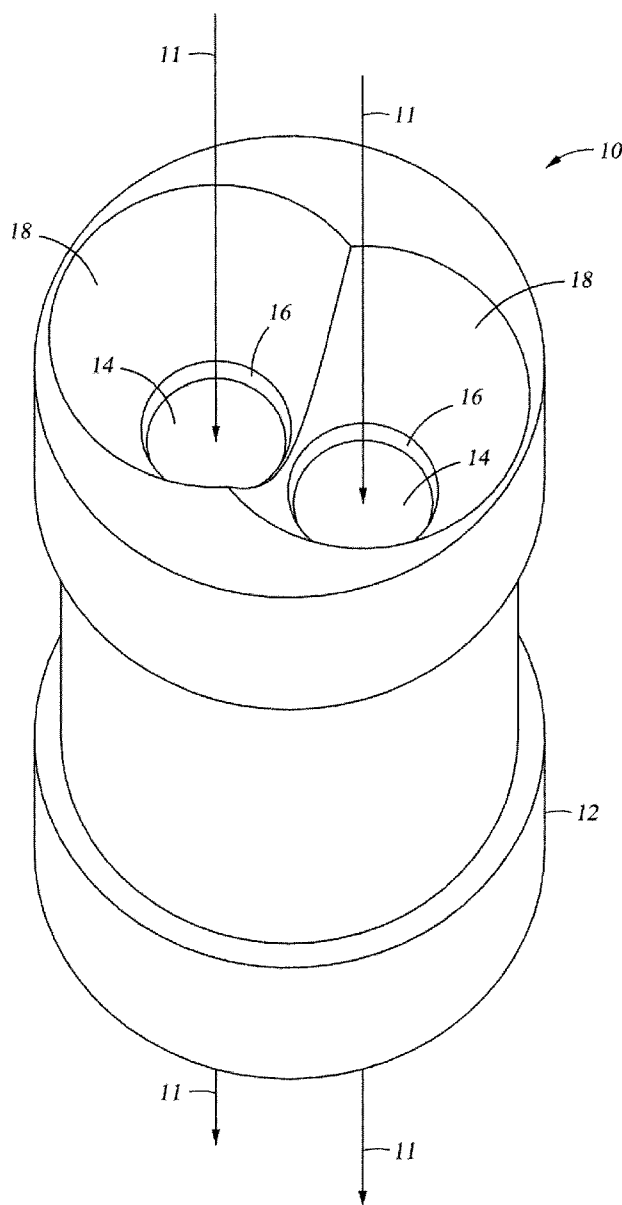




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KELLNER(10) **Pub. No.: US 2010/0314126 A1**(43) **Pub. Date: Dec. 16, 2010**(54) **SEAT APPARATUS AND METHOD**(22) Filed: **Jun. 10, 2009**(75) Inventor: **JUSTIN KELLNER,**
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CANTOR COLBURN LLP
20 Church Street, 22nd Floor
Hartford, CT 06103 (US)(57) **ABSTRACT**(73) Assignee: **BAKER HUGHES**
INCORPORATED, HOUSTON,
TX (US)

A seat apparatus comprises a housing defining at least a first flow path and at least a second flow path, a first seat disposed in the housing for receipt of a first object operative to obstruct the first flow path, and a second seat disposed in the housing for receipt of a second object operative to obstruct the second flow path and method.

