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(54) Title: SEAT APPARATUS AND METHOD

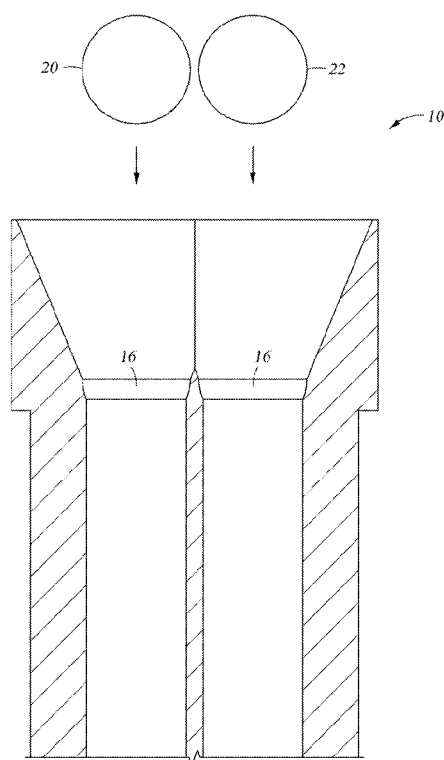


Fig. 2

(57) Abstract: 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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SEAT APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS AND PRIORITY CLAIM

[0001] This application claims the benefit of the filing date of United States Patent Application Serial Number 12/482,181 filed June 10, 2009, for “Seat Apparatus and Method.”

BACKGROUND

[0002] 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

[0003] 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.

[0004] 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.

[0005] 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

[0006] Referring now to the drawings wherein like elements are numbered alike in the several figures:

[0007] Figure 1 is a perspective view of an embodiment of a ball seat;

[0008] Figure 2 is a cut-away side view of the ball seat of Figure 1;

[0009] Figure 3 is a side cut-away view of a portion of an alternate embodiment of a ball seat;

[0010] Figure 4 is a perspective view of another alternate embodiment of a ball seat;

[0011] Figure 5 is a side cut-away view of the ball seat of Figure 4.

DETAILED DESCRIPTION

[0012] Referring to Figure 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.

[0013] Figure 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.

[0014] 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.

[0015] Figure 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 Figures 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.

[0016] Figure 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. Figure 5 illustrates a side partially cut-away view of a portion of the ball seat 40 (of Figure 4).

[0017] 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.

[0018] 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.

CLAIMS

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.

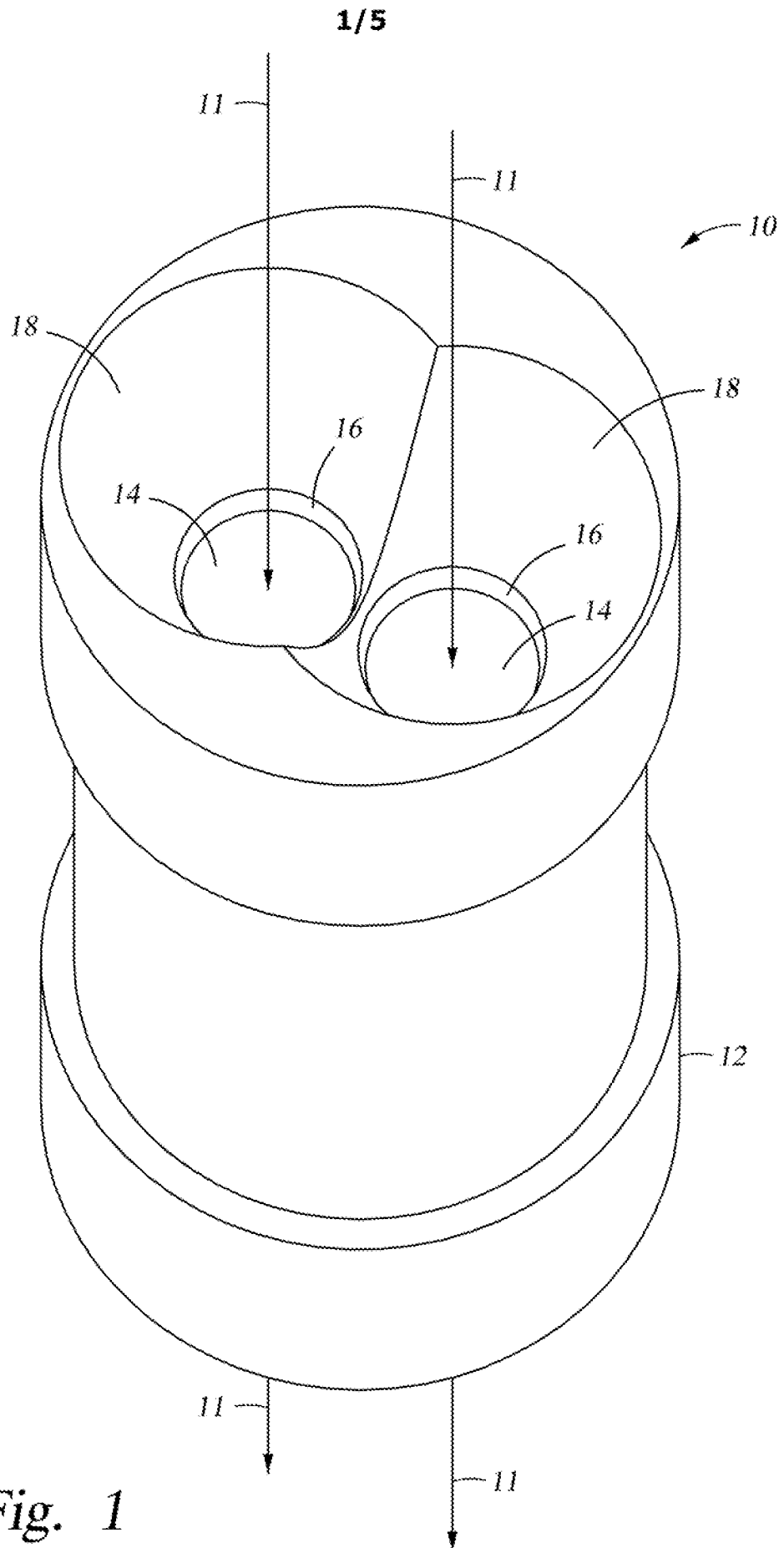
18. The seat apparatus as claimed in claim 11 wherein the concave portion is conically shaped.

