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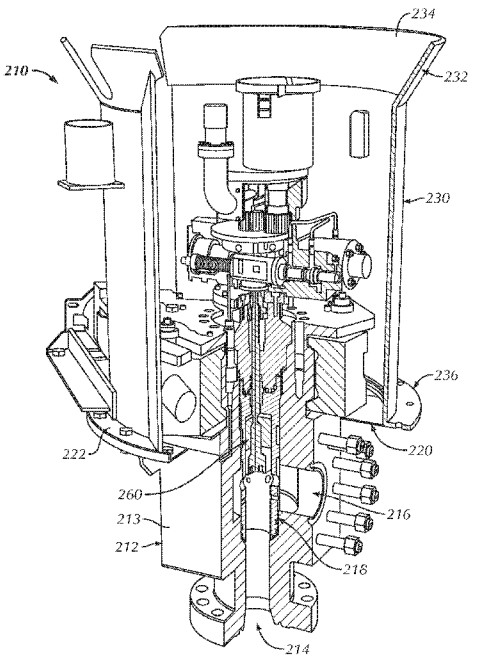


FIG. 3

(57) Abstract: A subsea choke system (200) includes a flow control device (204) fluidly coupled to a subsea well and a choke (210) coupled to the flow control device. The choke includes a choke body (212) coupled to the flow control device. A choke funnel base (220) having a receiving portion is coupled to at least one side of the choke body. Additionally, a choke funnel (230) is coupled to an upper surface of the choke funnel base to form the choke. The choke is formed from a structural insulating material such that at least one of the choke funnel or the choke funnel base is formed from a structural insulating material wherein the structural insulating material is exposed directly to subsea conditions.

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EXTENDED COOL-DOWN TIME SUBSEA CHOKE

BACKGROUND OF DISCLOSURE

Field of the Disclosure

[0001] Embodiments disclosed herein relate generally to subsea oil and gas production equipment. More particularly, embodiments disclosed herein relate to a structural insulation material for use on an insert retrievable subsea choke funnel and a funnel base.

Description of the Related Art

[0002] Subsea equipment may be used for many different applications. One particular application includes hydrocarbon production from a subsea well, which involves extracting or removing hydrocarbon fluid from a formation below the surface of the seafloor. In systems, such as hydrocarbon production systems or water injection systems, a variety of flow control devices are used to control a flow rate, a pressure, and other parameters of a fluid flow. These flow control devices may include valves, pressure regulators, meters and gauges, and chokes.

[0003] When subsea oil and gas systems or wells are located at depths of 5,000 feet or more, the pipelines and wellhead equipment are exposed to seawater that is just a few degrees above freezing. This same temperature can exist in shallow water at extreme latitudes, such as in the North Sea.

[0004] In order to operate reliably in these harsh conditions, some of the critical components in subsea equipment may be designed to wear out and be replaced after a set period. However, replacing these components in a subsea environment can present additional challenges, such as temporarily shutting down the well, which stops production or flow of the hydrocarbon fluid through the choke. During a temporary well shutdown, hot produced fluids within the production equipment become stagnant and are cooled by the surrounding seawater. If the stagnant fluids approach the seawater temperature, precipitates and hydrates can form in the equipment and block the flow of the fluid upon startup.

[0005] Precipitates and hydrates can start to form in the hydrocarbon fluid as the temperature decreases inside the subsea equipment during shutdown due to the drop in temperature. Formation of precipitates inside oil and gas equipment is highly undesirable because they can reduce the production flowrate and cause blockages. Precipitate formation can be reduced by injecting specialized chemicals into the system. However, these specialized chemicals are relatively costly. The frequency of this costly chemical injection can be reduced by reducing the heat loss from the system during shutdown. Therefore, reducing heat loss from the production fluid to the surrounding environment may reduce overall operating cost.

[0006] Thermal insulation is sometimes installed around subsea pipelines and wellhead equipment to slow the cooling process and delay hydrate formation until flow can be restored. However, in many subsea wells, especially those in deep water, the insulation requirements are further complicated by the extreme pressures of the seawater surrounding the well and by the extreme temperatures of the hydrocarbon fluids exiting the well. In some cases the pressure of the surrounding seawater may reach 5,000 psi or greater, and the pressure can consequently damage the insulation and lead to increased precipitate formation in the subsea components due to less thermal insulation. Further, in some cases the temperature of the exiting fluids may reach 300°F or higher, and the fluids will consequently heat both the surrounding equipment and the insulation. Therefore, any insulation material which is used on such wells must be able to withstand these extreme pressures and temperatures without detriment to its thermal or mechanical properties.

[0007] Referring now to Figure 1, a subsea system 100 located on the seafloor 102 is shown in a perspective view. As shown, the subsea system 100 includes a subsea Christmas tree 104. The subsea Christmas tree (or tree) 104 includes a plurality of valves and fittings for controlling the flow of fluid into or out of the well. The structural components of the tree 104 may be made substantially of steel and a thermal insulation material applied to the external surfaces of the tree 104. The thermal insulation material may help reduce the formation of precipitates within the tree 104.

[0008] The tree 104 can be mounted to the top of a wellhead of a well. The tree 104 receives a fluid from the well and the fluid travels through the valves in the tree 104, and the fluid may exit the tree 104 to the flow line 106. The flow line 106 leads to a production facility 108, such as a fixed or floating production platform. However, the flow line 106 may lead to any type of production platform, rig, vessel, or any type of facility known in the art.

SUMMARY

[0009] In one aspect, the present disclosure relates to a subsea choke system including a flow control device fluidly coupled to a subsea well and a choke coupled to the flow control device. The choke includes a choke body coupled to the flow control device. The choke also includes a choke funnel base having a receiving portion is coupled to at least one side of the choke body. Additionally, a choke funnel is coupled to an upper surface of the choke funnel base to form the choke. The choke is formed from a structural insulating material such that at least one of the choke funnel or the choke funnel base is formed from a structural insulating material wherein the structural insulating material is exposed directly to subsea conditions.