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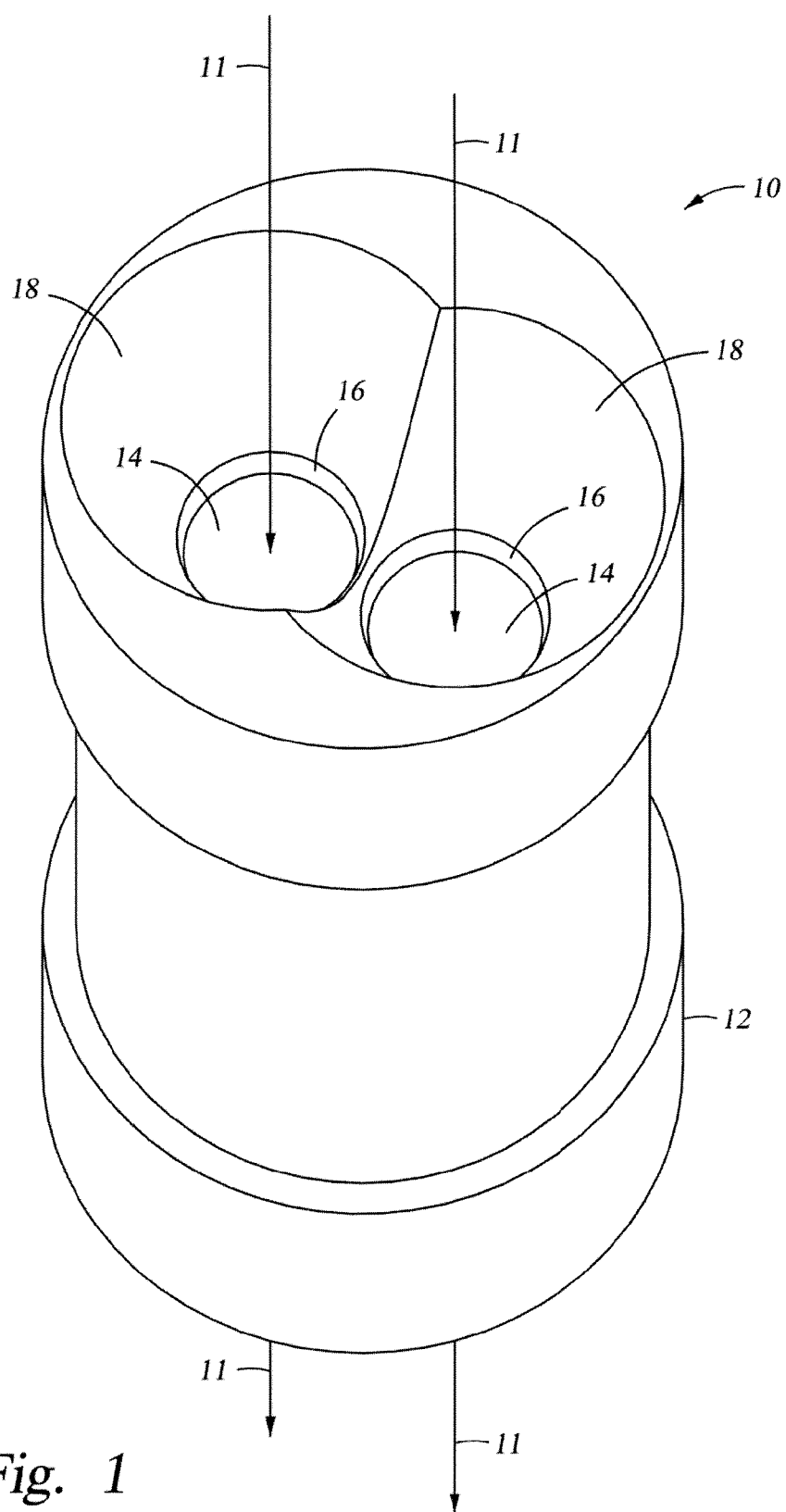


