(12) UK Patent (19) GB (11) 2569128 (13) B

(45) Date of B Publication 23.02.2022

(54) Title of the Invention: A valve

(51) INT CL: ***F16K 5/06*** (2006.01) ***B33Y 10/00*** (2015.01) ***B33Y 80/00*** (2015.01)

(21) Application No: **1720281.3**

(22) Date of Filing: **05.12.2017**

(43) Date of A Publication **12.06.2019**

(56) Documents Cited:
GB 2343735 A
GB 2332501 A
CN 104653812 A
US 3518742 A
US 20050274014 A1

(58) Field of Search:
As for published application 2569128 A viz:
INT CL **B33Y, F16K**
Other: **Online: WPI, EPODOC**
updated as appropriate

Additional Fields
Other: **None**

(72) Inventor(s):
James Ronnie Mincher

(73) Proprietor(s):
Glenalmond Group Limited
5 Kelvin Park South, EAST KILBRIDE, G75 0RH, United Kingdom

(74) Agent and/or Address for Service:
Murgitroyd & Company
Murgitroyd House, 165-169 Scotland Street, GLASGOW, G5 8PL, United Kingdom

GB 2569128 B

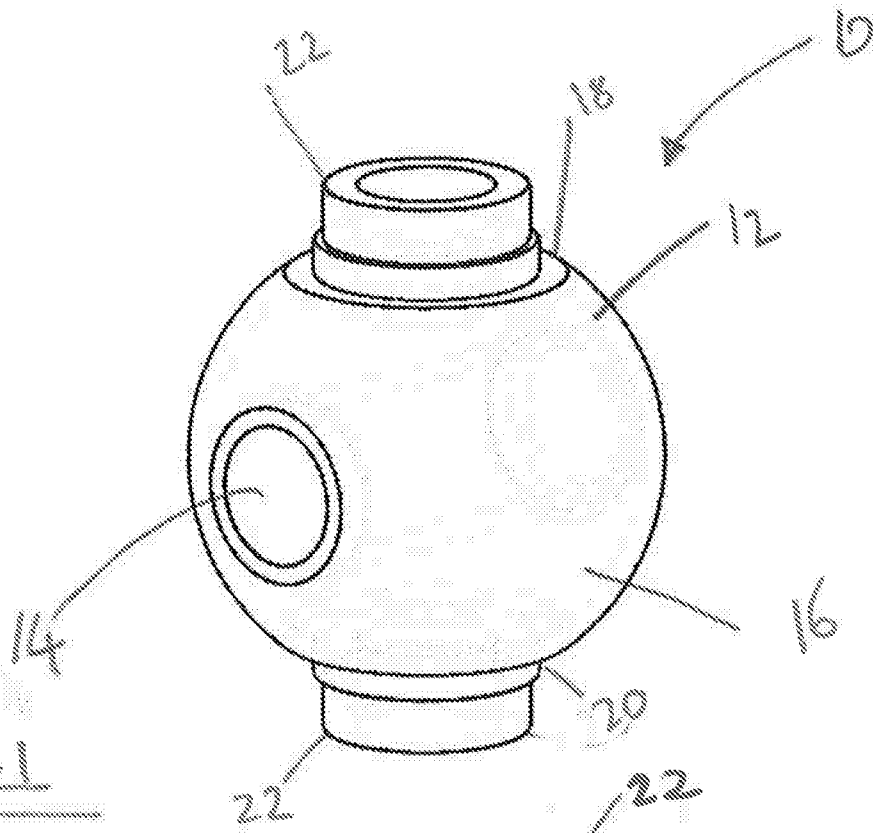

FIG. 1

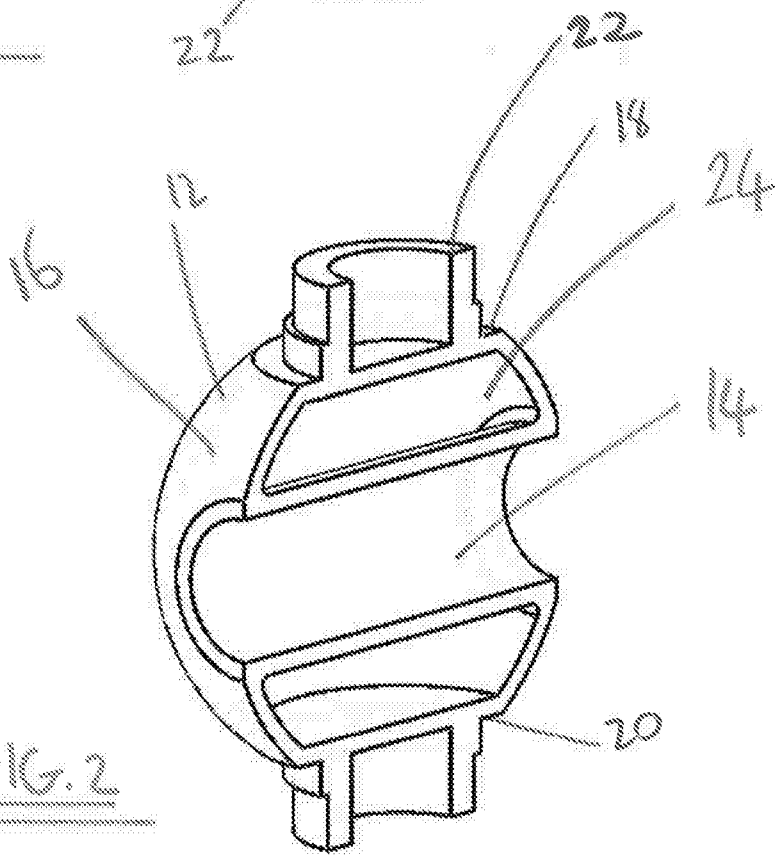

FIG. 2

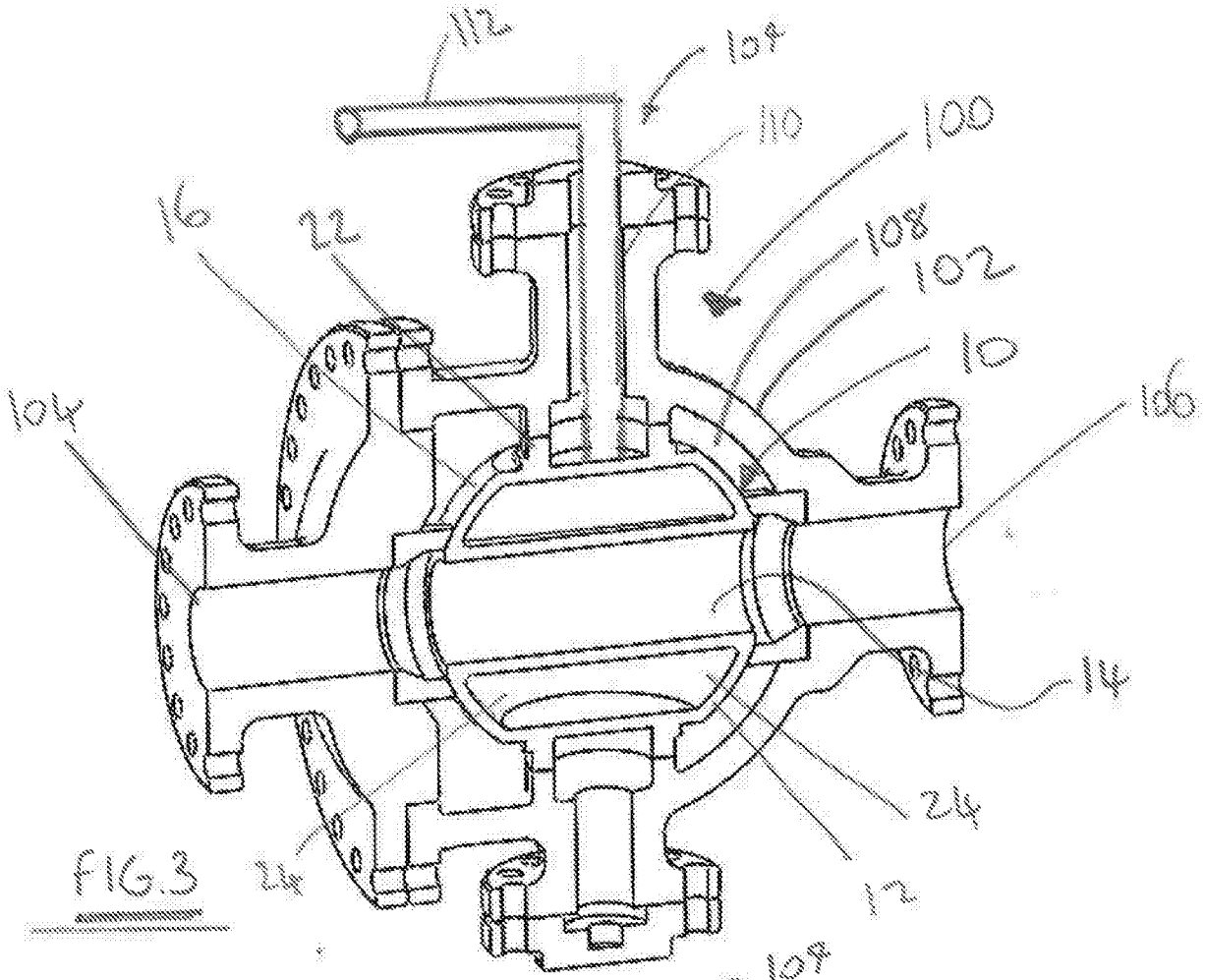
112
104
110
100
16
22
108
102
10
106
104
14
24
24
12