[0010] In another aspect, the present disclosure relates to an apparatus including a choke funnel having an annular lip on an upper portion thereof. A choke funnel base is coupled to a lower portion of the choke funnel. Additionally, the apparatus is formed from a structural insulating material such that at least one of the choke funnel or the choke funnel base is formed from a structural insulating material.

[0011] In another aspect, embodiments disclosed herein relate to a method including forming a choke funnel and a choke funnel base. The method includes coupling the choke funnel base to at least one side of a choke body and coupling the choke funnel to the choke funnel base. Additionally, at least one of the choke funnel or the choke funnel base is formed from a structural insulating material.

[0012] Other aspects of the present disclosure will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0013] Features of the present disclosure will become more apparent from the following description in conjunction with the accompanying drawings.

[0014] Figure 1 is a perspective view of a subsea production system.

[0015] Figure 2 is a perspective view of a choke mounted on a flow control device.

[0016] Figure 3 is a partial cross-sectional view of a choke with a choke funnel and a choke funnel base.

[0017] Figure 4A is a perspective view of the choke funnel base of the choke of Figure 3.

[0018] Figure 4B is a bottom view of the choke funnel base of Figure 4A.

[0019] Figure 5A is a perspective view of the choke funnel of the choke of Figure 3.

[0020] Figure 5B is a top view of the choke funnel of Figure 5A.

DETAILED DESCRIPTION

[0021] Embodiments disclosed herein relate to assemblies and methods to mitigate the formation of precipitates by reducing the rate of heat loss in subsea equipment including, but not limited to, flow control devices such as choke valves. More specifically, embodiments disclosed herein generally relate to components on an insert and retrievable subsea choke valve formed from a structural insulating material.

[0022] Referring now to Figure 2, a perspective view of a system 200 is shown. In one or more embodiments, the system 200 is a subsea flow control system that

includes a flow control device 204 and a choke valve 210. The choke 210 includes a choke body 212 that can be fluidly coupled to the flow control device 204. The choke 210 is configured to receive a fluid from the flow control device 204 and control the flow rate and pressure of the fluid.

[0023] Choke body 212 may include a lower opening 214 and a side opening 216. In one embodiment, the choke 210 includes a side opening 216 that is connected to and receives a fluid from the flow control device 204. The side opening 216 may be configured to connect the choke 210 to the flow control device 204 or to a flow line (not labeled). The choke 210 may also include a lower opening 214 that fluid exits through. The lower opening 214 may be configured to connect the choke 210 to a flow line (not labeled) or to the flow control device 204.

[0024] The choke 210 includes a choke funnel base 220 that can be coupled to the choke body 212. The choke funnel base 220 may include a plurality of connection surfaces 228 that are configured to connect the choke funnel base 220 to one or more sides 213 of the choke body 212. One of ordinary skill in the art will appreciate that the choke funnel base 220 may be connected to the choke body 212 by any type of connection known in the art, including for example mechanical fasteners, welding, heat staking, or adhesion.

[0025] The choke 210 also includes a choke funnel 230 that can be coupled to an upper surface of the choke funnel base 220. In one embodiment, an annular lip 232 is disposed along an upper portion of the choke funnel 230, and the annular lip 232 is configured to receive and guide a choke insert running tool (not shown) in the choke funnel 230. One of ordinary skill in the art will appreciate that choke funnel 230 may be connected to the choke funnel base 220 by any type of connection known in the art, including for example mechanical fasteners, welding, heat staking, or adhesion.

[0026] The choke funnel 230 may include one or more sections (not labeled) that allow components to extend through the choke funnel 230, from an interior thereof. In one or more embodiments, the choke 210 is configured to interact with a remotely operated vehicle ("ROV") when located proximate to the seafloor. For example, ROV controls 242 extend outside of the choke funnel 230 in order to allow for an ROV (not shown) to be able to reach and operate the ROV controls 242. An ROV

grip 240 may be disposed on an outer surface of the choke funnel 230. The ROV grip 240 may include a plurality of bars that an ROV can grab onto during the insert and retrieval process, which is described in greater detail below. The ROV grip 240 may be positioned so that the ROV can easily grab onto the grip 240 and so that the ROV can reach the ROV controls 242 at the same time. However, the ROV grip 240 may be positioned at any location in the subsea system 200. Additionally, the ROV grip 240 may be positioned to allow the ROV to reach any component in the subsea system 200.

[0027] Referring now to Figure 3, a partial cross-sectional view of choke 210 is shown. The choke 210 includes choke body 212, choke funnel base 220, and choke funnel 230. The choke 210 may be equipped with a multi-hole cage 218 that is attached to a cage actuation system 260. In one embodiment, the choke 210 receives a fluid (*e.g.*, hydrocarbon fluid) through the side opening 216, the fluid flows around and through the multi-hole cage 218, and then the fluid exits through the lower opening 214. The choke 210 can be operated in a reverse flow configuration; where the choke 210 receives a fluid through the lower opening 214, the fluid flows up through the multi-hole cage 218, and then the fluid exits through the side opening 216. The reverse flow configuration may include operating continuously at a maximum operating pressure and flow rate. Flow control with the multi-hole cage 218 will be discussed in greater detail below.

[0028] Side opening 216 may be disposed on one of the sides 213 of the choke body 212 and extend in a horizontal direction. Lower opening 214 may be disposed on a lower portion of the choke body 212 and extend in a vertical direction. The choke 210 may receive a fluid through the side opening 216 or the fluid may exit through the side opening 216. The choke 210 may receive a fluid through the lower opening 214 or the fluid may exit through the lower opening 214.

[0029] In one embodiment, the choke funnel 230 is a hollow cylindrical body that extends vertically upward from the choke funnel base 220. The choke funnel 230 may extend away from the choke funnel base 220. The choke funnel base 220 may be coupled to the choke body 212 above the side opening 216. Alternatively, the choke funnel base 220 can be coupled to the choke body 212 above the side opening 216.

