

Dual Tubing Hanger

FIELD OF INVENTION

- 5 Embodiments of the present invention provide a dual tubing hanger for use in a wellhead.

BACKGROUND

- 10 In various types of wells, the produced fluid flows through tubing, which is a string of conduit within a casing. The tubing may be supported at the wellhead using a tubing hanger. In some applications, a dual tubing hanger is used, which allows two different fluids to flow. In some cases, the two fluids may be fluid that is extracted from different locations underground. In other applications, one fluid may be
15 extracted, while another fluid is pumped into the underground chamber to maintain chamber volume.

- One example of a prior art dual tubing hanger system, designated generally as reference numeral 100, is shown in Figure 1. Figure 1 shows a cross-sectional side
20 view of the dual tubing hanger system 100. The dual tubing hanger system 100 includes a dual tubing hanger 110 located within a wellhead 102. The dual tubing hanger 110 includes a cylindrical hanger body 112 mounted on a landing shoulder 106 within a central bore 104 of the wellhead 102.

- 25 First and second mandrels 114, 116 are encased within the cylindrical hanger body 112. Each mandrel 114, 116 has a central bore 115, 117, respectively, that facilitates the flow of a fluid in one direction or the other. Each mandrel 114, 116 also has an opening 117, 119 that provides one outlet/inlet for the fluid. In order to prevent the fluid traversing opening 117 from leaking into a space above the
30 cylindrical hanger body 112 within the central bore 104, a first pair of seals 120 are located at a position above the opening 117. A second pair of seals 122 is located between the opening 117 and the opening 119 to prevent a mixing of the first and second fluids. A third pair of seals 124 is located below the opening 119 to prevent

fluid traversing opening 119 from leaking into a space below the cylindrical hanger body 112 within the central bore 104.

Each pair of seals 120, 122, 124, are positioned perpendicularly with respect to the central bore 104. The seals 120, 122 allow a portion of the fluid traversing the central bore 115 of the mandrel 114 to enter a space 130 between the hanger body 112 and the wellhead 102. The seals 120, 122 prevent the fluid from leaking out. Similarly, the seals 122, 124 allow a portion of the fluid traversing the central bore 117 of the mandrel 116 to enter a space 132 between the hanger body 112 and the wellhead 102. The seals 122 prevent the first fluid from mixing with the second fluid.

The wellhead 102 is generally located below some sort of decking (not shown) that allows well operators to access the wellhead 102. One problem associated with this system 100 is that the two outlets 117, 119 must be vertically spaced apart within the central bore 104 of the wellhead 102 to allow sufficient clearance for the seals 122 to effectively isolate the two liquids. This may create clearance issues between the decking and various connections 140, 142 that are needed to rout the fluid traversing the openings 117, 119.

It would therefore be an improvement in the art if a system could be developed that overcomes one or more of the deficiencies noted above.

SUMMARY

One aspect of the present invention provides a dual tubing hanger mounted in a wellhead having a cylindrical bore with an inner diameter. The dual tubing hanger may include: a cylindrical hanger body having an outer diameter less than the inner diameter of the cylindrical bore; a first mandrel located within the hanger body, the first mandrel capable of transporting a first fluid and having a first outlet at a first elevation extending through the cylindrical hanger body; a second mandrel located within the hanger body, the second mandrel capable of transporting a second fluid and having a second outlet

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extending through the cylindrical hanger body at substantially the first elevation; a first seal located between the hanger body and the cylindrical bore, said first seal mounted substantially parallel to a cross-section of said bore and located below said first and second outlets; a second seal mounted substantially parallel to a cross-section of said bore and located above said first and second outlets; and a third seal mounted at an angle with respect to a cross-section of said bore, such that said third seal extends from a position below said first and second outlets to a position above said first and second outlets; wherein the first, second and third seals are capable of isolating the first fluid from the second fluid.

Each of said first, second and third seals may further include a pair of o-rings mounted in corresponding grooves in the cylindrical hanger body. The o-rings may be made from nitrile. In these embodiments, the first fluid may be sealed between the hanger body, the cylindrical bore, the first seal, and the third seal. Similarly, the second fluid may be sealed between the hanger body, the cylindrical bore, the second seal, and the third seal.