FIG. 3

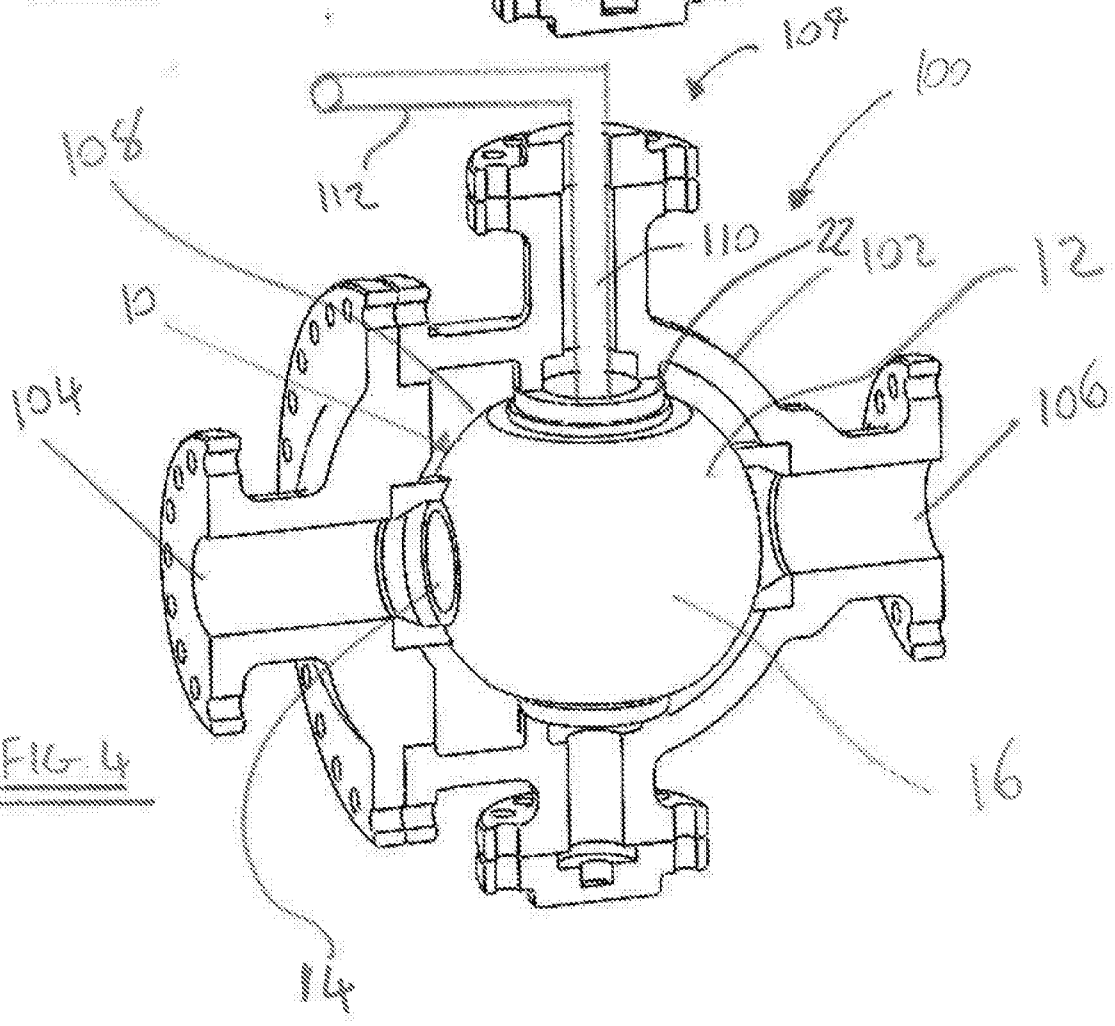
109
100
108
112
110
22
102
12
10
104
106
16
14