[0030] As shown in Figure 3, the choke funnel base 220 and the choke funnel 230 may be coupled with a plurality of connectors 222. The choke funnel 230 includes an annular lip 232 disposed on an upper portion of the choke funnel 230. The annular lip 232 may include an outwardly angled receiving surface 234 that is configured to receive a choke insert running tool. One of ordinary skill in the art will appreciate that the connectors 222 may include any type of connection known in the art, including for example mechanical fasteners, welding, heat staking, or adhesion.

[0031] Referring now to Figures 4A and 4B, the choke funnel base 220 is shown in a perspective view and a bottom view, respectively. In one or more embodiments, choke funnel base 220 is a substantially flat circular-shaped disk. As shown, the choke funnel base 220 can include a plurality of connector holes 224 disposed along a radially outer portion of the choke funnel base 220. In one embodiment, the connector holes 224 are configured to receive the connectors 222 (Figures 2 and 3) in order to couple the choke funnel 230 (Figures 2 and 3) and the choke funnel base 220 together. The choke funnel base 220 may include a receiving portion 226 that is configured to slidingly engage the choke body 212 (Figures 2 and 3).

[0032] The choke funnel base 220 may include a plurality of connection surfaces 228 vertically disposed around the perimeter of the receiving portion 226 on a lower surface of the choke funnel base 220. The connection surfaces 228 are configured to couple the choke funnel base 220 to the choke body 212 (Figures 2 and 3). In one embodiment, after sliding the receiving portion 226 onto the choke body 212, the choke funnel base 220 is connected to three of the sides 213 on choke body 212 (Figures 2 and 3) by three of the connection surfaces 228.

[0033] In one embodiment, a plurality of support members 227 are disposed on a lower surface of the choke funnel base 220 and are configured to increase the rigidity and strength of the choke funnel base 220. The support members 227 may include the connections surfaces 228. The support members 227 can be formed with the choke funnel base 220 and formed from the same structural insulating material. Alternatively, the support members 227 can be formed separately from the choke funnel base 220 and connected to the choke funnel base 220 by any method known in the art. In one or more embodiments, the outer diameter 250 of the choke funnel base

220 is approximately 42 inches. A height (not labeled) of the choke funnel base 220 may be approximately 4 inches. Other diameters and heights may be used.

[0034] Referring now to Figures 5A and 5B, the choke funnel 230 is shown in a perspective view and a top view, respectively. In one or more embodiments, choke funnel 230 is a hollow cylindrical body that includes a lower portion 236 that is configured to connect to the choke funnel base 220 (Figures 2 and 3). The lower portion 236 may include a plurality of connector holes 238 that are configured to receive the connectors 222 (Figure 3) in order to couple the choke funnel 230 and the choke funnel base 220 (Figure 3) together.

[0035] As shown in Figures 5A and 5B, the choke funnel 230 includes annular lip 232 disposed on an upper portion thereof. The annular lip 232 may include an outwardly angled receiving surface 234 that is configured to receive a choke insert running tool (not shown).

[0036] In one embodiment, a plurality of vertical support members 237 are disposed on an outer surface of the choke funnel 230 and are configured to increase the rigidity and strength of the choke funnel 230. The vertical support members 237 may extend in a radially outward direction from an outer surface of the choke funnel 230. The vertical support members 237 may be disposed along the vertical height of the choke funnel 230 from the lower portion 236 to the annular lip 232. The vertical support members 237 may be formed with the choke funnel 230 and formed from the same structural insulating material. Alternatively, the vertical support members 237 can be formed separately from the choke funnel 230 and connected to the choke funnel 230 by any method known in the art. A support ring 239 may be disposed on an outer surface of the choke funnel 230 and are configured to increase the rigidity and strength of the choke funnel 230. The support ring 239 may extend in a radially outward direction from an outer surface of the choke funnel 230. In one embodiment, the support ring 239 is disposed at an angle substantially perpendicular to an outer surface of the annular lip 232.

[0037] In one embodiment, an outer diameter 252 of the choke funnel 230 is approximately 42 inches. An inner diameter 254 of the choke funnel 230 may be less than 42 inches. The outer diameter 252 of choke funnel 230 may extend past the

choke body 212. The inner diameter 254 of the choke funnel 230 may be configured to receive a choke insert running tool or any other wire line deployed device known in the art. Other diameters may be used.

[0038] With reference to Figures 2-5B together, the manufacturing, installation, and use of the choke funnel base 220 and choke funnel 230 is now discussed. In one or more embodiments, the choke funnel 230 and the choke funnel base 220 are formed from a structural insulating material. The term "structural insulating material" as used herein refers to a material that can structurally support the component that it forms and thermally insulate the component that it forms. The structural insulating material may comprise at least one of a polymer, *e.g.*, polyether ether ketone (PEEK), acetal, or polyethylene terephthalate (PET), a ceramic, *e.g.*, clay, ceramic-composites, or graphite, or a composite material, *e.g.*, carbon composite (such as carbon fiber), KEVLAR, or a glass filled matrix.

[0039] The choke funnel 230 and the choke funnel base 220 may both be formed from the same structural insulating material or the choke funnel 230 and the choke funnel base 220 may be formed from different materials. The choke funnel 230 and the choke funnel base 220 may be formed separately or together. For example, the choke funnel 230 and/or the choke base 220 may be formed from a polymer composite material by, for example, molding inlay, vacuum forming, hot isostatic pressing, or any combination thereof. In another embodiment, the choke funnel 230 and/or the choke base 220 may be formed from a composite material by, for example, machining, molding, casting, hot forming, and injection molding. In another embodiment, the choke funnel 230 and/or the choke base 220 may be formed from a ceramic material by, for example, cutting features and firing, molding and firing, sintering, slip casting, dry pressing, hot isostatic pressing, machining or any combination thereof. One skilled in the art will understand that additional methods of forming the choke funnel 230 and the choke funnel base 220 may be used with any of the materials without departing from the scope of the present disclosure. In one embodiment, the structural insulating material may be rated to operate at least 10,000 feet water depth for a 25 year lifespan.