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

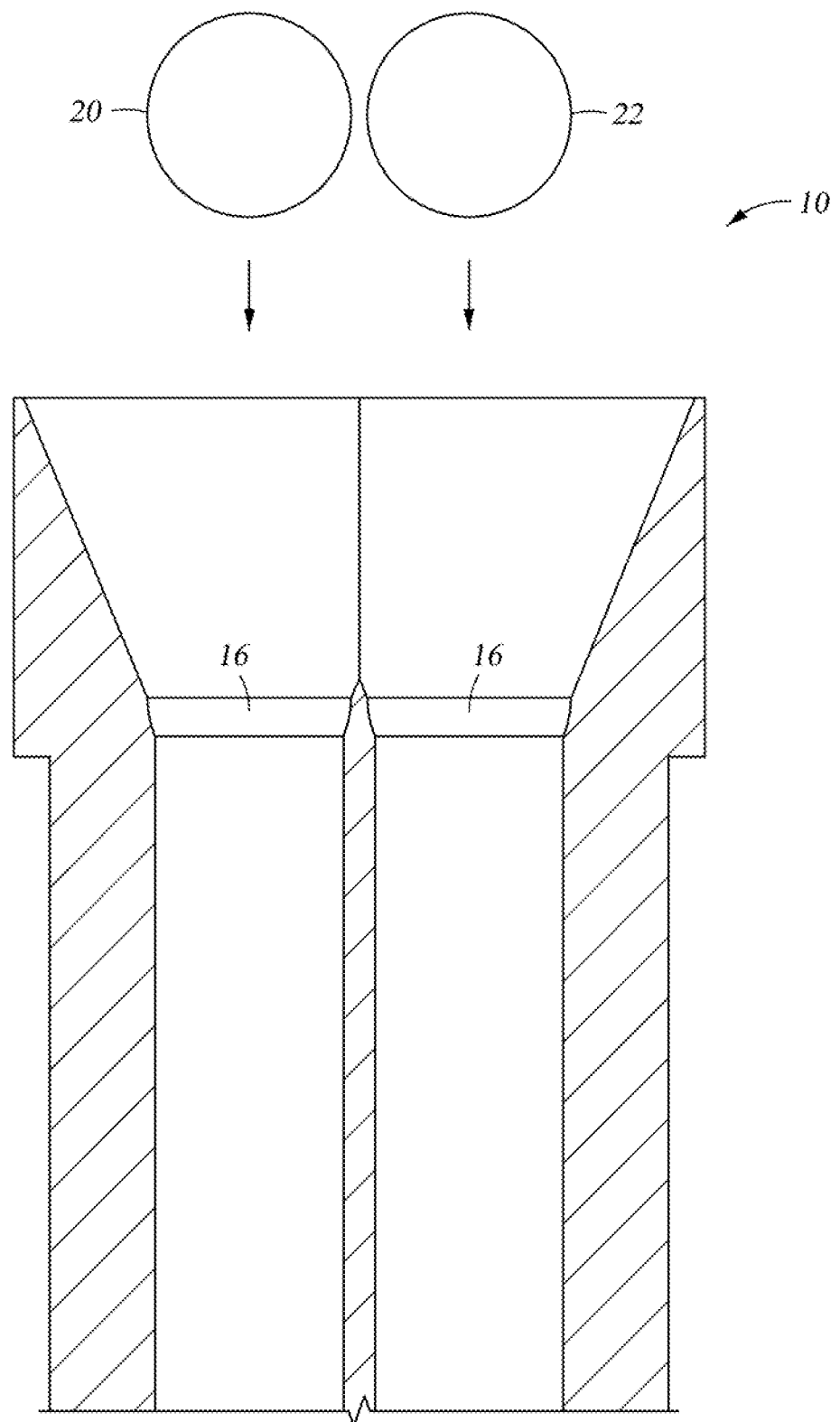
disposing a first object in a first seat in a housing, the first object operative to engage the first seat and to obstruct a first flow path partially defined by the housing; and