FIG. 4

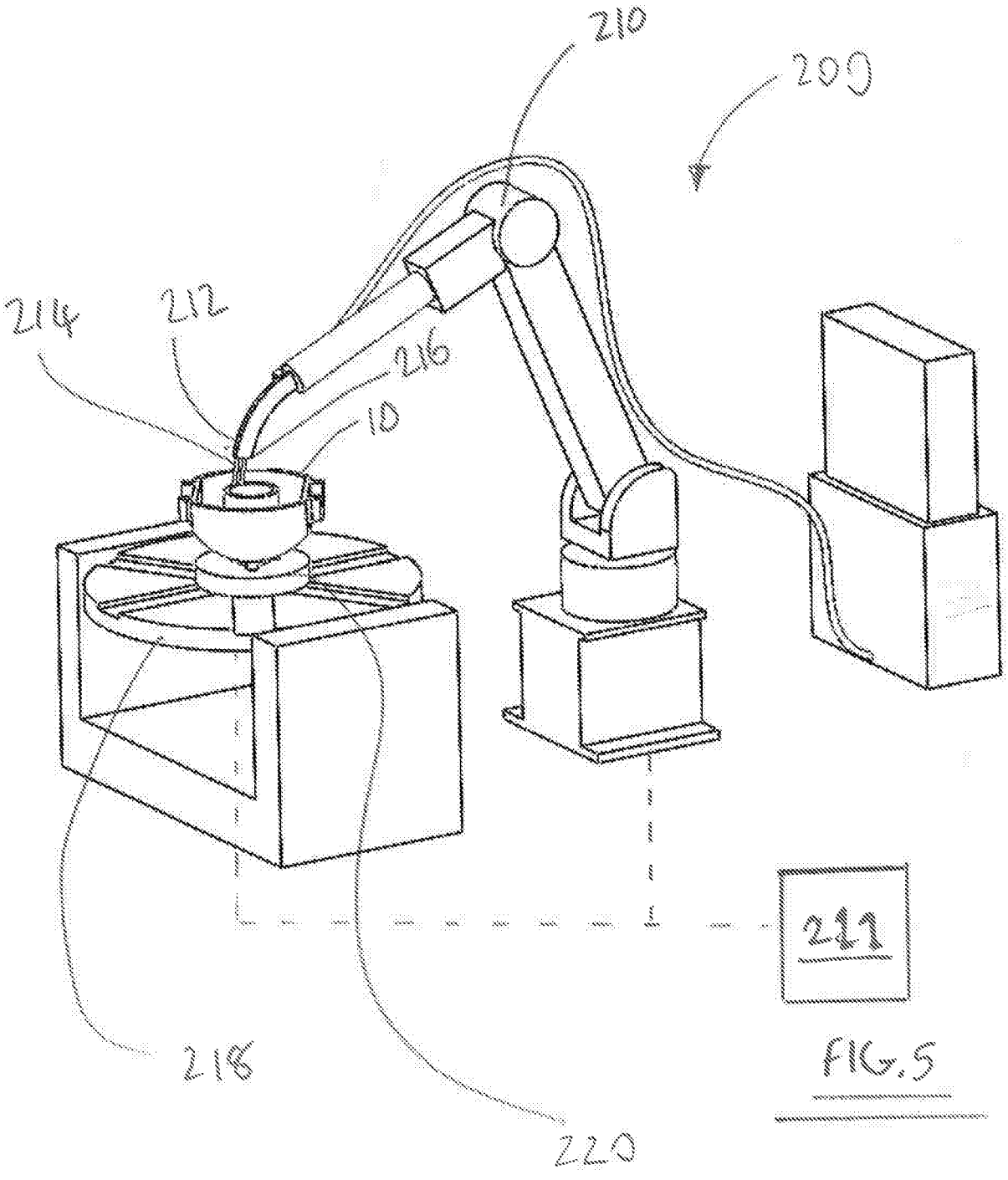

FIG. 5

The following terms are registered trade marks and should be read as such wherever they occur in this document:

Inconel

A VALVE

Field of Invention

This invention relates to valves, and in particular ball valves.

Background of Invention

Ball valves are known and are used in a variety of applications. For example, ball valves are used as control valves in oil and gas production, water flow and slurry dispensation.

Known valves typically comprise a housing having a fluid inlet and a fluid outlet, and a chamber located between the fluid inlet and fluid outlet, which houses a rotatable ball. The rotatable ball includes a passage extending therethrough, and is rotatable between a first and a second position. In the first position, the passage is aligned with the fluid inlet and fluid outlet, and fluid flow is permitted between the fluid inlet and fluid outlet. In the second position, the passage is not aligned with the fluid inlet and fluid outlet, and fluid flow is not permitted between the fluid inlet and fluid outlet.

The rotatable ball is typically formed from metal as a solid member, which is manufactured using a casting or forging method. As a result, such ball members are typically very heavy, and require a lot of energy to manufacture. The weight of the ball makes transportation and assembly of the ball valve difficult and even dangerous, especially if the valve is being assembled manually in an offshore location.

It is the object of the present invention to obviate or mitigate at least one disadvantage with prior ball valves.

Summary of Invention

According to a first aspect of the present invention, there is provided a ball component for a ball valve, the ball component comprising:

a body; and

a passage extending through the body,

wherein the body includes at least one enclosed space, wherein the body comprises successive fused layers of material.

The “enclosed space” is a hollow portion within the ball component that is a space which is empty but also completely enclosed.