[0040] In one embodiment, the annular lip 232 and the ROV grip 240 are formed with the choke funnel 230, such that the annular lip 232 and the ROV grip 240 are formed from the same structural insulating material as the choke funnel 230. However, the annular lip 232 and the ROV grip 240 may be attached after the choke funnel 230 is formed, and the annular lip 232 and the ROV grip 240 can be formed from any material known in the art. The choke funnel 230 may have an outer diameter 252 that extends past the choke body 212.

[0041] One skilled in the art will understand that the structure of the choke funnel 230 and choke funnel base 220 may be modified to account for the characteristics of the materials being used. For example, the choke funnel 230 and/or choke funnel base 220 may include additional reinforced areas to further strengthen the choke funnel 230 and/or choke funnel base 220. For example, some areas of the choke funnel 230 and/or choke funnel base 220 may be thicker than a conventional choke funnels and bases.

[0042] The choke funnel base 220 is installed on a choke 210 by coupling the choke funnel base 220 to the choke body 212. The plurality of receiving portions 226 can be connected to the sides 213 of the choke body 212. After the choke funnel base 220 is installed on the choke body 212, the choke funnel 230 can be coupled to an upper surface of the choke funnel base 220. A lower portion 236 of the choke funnel 230 can be connected to a radially outer portion of the choke funnel base 220 with a plurality of connectors 222. In one embodiment, the connectors 222 are configured to extend through the connector holes 238 in the choke funnel 230 and be received in the connector holes 224 in the choke funnel base 220 in order to affix the choke funnel 230 to the choke funnel base 220.

[0043] In one or more embodiments, the choke 210 is fluidly coupled to a flow control device 204 by connecting the side opening to the flow control device 204. The choke funnel base 220 and choke funnel 230 may be installed on the choke body 212 before or after the choke 210 is installed on the flow control device 204. After the choke funnel base 220 and choke funnel 230 are installed on the choke 210, and the choke 210 is installed on the flow control device 204, the flow control device 204 may be installed in a subsea system located proximate to the seafloor. In one

embodiment, the subsea system is a well. However, the flow control device 204 and choke 210 can be used with oil wells, gas wells, water injection wells, water disposal wells, gas injections, gas lift applications, and any other type of well-known in the art. For oil and gas production wells, the choke 210 may control the flow of a hydrocarbon fluid (*e.g.,* oil and gas) out of the well. The choke 210 can also control the injection of gas or water for gas injection wells, water injection wells, water disposal wells.

[0044] The choke 210 can control the flow of fluid by changing the cross-sectional area at a location that the fluid flows through. The choke 210 can be equipped with a multi-hole cage 218 that is attached to a cage actuation system 260. The cage 218 may be a hollow cylinder with different sized holes around its body. The cage actuation system 260 is configured to change the cross-sectional area where the fluid flows through the cage 218. The cage actuation system 260 may include a plug (not labeled) that is disposed within the cage 218, and the cage actuation system 260 moves the plug vertically (along a central axis of the cage 218) up and down to expose more or less of the holes. The more holes that are exposed, the greater the area for fluid to flow through, so the flow rate is increased. To decrease the flow rate, fewer holes are exposed by moving the cage 218 with the cage actuation system 260. The holes on the cage 218 may be different sizes and shapes. The holes may be disposed on the cage 218 in any pattern known in the art. The cage 218 is capable of operating in a fully reversed flow configuration at a maximum working pressure, where the fluid flows from the inside to the outside of the cage 218.

[0045] In one or more embodiments, the cage 218 is designed to wear out and be replaced in an insert and retrieval process. The insert and retrieval process includes deploying an ROV (not shown) to the subsea location where the choke 210 is located and has been operating. The choke 210 is shut and flow through the choke 210 is stopped in order to prevent the fluid from leaking out. In one embodiment, the ROV grabs onto the ROV grip 240 with one arm and operates the ROV controls 242 with another arm, which allows the ROV to remove the cage 218 and other replaceable or intervening components. A choke insert running tool is deployed to the choke 210, and after these components are removed, the choke insert running tool is received with the choke funnel 230. The annular lip 232 of the choke funnel 230 allows for the

choke insert running tool to be received even if there is a rough alignment capture angle. The choke funnel 230 guides the choke insert running tool into engagement with the choke 210. The choke insert running tool inserts the replacement components and installs them in the choke 210. After the components are inserted and installed, operation of the choke 210 may be resumed. The choke insert running tool, ROV, and retrieved components are removed from the choke 210.

[0046] In one or more embodiments, the flow control device 204 is a subsea Christmas tree or any other flow control device known in the art. In one or more embodiments, the choke 210 is an insert and retrievable subsea choke. Insert and retrievable subsea choke may refer to a choke that is configured to operate in a subsea environment and has components that are designed to wear out, be retrieved by an ROV and be replaced by inserting a replacement component with a choke insert running tool.

[0047] In one or more embodiments, the structural insulating material has a thermal conductivity coefficient that is relatively lower than a thermal conductivity coefficient of steel. The structural insulating material has a thermal conductivity coefficient in a range from about 0.05 to 0.3 W/mK. In one embodiment, the structural insulating material has a thermal conductivity coefficient of approximately 0.16 W/mK.

[0048] In one or more embodiments, the choke funnel 230 and the choke funnel base 220 are structurally supported and thermally insulated by the structural insulating material alone. The choke funnel 230 and the choke funnel base 220 may include substantially no steel and have no additional insulating material within or disposed thereon. In one embodiment, the choke funnel 230 and the choke funnel base 220 may be formed from steel or any other material known in the art and the choke funnel 230 and the choke funnel base 220 may have foam insulation or any additional insulating material known in the art disposed thereon.