Fig. 1

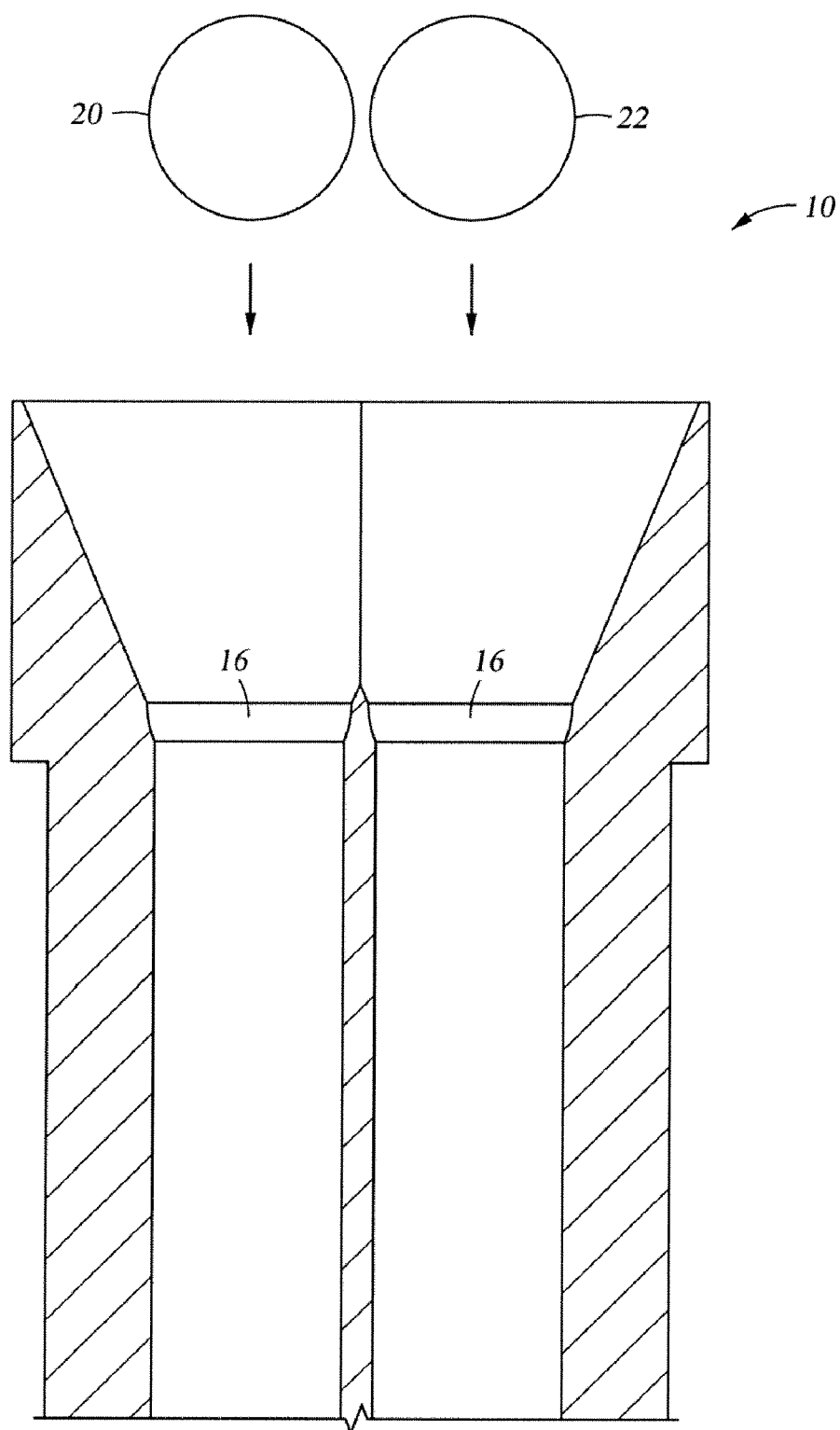


Fig. 2

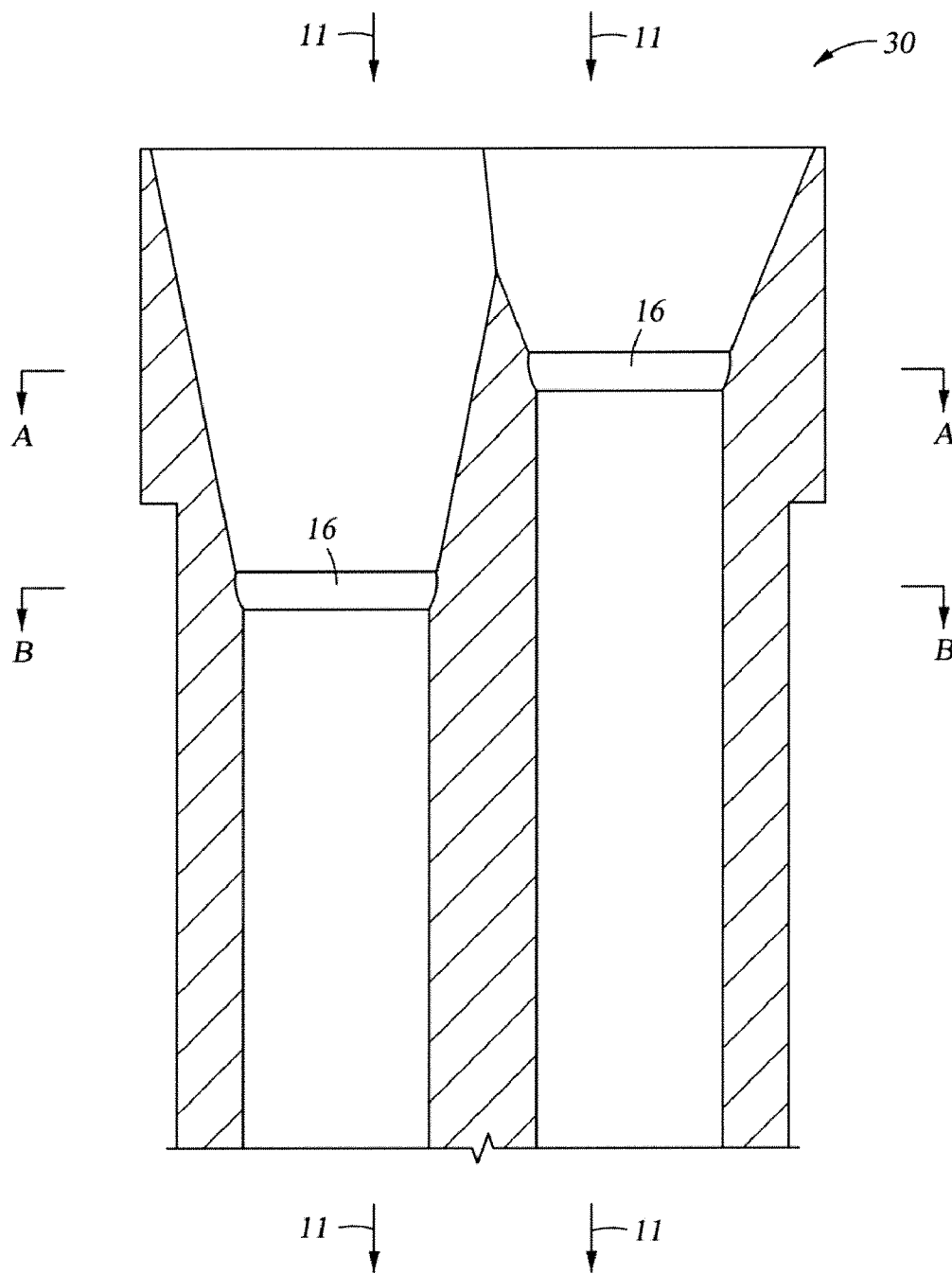


Fig. 3

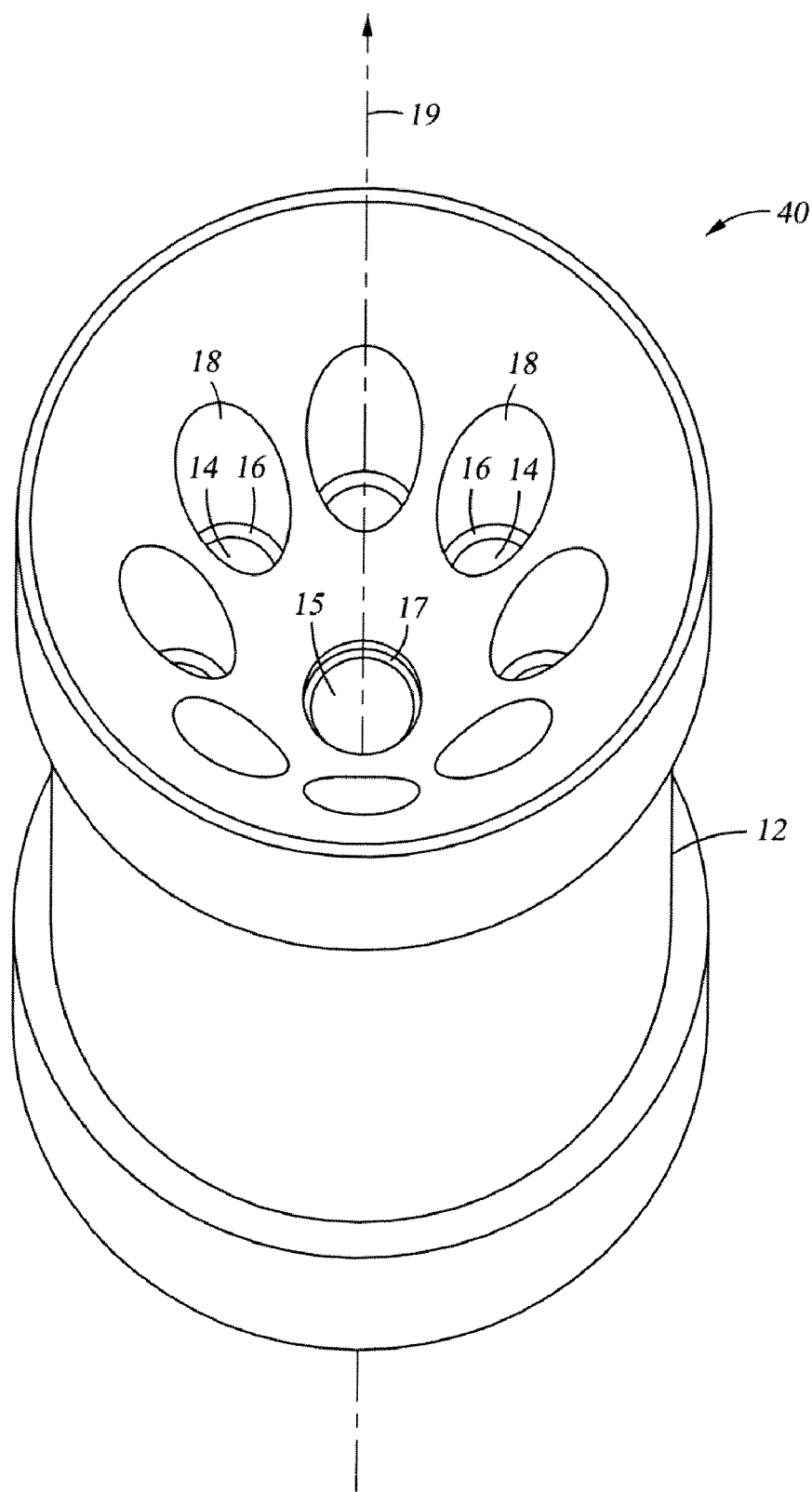


Fig. 4

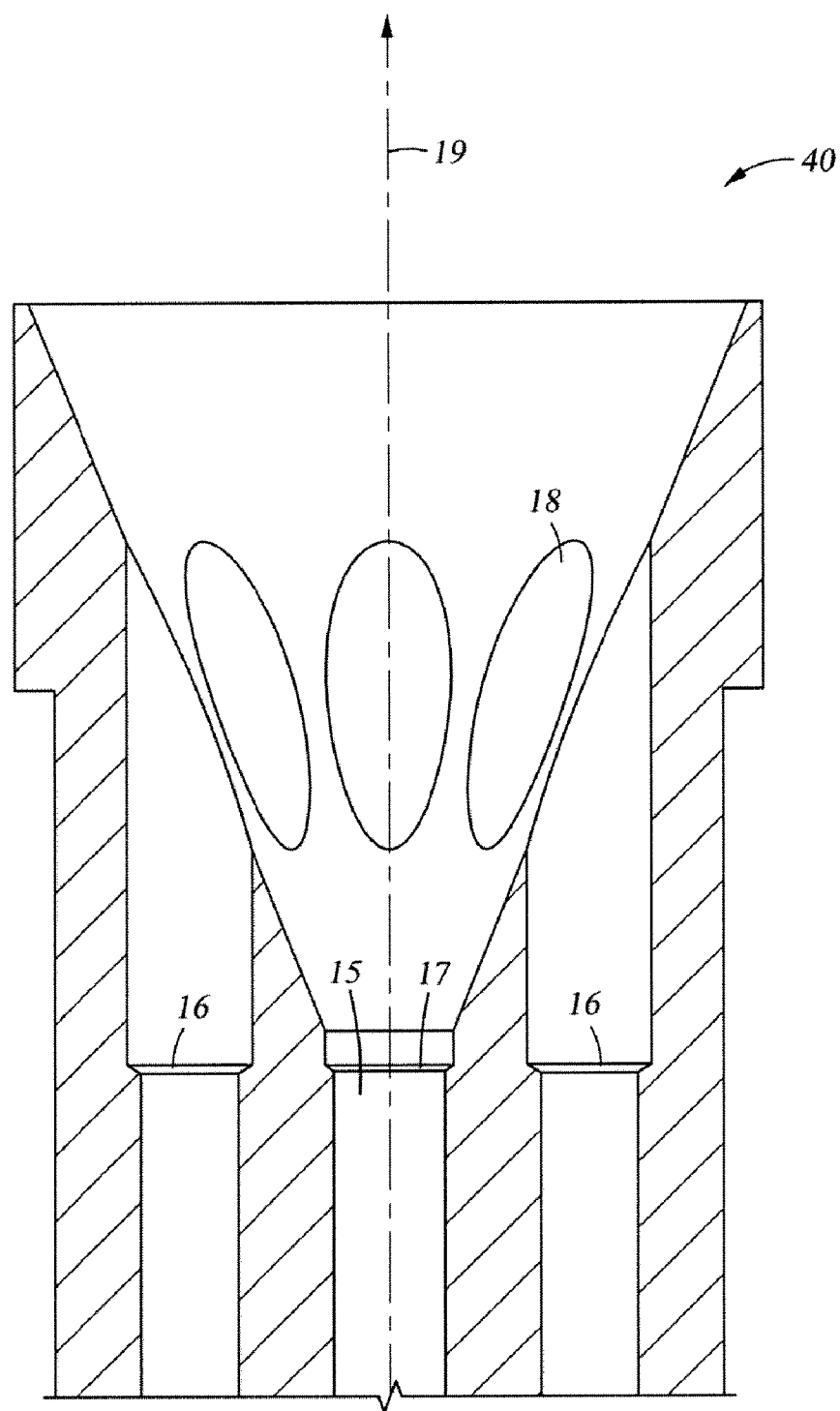


Fig. 5

SEAT APPARATUS AND METHOD

BACKGROUND

[0001] Seats such as, for example ball seats are well known in downhole industries and especially so in the drilling and completion industry. Commonly, ball seats are used to regulate the flow of fluids and actuate downhole devices. Although ball seat configurations are many and are ubiquitous in their use within the art, the number of stacked ball seats that can be employed with traditional systems is limited. Improving the number of ball seats that may be stacked in a borehole will be welcomed by the art.