The at least one enclosed space may circumscribe the passage.

The volume of the at least one enclosed space may be at least 10% of the total volume occupied by the ball component.

The body may comprise a truncated sphere having first and second truncated ends, wherein one of the first and second truncated ends comprises an attachment element attachable to an actuation mechanism of the ball valve.

According to a second aspect of the present invention, there is provided a ball valve comprising:

a housing having a fluid inlet and a fluid outlet;

the ball component according to the first aspect located in the housing between the fluid inlet and fluid outlet; and

an actuation mechanism attached to the ball component, the mechanism being configured to rotate the body of the ball component between a first position in which the passage fluidly connects the inlet and the outlet, and a second position in which the inlet and outlet are not fluidly connected.

According to a third aspect of the present invention, there is provided a method of manufacturing a ball component of a ball valve by additive manufacture, the method including the steps of:

depositing and fusing a layer of material to one or more locations on a substrate; and

repeating the depositing and fusing step to build up successive layers of material so as to form a body having: a passage extending through the body, and at least one enclosed space within the body.

The depositing and fusing step may utilise an electric arc component and a metallic wire feedstock.

Brief Description of the Drawings

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 shows a ball component for a ball valve according to the present invention;

Fig. 2 shows a section view of the ball component of Fig. 1;

Fig. 3 shows a section view of both a ball valve and the ball component of Fig. 1;

Fig. 4 shows a further section view of the ball valve of Fig. 3; and

Fig. 5 shows a stage of a method of manufacturing the ball component of Fig. 1.