In some embodiments, the first and second fluids may be any one of crude oil, water, and a water solution.

In alternate embodiments, the wellhead may further include a first opening allowing passage of the first liquid, and a second opening allowing passage of the second liquid.

An alternate aspect of the present invention provides a method of isolating a first fluid from a second fluid in a dual tubing hanger mounted in a wellhead having a cylindrical bore with an inner diameter. The method may include the steps of: providing a cylindrical hanger body having an outer diameter less than the inner diameter of the cylindrical bore; providing a first mandrel located within the hanger body, the first mandrel capable of transporting a first fluid and having a first outlet at a first elevation extending through the cylindrical hanger body; providing a second mandrel located within the hanger body, the second mandrel capable of transporting a second fluid and having a second outlet extending through the cylindrical hanger body at substantially the

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first elevation; and providing a first seal located between said hanger body and said cylindrical bore, said first seal mounted substantially parallel to a cross-section of said bore and located below said first and second outlets; providing a second seal mounted substantially parallel to a cross-section of said bore and located above said first and second outlets; and providing a third seal mounted at an angle with respect to a cross-section of said bore, such that said third seal extends from a position below said first and second outlets to a position above said first and second outlets;

wherein the first, second and third seals are capable of isolating the first fluid from the second fluid.

In an embodiment, said first fluid is sealed between said hanger body, said cylindrical bore, said first seal, and said third seal. In an embodiment, said second fluid is sealed between said hanger body, said cylindrical bore, said second seal, and said third seal.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 is a cross-sectional side view of one prior art dual tubing hanger installed in a wellhead;

Figure 2 is a cut-away perspective view of one embodiment of a dual tubing hanger according to the present invention;

Figure 3 is a cross-sectional side view of the dual tubing hanger of Figure 2; and

Figure 4 is a cross-sectional side view of the dual tubing hanger of Figures 2 and 3 mounted in a wellhead.

DETAILED DESCRIPTION

Figure 2 is a cut-away perspective view of one embodiment of a dual tubing hanger, designated generally as reference numeral 200, according to the present invention. Figure 3 is a cross-sectional side view of the dual tubing hanger 200. Figure 4 is a cross-sectional side view of the dual tubing hanger 200 installed in a wellhead 300. While embodiments of the present invention are discussed below with reference to a dual tubing hanger 200 installed within a wellhead 300, it is understood that other applications of the dual tubing hanger are also possible.

With continuing reference to Figures 2-4, the dual tubing hanger 200 includes a hanger body 202 that encloses a first mandrel 220 and a second mandrel 240.

Each mandrel 220, 240 includes a mandrel body 222, 242 enclosing a central bore 224, 244, respectively. Each mandrel 220, 240 further includes a fluid opening 226, 246 that provides one inlet/outlet for a fluid traversing through the central bores 224, 244. Each fluid opening 226, 246 is aligned with a corresponding opening 228, 248 in the hanger body 202. In this embodiment, the fluid openings 226, 246 are located at similar horizontal levels. The mandrels 220, 240 may be secured within the hanger body 202 using a locking ring 210 and a latch pin assembly 211. It is understood that other mechanisms for securing the mandrels 220, 240 within the hanger body 202 may also be used.

One or more S-seals 250a, 250b may be located within corresponding grooves on each mandrel body 222, 242 above the fluid openings 226, 246. Similarly, one or more S-seals 252a, 252b may be located within corresponding grooves on each mandrel body 222, 242 below the fluid openings 226, 246. The S-seals 250, 252 assist in preventing fluid traversing the central bores 224, 244 and/or the fluid openings 226, 246 from leaking outside of the sealed area. It is understood that additional seals, or other types and numbers of seals, may also be used.

The hanger body 202 may include a locking sleeve, 204, a split ring 206 and a stopper pin 208 that are used in combination to secure the dual tubing hanger 200 within an inside surface 302 of a bore 304 of the wellhead 300. The hanger body 202 may also include various means for sealing the hanger body 202 within the bore 304 of the wellhead 300 to isolate the fluid traversing the bore 224 and fluid opening 226 from the fluid traversing the bore 244 and fluid opening 246.