[0049] Advantageously, apparatus and method embodiments disclosed herein may increase the amount of time until a chemical injection into the system is required during a flow shutdown situation, which reduces the overall operating cost of a subsea flow control system. Embodiments disclosed herein provide a choke funnel and a choke funnel base formed from a structural insulating material that reduces the rate of

heat loss from a fluid and mitigates the formation of precipitates during an insert and retrieval process. Thus, should an insert and retrievable component wear out and require replacement, the structural insulating material will reduce the rate of heat loss from the fluid in the choke and increase the amount of time until a chemical injection is required during the insert and retrieval process, in order to reduce the overall operating cost.

[0050] While the disclosure has been presented with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the present disclosure. Accordingly, the scope of the application should be limited only by the attached claims.

CLAIMS

What is claimed is:

1. A system comprising:
   a flow control device fluidly coupled to a subsea well; and
   a choke coupled to the flow control device, the choke comprising:
      a choke body coupled to the flow control device;
      a choke funnel base having a receiving portion coupled to at least one side of the choke body; and
      a choke funnel coupled to an upper surface of the choke funnel base,
      wherein at least one of the choke funnel or the choke funnel base are formed from a structural insulating material wherein the structural insulating material is exposed directly to subsea conditions.

2. The system of claim 1, wherein the choke funnel comprises a hollow cylindrical body.

3. The system of claim 2, further comprising an annular lip disposed on an upper portion of the choke funnel, wherein the annular lip comprises an outwardly angled receiving surface configured to receive a choke insert running tool.

4. The system of claim 1, wherein the choke funnel base is a substantially flat circular-shaped disk.

5. The system of claim 1, wherein at least one of the choke funnel or choke funnel base have an outer diameter that is greater than an outer diameter of the choke body.

6. The system of claim 1, wherein the structural insulating material comprises at least one of the group consisting of a polymer, a ceramic, and a composite material.

7. The system of claim 1, wherein the structural insulating material has a thermal conductivity coefficient in a range from about 0.05 to 0.3 (W/mK).

8. The system of claim 1, wherein the choke is a retrievable subsea choke insert comprising retrievable and replaceable wear components.

9. The system of claim 8, wherein the insert retrievable subsea choke is configured to be fluidly coupled to at least one of the group consisting of an oil well, gas well, water injection well, water disposal well, gas injection well, and gas lift application.

10. An apparatus comprising:

a choke funnel having an annular lip on an upper portion thereof; and

a choke funnel base coupled to a lower portion of the choke funnel,

wherein at least one of the choke funnel or the choke funnel base are formed from a structural insulating material.

11. The apparatus of claim 10, wherein at least one of the choke funnel or the choke funnel base comprises a plurality of support members.

12. The apparatus of claim 10, wherein the choke funnel extends away from the choke funnel base.

13. The apparatus of claim 10, wherein the choke funnel and the choke funnel base are coupled by at least one of the group consisting of mechanical fasteners, welding, heat staking, and adhesion.

14. The apparatus of claim 10, wherein the structural insulating material comprises at least one of the group consisting of a polymer, a ceramic, and a composite material.

15. The apparatus of claim 10, wherein the structural insulating material has a thermal conductivity coefficient in a range from about 0.05 to 0.3 (W/mK).

16. The apparatus of claim 10, wherein at least one of the choke funnel or the choke funnel base is configured to be coupled to an insert and retrievable subsea choke and to guide a choke insert running tool to the insert and retrievable subsea choke.

17. A method comprising:

forming a choke funnel and a choke funnel base;

coupling the choke funnel base to at least one side of a choke body; and

coupling the choke funnel to the choke funnel base,

wherein at least one of the choke funnel or choke funnel base are formed with a structural insulating material.

18. The method of claim 17, wherein the structural insulating material comprises at least one of the group consisting of a polymer, a ceramic, and a composite material.

19. The method of claim 17, wherein forming the choke funnel and choke funnel base comprises at least one of the group consisting of molding, casting, spraying, sintering, slip casting, dry pressing, hot isostatic pressing, injection molding, machining, hot forming, and compression molding.

20. The method of claim 17, wherein the structural insulating material structurally supports at least one of the choke funnel or the choke funnel base, and wherein the structural insulating material thermally insulates at least one of the choke funnel or the choke funnel base.

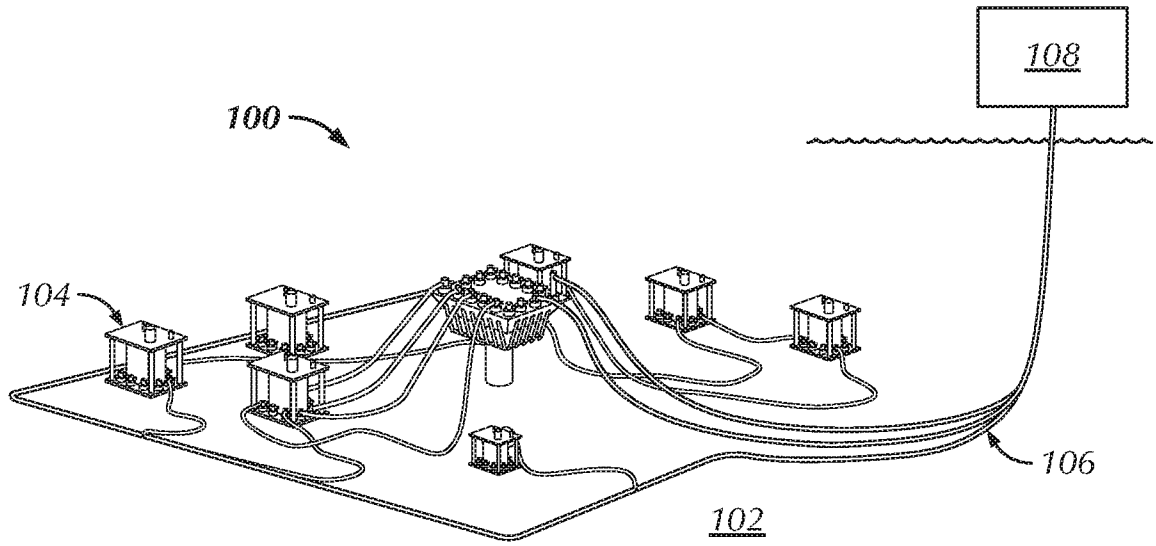


FIG. 1
(Prior Art)

