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(54) Title: SYSTEMS AND METHODS FOR PRODUCING OIL AND/OR GAS

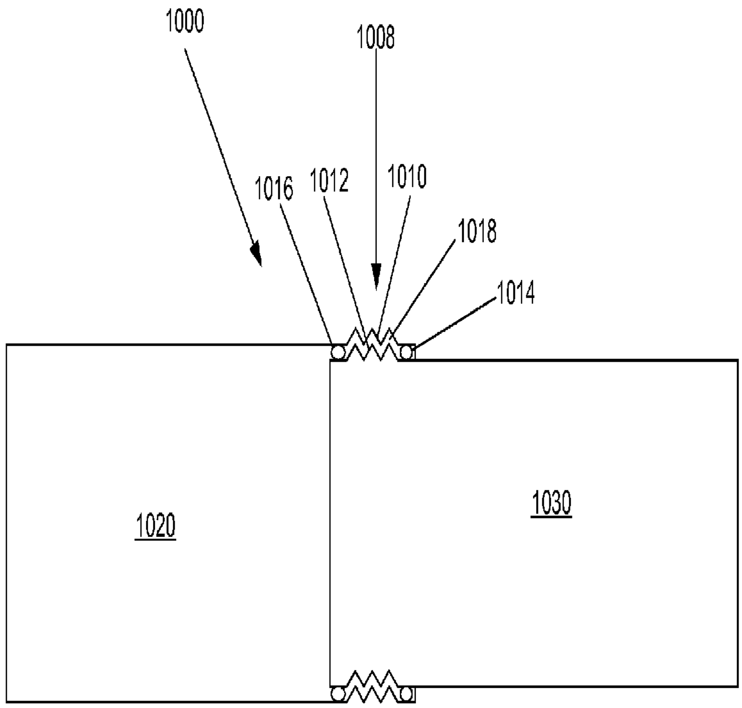

Figure 6

(57) Abstract: A system for producing oil and/or gas from an underground formation comprising a first well above the formation; the first well comprises a mechanism to inject a miscible enhanced oil recovery formulation into the formation; the first well comprises a first tubular and a second tubular, the first tubular threadingly engaged with the second tubular; a thread compound disposed on at least one of a thread of the first tubular and a thread of the second tubular; the thread compound comprises an additive adapted to swell when exposed to the miscible enhanced oil recovery formulation

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SYSTEMS AND METHODS FOR PRODUCING OIL AND/OR GAS

Field of the Invention

The present disclosure relates to systems and methods for producing oil and/or gas.

Background of the Invention

Enhanced Oil Recovery (EOR) may be used to increase oil recovery in fields worldwide. There are three main types of EOR, thermal, chemical/polymer and gas injection, which may be used to increase oil recovery from a reservoir, beyond what can be achieved by conventional means – possibly extending the life of a field and boosting the oil recovery factor.

Thermal enhanced recovery works by adding heat to the reservoir. The most widely practiced form is a steamdrive, which reduces oil viscosity so that it can flow to the producing wells. Chemical flooding increases recovery by reducing the capillary forces that trap residual oil. Polymer flooding improves the sweep efficiency of injected water. Miscible injection works in a similar way to chemical flooding. By injecting a fluid that is miscible with the oil, trapped residual oil can be recovered.

Referring to Figure 1, there is illustrated prior art system 100. System 100 includes underground formation 102, underground formation 104, underground formation 106, and underground formation 108. Production facility 110 is provided at the surface. Well 112 traverses formations 102 and 104, and terminates in formation 106. The portion of formation 106 is shown at 114. Oil and gas are produced from formation 106 through well 112, to production facility 110. Gas and liquid are separated from each other, gas is stored in gas storage 116 and liquid is stored in liquid storage 118.

U.S. Patent Application Publication Number 2005/093250 discloses a radially expandable sealed tubular joint for use in oil and gas wells having a pair of radially expandable tubular elements each having threading at a free end thereof and coupled to one another to form a flush joint connection, the threading including hooked incomplete threads located at least adjacent the free ends, and a sealing substance extending between and adhering to the threading of one element and the threading of the other element, wherein after a radial expansion of the coupled pair of elements the sealing substance remains extended between and adhered to the threading of one element and the threading of the other element. The sealing substance is either a greaseless elastomeric sealant coated on one or both of the pair of elements or a pure metal applied to each of the pair of elements. U.S. Patent Application Publication Number 2005/093250 is herein incorporated by reference in its entirety.

United Kingdom Patent Application GB-A 8253000033 discloses that screws, nuts, or screw caps, can be secured in screw or threaded structural parts by the interposition of a small quantity of a polymeric siloxane compound between the threads, the elastomer spreading between the threads when the parts are screwed together and sub-sequently as a result of the ability of the elastomer to flow when cold, the parts being thus adhesively bonded together. Moreover, the high molecular weight dimethyl polysiloxane can be dissolved in a solvent, such as an aromatic or chlorinated aliphatic hydrocarbon, or used in the form of a dispersion, in order to facilitate the introduction of the elastomer between the threads of the screws or nuts. When the solvent or dispersant evaporates, it will leave the high molecular dimethyl polysiloxane in its original form. United Kingdom Patent Application GB-A 8253000033 is herein incorporated by reference in its entirety.

Co-pending U.S. Patent Application Publication Number 2006/0254769, published November 16, 2006, and having attorney docket number TH2616, discloses a system including a mechanism for recovering oil and/or gas from an underground formation, the oil and/or gas comprising one or more sulfur compounds; a mechanism for converting at least a portion of the sulfur compounds from the recovered oil and/or gas into a carbon disulfide formulation; and a mechanism for releasing at least a portion of the carbon disulfide formulation into a formation. U.S. Patent Application Publication Number 2006/0254769 is herein incorporated by reference in its entirety.