In one embodiment, the sealing means may include a first sealing means 260 located above the fluid openings 226, 246, a second sealing means 270 located below the fluid openings 226, 246, and a third sealing means 280 located between the first and second sealing means 260, 270.

The first sealing means 260 can include an upper O-ring 262 secured in a corresponding upper O-ring groove 264 on the outside of the hanger body 202, and a lower O-ring 266 secured in a corresponding lower O-ring groove 268 on the outside of the hanger body 202. In this embodiment, the O-ring grooves 264, 268

may be positioned on the hanger body 202 substantially perpendicularly to the bore 304 of the wellhead 300, and to the bores 224, 244 of the first and second mandrels 220, 240.

- 5 The second sealing means 270 can include an upper O-ring 272 secured in a corresponding upper O-ring groove 274 on the outside of the hanger body 202, and a lower O-ring 276 secured in a corresponding lower O-ring groove 278 on the outside of the hanger body 202. In this embodiment, the O-ring grooves 274, 278 may be positioned on the hanger body 202 substantially perpendicularly to the bore
10 304 of the wellhead 300, and to the bores 224, 244 of the first and second mandrels 220, 240.

- The third sealing means 280 can include an upper O-ring 282 secured in a corresponding elliptical upper O-ring groove 284 on the outside of the hanger body
15 202, and a lower O-ring 286 secured in a corresponding elliptical lower O-ring groove 288 on the outside of the hanger body 202. In this embodiment, the elliptical O-ring grooves 284, 288 may be positioned on the hanger body 202 at an angle with respect to the perpendicular, such that the O-rings 282, 286 separate the first fluid from the second fluid. The O-rings 282, 286 thus assume an essentially elliptical
20 shape.

- In the configuration for the sealing means 260, 270, 280 described above, the first fluid traversing the fluid openings 226, 228 may be suspended in a small gap 310 defined by the inside surface 302 of the bore 304, the outside surface of the hanger
25 body 202, the upper O-ring 282 of the third sealing means 280, and the lower O-ring 266 of the first sealing means 260. The first fluid may then traverse an opening 316 in the wellhead 300, where various routing and/or pumping equipment (not shown) may be used to transfer the first fluid to any desired location.

- 30 Similarly, the second fluid traversing the fluid openings 246, 248 may be suspended in a small gap 312 defined by the inside surface 302 of the bore 304, the outside surface of the hanger body 202, the upper O-ring 272 of the second sealing means 270, and the lower O-ring 286 of the third sealing means 280. The second fluid may then traverse an opening 318 in the wellhead 300, where various routing and/or

pumping equipment (not shown) may be used to transfer the first fluid to any desired location.

5 The sealing arrangement described above isolates the first fluid from the second fluid, even though the fluid openings 226, 246 are located on substantially the same level. It is understood that the openings 226, 246 need not be exactly level with each other, but only need to be substantially level, such that the sealing arrangement described above provides the desired fluid isolation between the first and second fluids.

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In the embodiments described above, the sealing means 260, 270, 280 are capable of providing tight seals at pressures of at least 5000 pounds per square inch (approx 35,000 Kilo Pascals (KPa). In some embodiments, the O-rings 262, 266, 272, 276, 282, 286 may be made from nitrile. It is understood that other materials may also be used, as known to those of skill in the art.

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Depending upon the specific application, the first and second fluids can each be crude oil from different sources or depths, fresh water, salt water, or other water based solutions. Similarly, both fluids need not be traveling in the same direction.

20 In some embodiments, oil may be pumped upwards through one central bore, while water is pumped down through the other central bore. Alternately, oil from different depths or oil pockets located underground may be pumped up through different central bores. The embodiment described may also be useful in water well applications in which water may be pumped from different underground locations.