SUMMARY

[0002] A seat apparatus includes a housing defining at least a first flow path and at least a second flow path, a first seat disposed in the housing for receipt of a first object operative to obstruct the first flow path, and a second seat disposed in the housing for receipt of a second object operative to obstruct the second flow path.

[0003] A seat apparatus includes a housing defining at least a first flow path, the axis of the first flow path coincident with a longitudinal axis of the housing, at least a second flow path partially defined by the housing, a first seat disposed in the housing for receipt of a first object operative to obstruct the first flow path, and a second seat disposed in the housing for receipt of a second object operative to obstruct the second flow path.

[0004] A method for facilitating a pressure based operation in a downhole environment comprises disposing a first object in a first seat in a housing, the first object operative to obstruct a first flow path partially defined by the housing, and disposing a second object in a second seat in the housing, the second object operative to obstruct a second flow path partially defined by the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Referring now to the drawings wherein like elements are numbered alike in the several figures:

[0006] FIG. 1 is a perspective view of an embodiment of a ball seat;

[0007] FIG. 2 is a cut-away side view of the ball seat of FIG. 1;

[0008] FIG. 3 is a side cut-away view of a portion of an alternate embodiment of a ball seat;

[0009] FIG. 4 is a perspective view of another alternate embodiment of a ball seat;

[0010] FIG. 5 is a side cut-away view of the ball seat of FIG. 4.

DETAILED DESCRIPTION

[0011] Referring to FIG. 1, an exemplary embodiment of a ball seat **10** is illustrated. The ball seat **10** includes a housing **12** that includes tubular orifices **14**. The tubular orifices **14** define flow paths indicated by the arrows **11**. Seats **16** are disposed at the apertures of the orifices **14**. The illustrated embodiment includes concave portions **18** defined by the housing **12**. The concave portions may be, for example, conical, parabolic, or cylindrical in shape.

[0012] FIG. 2 illustrates a cut-away view of the ball seat **10**. In operation, the ball seat **10** may be placed downhole in a borehole. A first object **20** such as, for example, a spherical object may be introduced into the borehole and driven

towards the ball seat **10** by, for example, hydraulic pressure or gravity. One of the concave portions **18** directs the first object **20** into engagement with a seat **16**; blocking an orifice **14** and obstructing a flow path **11**. A second object **22** may similarly be driven towards the ball seat **10** and directed by the concave portions **18** into the empty seat **16**; blocking the second orifice **14** and obstructing the second flow path **11**. The obstruction of the flow paths allows an operator to pressure up against the obstructed ball seat **10** to facilitate a downhole pressure based operation. This may be a fracturing job or actuation of a desired downhole device, or to otherwise effect desired downhole operations.

[0013] Previous ball seat devices using a single orifice and seat arrangement may be less effective when the cross sectional areas of the orifice (and the associated diameter of the object) are less than a defined threshold cross sectional area. The threshold diameter may be a different diameter for different borehole systems and is associated with the likelihood of a pressure increase upstream of the orifice due to its restricted flow area. Orifice cross sectional areas less than the threshold cross sectional area may undesirably restrict the flow of fluid and cause the undesired and premature actuation of tools or other premature operations uphole relative to the ball seat device. The illustrated embodiments having more than one orifice allow the cross sectional areas of individual orifices (and the associated diameter of the objects) to be reduced while avoiding the restriction of the flow of fluid since the use of multiple orifices allows the net cross sectional area of the orifices to remain greater than the threshold cross sectional area.