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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*Fig. 2*

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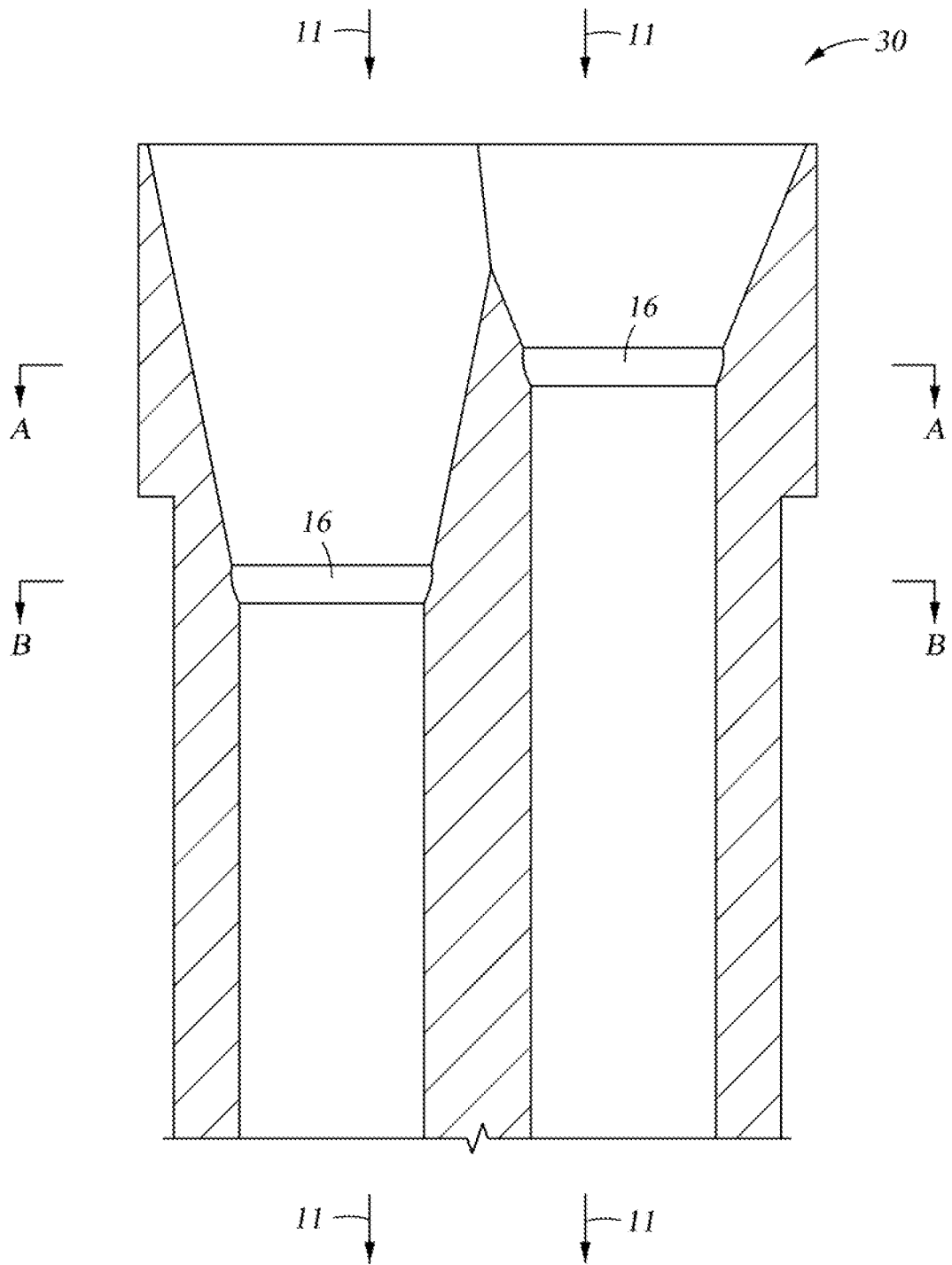