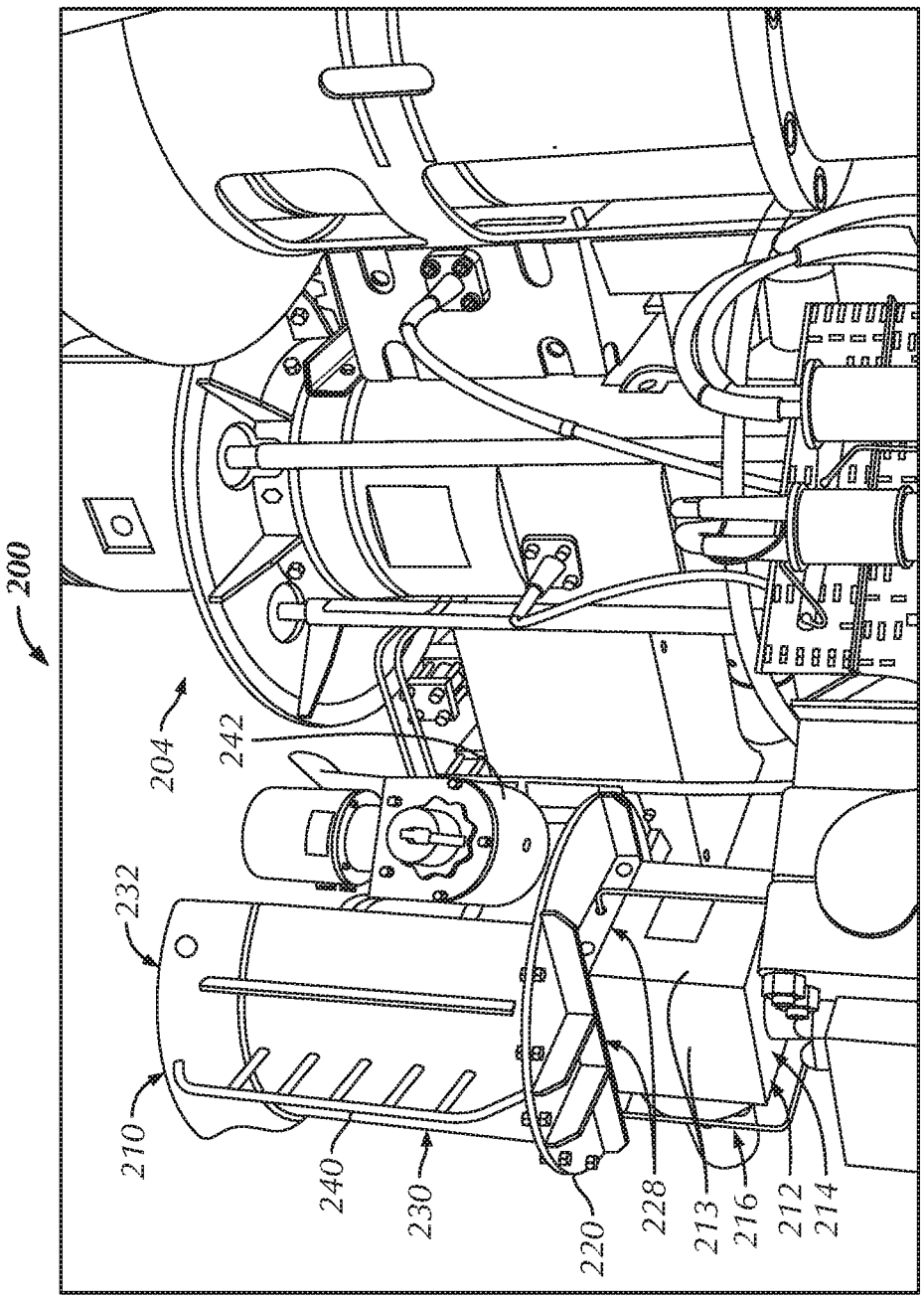


FIG. 2

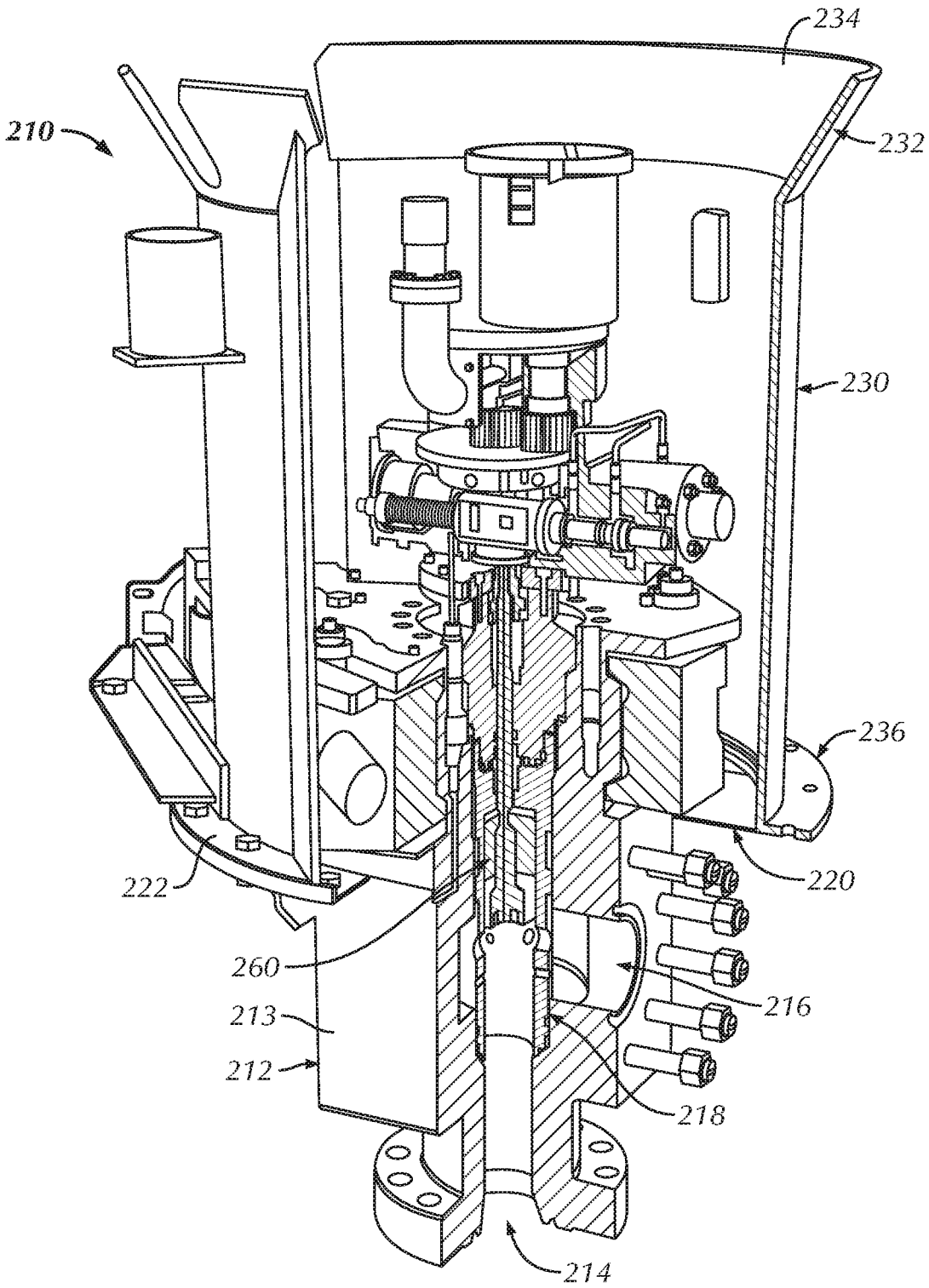


FIG. 3

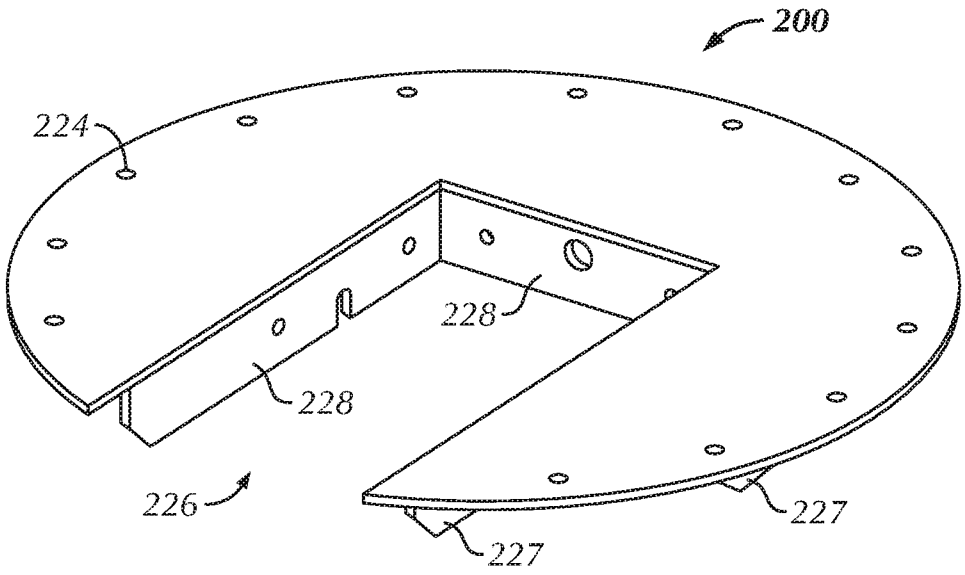

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FIG. 4A

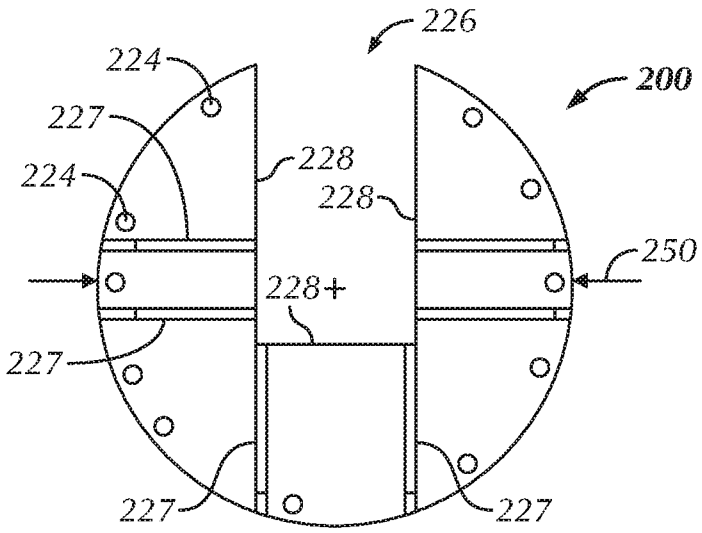

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FIG. 4B

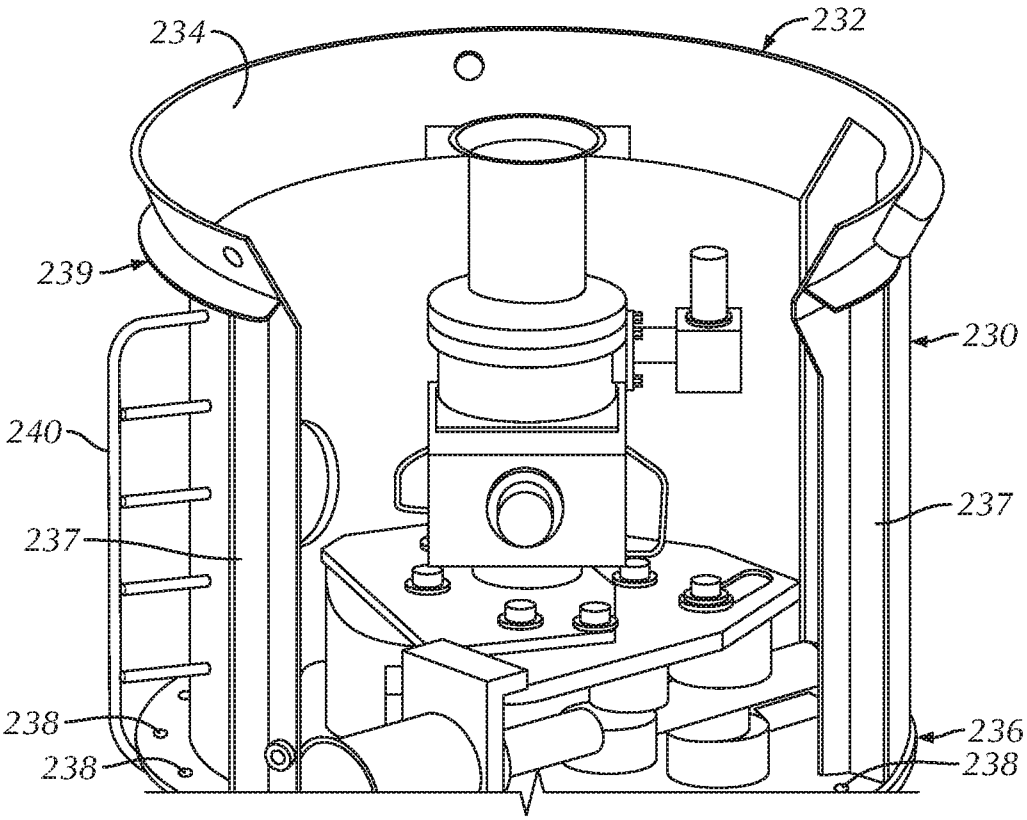


FIG. 5A

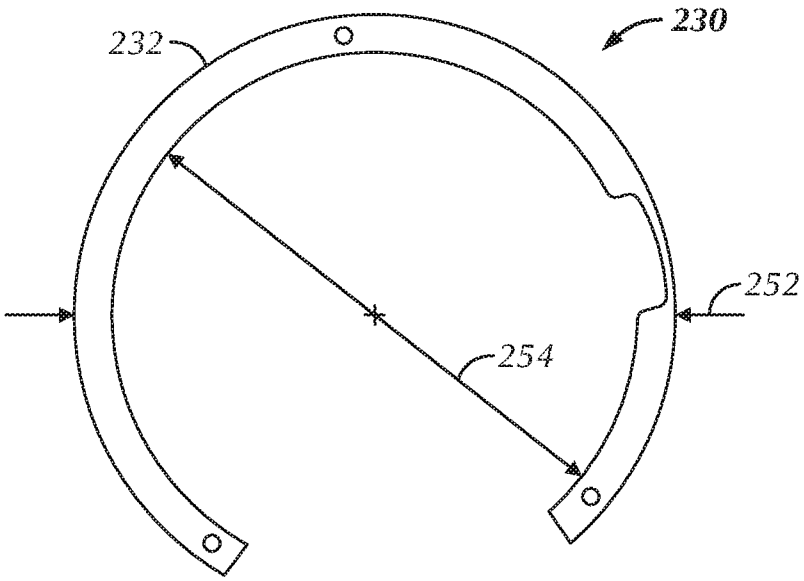


FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/028804

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B36/00 E21B41/00 F16L59/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Kkil: "SUBSEA CHOKES AND CONTROL VALVES