[0014] FIG. 3 illustrates a side cut-away view of a portion of an alternate exemplary embodiment of a ball seat **30**. The ball seat **30** is similar in operation to the ball seat **10** (of FIGS. 1 and 2) however; the seats **16** in the illustrated embodiment are disposed in different planes (A and B). In the illustrated example, the plane B is located downstream in the flow path direction (as indicated by the arrows **11**) relative to the plane A. The disposition of the seats **16** in different planes may improve the performance of the ball seat **30**.

[0015] FIG. 4 illustrates another alternate embodiment of a ball seat **40**. The ball seat **40** operates in a similar manner to the embodiments described above, and includes a plurality of seats **16** and concave portions **18**. In the illustrated embodiment, a seat **17** and associated flow path **15** have an axis coincident to the longitudinal axis **19** of the ball seat **40**. The seats **16** and associated flow paths **14** are disposed radially about the axis **19** in the housing **12**. FIG. 5 illustrates a side partially cut-away view of a portion of the ball seat **40** (of FIG. 4).

[0016] The Figures described above illustrate exemplary embodiments of ball seats. Other embodiments may include any number of ball seats having multiple seat portions, flow paths, alignment planes, and shapes that are operative to direct objects to engage the seats.

[0017] While one or more embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

1. A seat apparatus comprising:

- a housing defining at least a first flow path and at least a second flow path;

a first seat disposed in the housing for receipt of a first object operative to obstruct the first flow path; and
a second seat disposed in the housing for receipt of a second object operative to obstruct the second flow path.

2. The seat apparatus as claimed in claim 1 wherein the housing includes a first concave portion operative to guide the first object towards the first seat.

3. The seat apparatus as claimed in claim 1 wherein the housing includes a second concave portion operative to guide the second object towards the second seat.

4. The seat apparatus as claimed in claim 1 wherein the first seat and the second seat are coplanar.

5. The seat apparatus as claimed in claim 1 wherein the first seat is disposed on a first plane and the second seat is disposed on a second plane.

6. The seat apparatus as claimed in claim 1 wherein the first object is spherically shaped.

7. The seat apparatus as claimed in claim 1 wherein the first flow path defined by the housing is tubular.

8. The seat apparatus as claimed in claim 2 wherein the concave portion is parabolically shaped.

9. The seat apparatus as claimed in claim 2 wherein the concave portion is conically shaped.

10. A seat apparatus comprising:

a housing defining at least a first flow path, the axis of the first flow path coincident with a longitudinal axis of the housing;

at least a second flow path partially defined by the housing;
a first seat disposed in the housing for receipt of a first object operative to obstruct the first flow path; and

a second seat disposed in the housing for receipt of a second object operative to obstruct the second flow path.

11. The seat apparatus as claimed in claim 10 wherein the housing includes a first concave portion operative to guide the first object towards the first seat.

12. The seat apparatus as claimed in claim 10 wherein the housing includes a second concave portion operative to guide the second object towards the second seat.

13. The seat apparatus as claimed in claim 10 wherein the first seat and the second seat are coplanar.

14. The seat apparatus as claimed in claim 10 wherein the first seat is disposed on a first plane and the second seat is disposed on a second plane.

15. The seat apparatus as claimed in claim 10 wherein the first object is spherically shaped.

16. The seat apparatus as claimed in claim 10 wherein the first flow path defined by the housing is tubular.

17. The seat apparatus as claimed in claim 11 wherein the concave portion is parabolically shaped.

18. The seat apparatus as claimed in claim 11 wherein the concave portion is conically shaped.

19. A method for facilitating a pressure based operation in a downhole environment comprising:

disposing a first object in a first seat in a housing, the first object operative to engage the first seat and to obstruct a first flow path partially defined by the housing; and

disposing a second object in a second seat in the housing, the second object operative to engage the second seat and obstruct a second flow path partially defined by the housing.

20. The method of claim 19, wherein the method further comprises applying a hydraulic pressure to the housing, the hydraulic pressure operative to actuate the downhole device.

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