Fig. 3

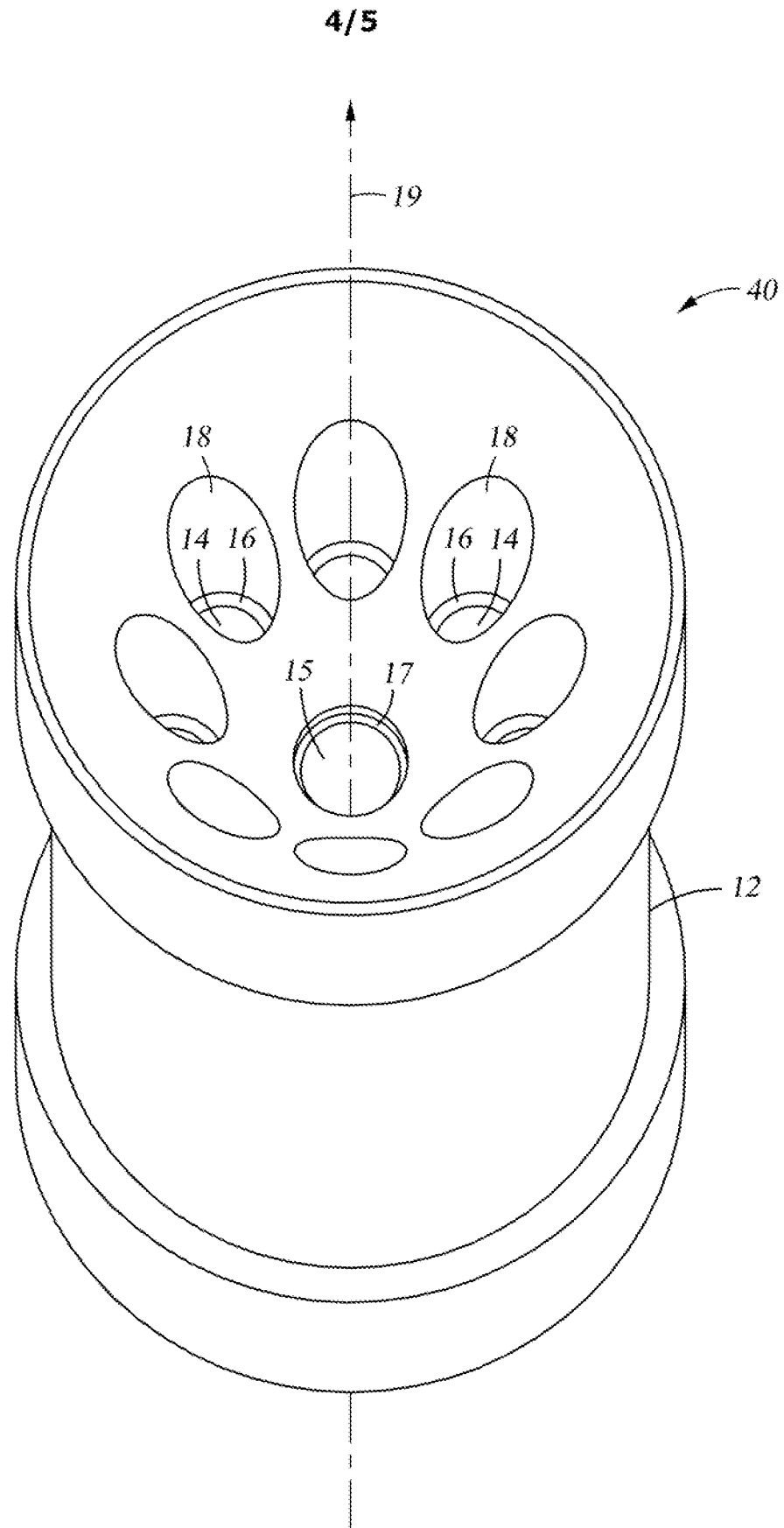