Detailed Description of the Drawings

With reference to Figs. 1 and 2, there is shown a ball component 10 for a ball valve according to the present invention. As shown, the ball component 10 includes a body 12, and a passage 14. The passage 14 extends through the body 12. In the depicted example, the passage 14 is a borehole with a circular cross-section. The body 12 may be formed from one or more of the following: cast and forged low alloy steel, stainless steel, inconel(RTM) alloy, duplex and titanium. An outer surface 16 of the body 12 is adapted such that it may be rotated within a valve housing (not shown in figure 1). In the depicted example, the body 12 comprises a truncated sphere having first and second truncated ends 18, 20. An attachment element 22 suitable for attachment to an actuation mechanism of the ball valve is provided at each of the first and second truncated ends 18, 20. In the depicted, example the attachment element 22 comprises a stepped cylinder. The stepped cylinder 22 is a cylindrical element having two portions which have different outer diameters. Each stepped cylinder 22 is stepped from a surface at each of the first and second truncated ends 18, 20.

Located within the body 12 is at least one enclosed space 24. The enclosed space 24 is a hollow portion within the ball component 10 that is a space which is empty but also completely enclosed. In the depicted example, the at least one enclosed space 24 comprises a single enclosed space, which circumscribes the passage 14. The volume of the at least one enclosed space 24 may be at least 10% of the total

volume occupied by the ball component 10. More specifically, the volume of the at least one enclosed space 24 may be at least 30% or 50% of the total volume occupied by the ball component 10.

Figs. 3 and 4 show a ball valve 100 which includes the ball component 10 described above. The valve 100 includes a housing 102 which has a fluid inlet 104 and a fluid outlet 106. The ball component 10 is located within a chamber 108 of the housing which is located between the fluid inlet 104 and the fluid outlet 106. The attachment element 22 of the ball component 10 is attached to an actuation mechanism 109 of the ball valve 100. The actuation mechanism 109 comprises a stem 110 and a handle shaft 112. The handle shaft 112 may rotate the stem 110 when a force is applied to it. The stem 110 is fixed to the attachment element 22 of the actuation mechanism 109 of the ball valve 100 by a mechanical connection such as a press fit or threaded connection. The ball component 10 is mounted within the chamber 108 such that it may rotate about an axis parallel with the stem 110. This allows the body 12 to be rotated between a first position and a second position. In the first position, as depicted in Figs. 3 and 4, the body 12 is positioned such that the passage 14 is aligned with the fluid inlet and fluid outlet 104, 106 and fluid flow is permitted through the valve 100. In the second position, the body 12 is positioned such that the passage 14 is not aligned with the fluid inlet and fluid outlet 104, 106 and fluid flow is not permitted through the valve 100, as the outer surface 16 of the body seals the fluid inlet from the fluid outlet.

Industrial Applicability

In use, if the valve is in the first position and a user wishes to prevent fluid flow between the fluid inlet 104 and the fluid outlet 106, the user simply rotates the stem 110 by pushing the handle shaft 112. This causes the body 12 to rotate from the first position to the second position, meaning the outer surface 16 of the body seals the fluid inlet 104 from the fluid outlet 106, and fluid flow between the fluid inlet 104 and fluid outlet 106 is prevented. If the user wishes to allow fluid flow between the fluid inlet 104 and fluid outlet 106, the user simply rotates the stem 110 by pushing the handle shaft 112 such that the body 12 is in the second position, meaning the passage 14 is aligned with the fluid inlet 104 and fluid outlet 106, and fluid flow is allowed between the fluid inlet 104 and fluid outlet 106.

With reference to Fig. 5, a method of how the ball component 10 for a ball valve may be manufactured will now be described.

The ball component 10 may be manufactured using an additive manufacture process, which utilises an additive manufacture apparatus 200. In the depicted example, the additive manufacture apparatus 200 comprises a controller 211 and a 5 axis robotic arm 210 which is in communication with the controller 211. A free end 212 of the robotic arm 210 is provided with a metallic wire feedstock 214, and a heat source 216, which is in communication with the controller 211. The heat source 216 is suitable for heating a portion of the metallic wire feedstock 214 located at the free end 212 of the arm 210 such that the portion of the feedstock is molten. In the depicted example, the heat source 216 is an electric arc component. The free end 212 of the robotic arm 210 is movable along 5 different axes in response to commands from the controller 211.