SUBSEA CHOKES AND CONTROL VALVES kentintrol 02 SUBSEA CHOKES AND CONTROL VALVES QUALITY MANUFACTURING", , 16 September 2014 (2014-09-16), pages 1-16, XP055290109, Retrieved from the Internet: URL:http://www.kentintrol.com/public/downloads/brochures/Subsea-Choke-Control-Valves.pdf [retrieved on 2016-07-20] page 3 page 6 page 11	1-20

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 2016	02/08/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dantinne, Patrick

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/028804

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 6 520 261 B1 (JANOFF DWIGHT D [US] ET AL) 18 February 2003 (2003-02-18) abstract; figure 2	1-20
A	Abco: "Subsea wellhead guide funnel", , 23 October 2013 (2013-10-23), pages 1-1, XP055290206, Retrieved from the Internet: URL:http://www.abcosubsea.com/wp-content/uploads/2014/06/ABCO-Subsea-Wellhead-Guide-Funnel.pdf [retrieved on 2016-07-21] the whole document	1-20
A	US 2009/090500 A1 (DAMSLETH PER [NO] ET AL) 9 April 2009 (2009-04-09) paragraph [0016]; figures 1.3,4	1-20
A	WO 01/63088 A1 (ABB OFFSHORE SYSTEMS AB [NO]; QVAM HELGE ANDREAS [NO]; AUGILERA PATRIC) 30 August 2001 (2001-08-30) page 3, line 22 - line 29; figures 1,2	1-20

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