Fig. 4

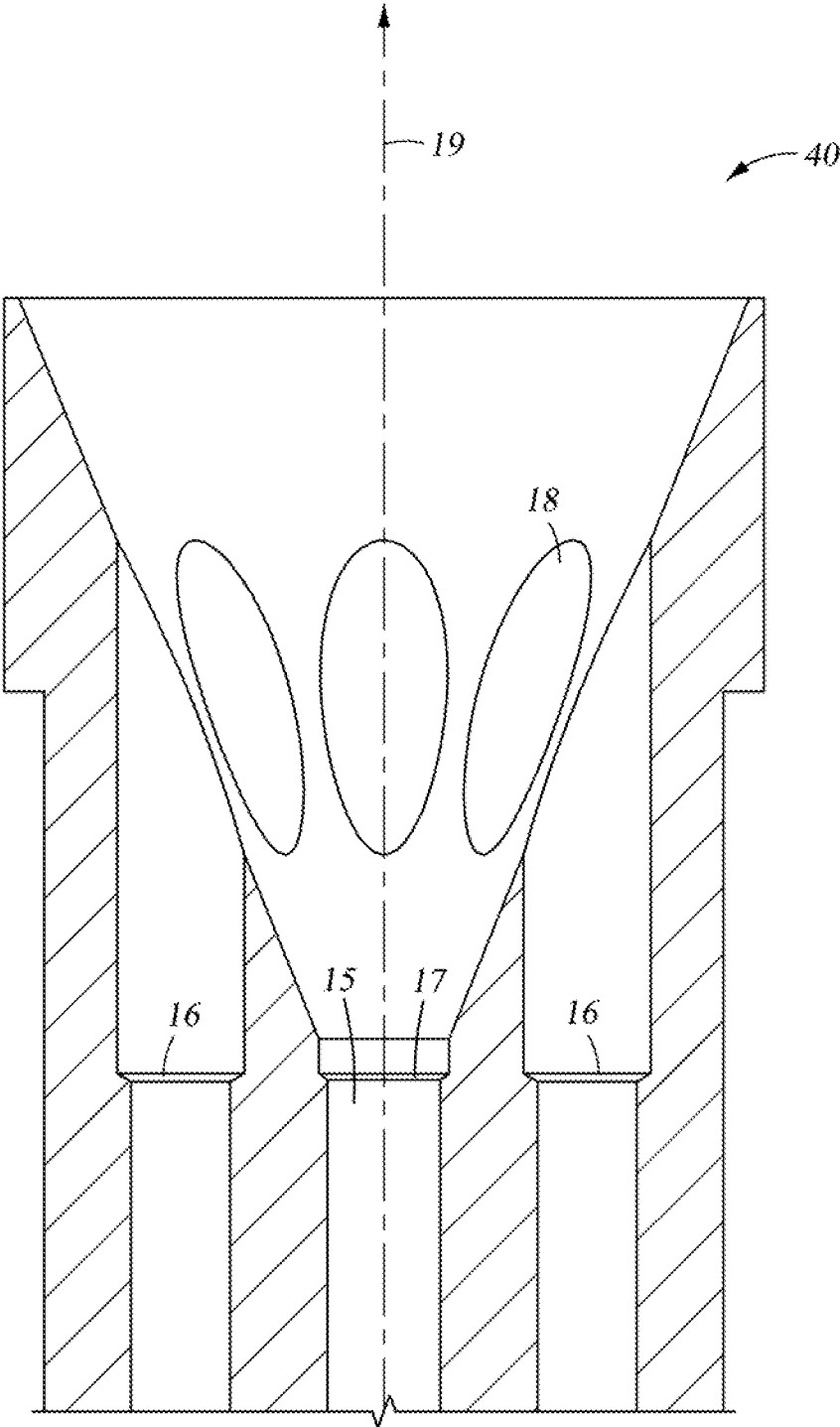


Fig. 5