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The dual tubing hanger 200 is designed to fit snugly within the bore 304 of the wellhead 300. In some embodiments, the S-seals 211 located at the bottom of the hanger body 202 may rest on a landing shoulder 320 located within the bore 304. Once the dual tubing hanger 200 is mounted in the bore 304, the mandrels 220, 240
30 engage with corresponding risers (not shown) to effectively transfer the first and second fluids. It is understood that the explanation above is provided by way of example only. There are many methods and specific configurations for connecting a dual tubing hanger within a wellhead that can be used with embodiments of the present invention. It is further understood that various routing and or pumping

equipment may be connected to the wellhead 300 to provide fluid delivery, both out of the mandrels and into the mandrels, as desired.

Embodiments of the present invention provide a distinct advantage over prior art dual tubing hangers. The embodiments allow fluid from both mandrels to enter/exit on substantially the same level. This simplifies the connections to the other routing/pumping equipment. It also provides more clearance above a top of the wellhead, as the routing/pumping equipment need not be located on separate levels.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A dual tubing hanger mounted in a wellhead having a cylindrical bore with an inner diameter, the dual tubing hanger comprising:
- 5 a cylindrical hanger body having an outer diameter less than the inner diameter of the cylindrical bore;
- a first mandrel located within said hanger body, said first mandrel capable of transporting a first fluid and having a first outlet at a first elevation extending through said cylindrical hanger body;
- 10 a second mandrel located within said hanger body, said second mandrel capable of transporting a second fluid and having a second outlet extending through said cylindrical hanger body at substantially said first elevation; a first seal located between said hanger body and said cylindrical bore, said first seal mounted substantially parallel to a cross-section of said bore and located below said first and
- 15 second outlets;
- a second seal mounted substantially parallel to a cross-section of said bore and located above said first and second outlets; and
- a third seal mounted at an angle with respect to a cross-section of said bore, such that said third seal extends from a position below said first and second outlets
- 20 to a position above said first and second outlets;
- wherein said first, second and third seals are capable of isolating said first fluid from said second fluid.
2. The dual tubing hanger of claim 1, wherein each of said first, second and third
- 25 seals further comprises a pair of o-rings mounted in corresponding grooves in said cylindrical hanger body.
3. The dual tubing hanger of claim 2, wherein said o-rings comprise nitrile.
- 30 4. The dual tubing hanger of any one of the previous claims, wherein said first fluid is sealed between said hanger body, said cylindrical bore, said first seal, and said third seal.
5. The dual tubing hanger of any one of the previous claims, wherein said
- 35 second fluid is sealed between said hanger body, said cylindrical bore, said second seal, and said third seal.

6. The dual tubing hanger of any one of the previous claims, wherein said first and second fluids comprise any one of crude oil, water, and a water solution.
- 5 7. The dual tubing hanger of any one of the previous claims, wherein said wellhead further comprises a first opening allowing passage of said first liquid, and a second opening allowing passage of said second liquid.
- 10 8. A method of isolating a first fluid from a second fluid in a dual tubing hanger mounted in a wellhead having a cylindrical bore with an inner diameter, the method comprising the steps of:
- 15 providing a cylindrical hanger body having an outer diameter less than the inner diameter of the cylindrical bore;
- providing a first mandrel located within said hanger body, said first mandrel capable of transporting a first fluid and having a first outlet at a first elevation extending through said cylindrical hanger body;
- 20 providing a second mandrel located within said hanger body, said second mandrel capable of transporting a second fluid and having a second outlet extending through said cylindrical hanger body at substantially said first elevation; and
- 25 providing a first seal located between said hanger body and said cylindrical bore, said first seal mounted substantially parallel to a cross-section of said bore and located below said first and second outlets;
- providing a second seal mounted substantially parallel to a cross-section of said bore and located above said first and second outlets; and
- 30 providing a third seal mounted at an angle with respect to a cross-section of said bore, such that said third seal extends from a position below said first and second outlets to a position above said first and second outlets;
- wherein said first, second and third seals are capable of isolating said first fluid from said second fluid.
- 35 9. The method of claim 8, wherein said first fluid is sealed between said hanger body, said cylindrical bore, said first seal, and said third seal.
10. The method of one of claims 8 and 9, wherein said second fluid is sealed between said hanger body, said cylindrical bore, said second seal, and said third seal.