The apparatus 200 also includes a rotatable platform 218, which is in communication with the controller 211. The platform 218 includes a surface 220, which acts as a substrate whereupon the ball component 10 for a ball valve is manufactured.

The controller 211 commands the heat source 216 to heat the portion of the feedstock such that the portion of the feedstock is molten. The controller 211 then controls the free end 212 of the arm 210 such that the arm deposits the molten feedstock at select locations on the substrate 220 to form a first layer of the ball component 210. After a period of time has elapsed and the first layer has cooled, the controller 210 controls the free end 212 of the arm 210 such that it deposits molten feedstock to form a second layer of the ball component, which is fused to the first layer on top of the first layer. This process is repeated for subsequent layers until the ball component is completed. During the process, the controller 210 controls the free end 212 of the arm 210 to deposit and fuse molten feedstock such that the manufactured ball component 10 includes a body portion including an enclosed space, and a passage extending through the body.

The empty enclosed space 24 significantly reduces the weight of the ball component 10 of the ball valve. This means that the ball component may be more easily and safely transported, and the ball valve may be more safely and easily assembled.

Further, the provision of the enclosed space 24 means that less material is required to manufacture the ball component 10. This not only leads to cost savings, but also means that less metal/alloy is required to be heated to a temperature such that the metal/alloy is molten. This means less energy is required to manufacture the ball component.

Further, the method of manufacturing a ball valve according to the present invention allows the ball component to include at least one enclosed space, meaning the ball component may be manufactured using less material and for less of a cost.

In addition, the method of manufacturing a ball valve according to the present invention is less complex than a casting method. This saves time and money.

Modifications and improvements may be incorporated without departing from the scope of the invention, which is defined by the appended claims.

The at least one enclosed space may comprise a plurality of enclosed spaces within the ball component.

The body described above has the form of a truncated sphere. However, the body may have the form of an ellipsoid or any other form that allows the body to rotate within the ball valve.

The actuation mechanism described above is a manually operated actuation mechanism. However, the actuation mechanism may be an electro-mechanically operated actuation mechanism. The electro-mechanically operated actuation mechanism may comprise a mechanical element configured to turn the body of the valve and an electrical drive element configured to act upon the mechanical element. The electrical drive element may be in communication with a sensor upstream of the valve and may rotate the valve in response to a signal received from the sensor.

The additive manufacture apparatus described above includes a 5 axis robotic arm. However, the apparatus may comprise a column gantry instead of a 5 axis robotic arm.

Claims

1. A ball component for a ball valve, the ball component comprising:
   a body; and
   a passage extending through the body,
   wherein the body includes at least one enclosed space, wherein the body comprises successive fused layers of material.

2. The ball component of claim 1, wherein the enclosed space circumscribes the passage.

3. The ball component of claim 1 or 2, wherein the volume of the at least one enclosed space is at least 10% of the total volume occupied by the ball component.

4. The ball component of any preceding claim, wherein the body comprises a truncated sphere having first and second truncated ends, wherein one of the first and second truncated ends comprises an attachment element attachable to an actuation mechanism of the ball valve.

5. A ball valve comprising:
   a housing having a fluid inlet and a fluid outlet;
   the ball component according to any of claims 1 to 4 located in the housing between the fluid inlet and fluid outlet; and
   an actuation mechanism attached to the ball component, the mechanism being configured to rotate the body of the ball component between a first position in which the passage fluidly connects the inlet and the outlet, and a second position in which the inlet and outlet are not fluidly connected.

6. A method of manufacturing a ball component of a ball valve by additive manufacture, the method including the steps of:
   depositing and fusing a layer of material to one or more locations on a substrate; and

repeating the depositing and fusing step to build up successive layers of material so as to form a body having: a passage extending through the body, and at least one enclosed space within the body.

7. The method of claim 6, wherein the depositing and fusing step utilises an electric arc component and a metallic wire feedstock.