There is a need in the art for improved systems and methods for enhanced oil recovery. There is a further need in the art for improved systems and methods for enhanced oil recovery using a solvent, for example through viscosity reduction, chemical effects, and miscible flooding. There is a further need in the art for improved systems and methods for solvent miscible flooding. There is a further need in the art for improved systems and methods for transporting a miscible solvent in a pipe during an enhanced oil recovery operation. There is a need in the art for improved thread compounds to be used with a miscible solvent in a pipe during an enhanced oil recovery operation.

Summary of the Invention

In one aspect, the invention provides a system for producing oil and/or gas from an underground formation comprising a first well above the formation; the first well comprises a mechanism to inject a miscible enhanced oil recovery formulation into the formation; the first well comprises a first tubular and a second tubular, the first tubular threadingly engaged with the second tubular; a thread compound disposed on at least one of a thread of the first tubular and a thread of the second tubular; the thread compound comprises an additive adapted to swell when exposed to the miscible enhanced oil recovery formulation.

In another aspect, the invention provides a method for producing oil and/or gas comprising lowering a first tubular into a first well; threadingly engaging the first tubular to a second tubular; lowering the second tubular into the first well; injecting a carbon disulfide formulation into a formation from the first well; wherein threadingly engaging the first tubular to the second tubular comprises placing a thread compound on at least one of a thread on the first tubular and a thread on the second tubular, the thread compound comprises an additive adapted to swell when exposed to the carbon disulfide formulation.

Advantages of the invention include one or more of the following:

Improved systems and methods for enhanced recovery of hydrocarbons from a formation with a solvent.

Improved systems and methods for enhanced recovery of hydrocarbons from a formation with a fluid containing a miscible solvent.

Improved systems and methods for secondary recovery of hydrocarbons.

Improved systems and methods for enhanced oil recovery.

Improved systems and methods for enhanced oil recovery using a miscible solvent.

Improved systems and methods for enhanced oil recovery using a compound which may be miscible with oil in place.

Improved systems and methods for transporting and/or containing a compound in a pipe which may be miscible with oil in place.

Improved systems and methods for sealing a compound in a pipe which may be miscible with oil in place.

Brief Description of the Drawings

Figure 1 illustrates an oil and/or gas production system.

Figure 2 illustrates an oil and/or gas production system.

Figures 3a-3c illustrate oil and/or gas production systems.

Figure 4 illustrates an oil and/or gas production system.

Figures 5a and 5b illustrate an oil and/or gas production system with a concentric tubular arrangement.

Figure 6 illustrates a threaded tubular connection.

Detailed Description of the Invention

Figure 2:

Referring now to Figure 2, in some embodiments system 200 is illustrated. System 200 includes underground formation 202, underground formation 204, underground formation 206, and underground formation 208. Facility 210 may be provided at the surface. Well 212 traverses formations 202 and 204, and has multiple openings in formation 206. Portions 214 of formation 206 may be optionally fractured and/or perforated. During primary production, oil and gas from formation 206 may be produced into portions 214, into well 212, and travels up to facility 210. Facility 210 then separates gas, which may be sent to gas processing 216, and liquid, which may be sent to liquid storage 218. Facility 210 also includes miscible enhanced oil recovery formulation storage 230.

As shown in Figure 2, miscible enhanced oil recovery formulation may be pumped down well 212 that is shown by the down arrow and pumped into formation 206. Miscible enhanced oil recovery formulation and oil and/or gas may be then produced back up well 212 to facility 210, as shown by up arrow. Facility 210 may be adapted to separate and/or recycle miscible enhanced oil recovery formulation, for example by boiling the formulation, condensing it or filtering or reacting it, then re-injecting the formulation into well 212.

In some embodiments, miscible enhanced oil recovery formulation may be pumped into formation 206 below the fracture pressure of the formation, for example from about 40% to about 90% of the fracture pressure.

The recovery of oil and/or gas with one or more wells (such as well 212) from underground formation 206 may be accomplished by any known method. Suitable methods include subsea production, surface production, primary, secondary, or tertiary production. The selection of the method used to recover the oil and/or gas from underground formation 206 is not critical.

System 200 may include one or more tubulars with threaded connections.

Figures 3a and 3b:

Referring now to Figures 3a and 3b, in some embodiments of the invention, system 200 is illustrated. System 200 includes underground formation 202, underground formation 204, underground formation 206, and underground formation 208. Facility 210 may be provided at the surface. Well 212 traverses formations 202 and 204, and has openings in formation 206. Portions 214 of formation 206 may be optionally fractured and/or perforated. During primary production, oil and gas from formation 206 may be produced into portions 214, into well 212, and travels up to facility 210. Facility 210 then separates gas, which may be sent to gas processing 216, and liquid, which may be sent to liquid storage 218. Facility 210 also includes miscible enhanced oil recovery formulation storage 230.

As shown in Figure 3a, miscible enhanced oil recovery formulation may be pumped down well 212 that is shown by the down arrow and pumped into formation 206. Miscible enhanced oil recovery formulation may be left to soak in formation for a period of time from about 1 hour to about 15 days, for example from about 5 to about 50 hours.

After the soaking period, as shown in Figure 3b, miscible enhanced oil recovery formulation and oil and/or gas may be then produced back up well 212 to facility 210. Facility 210 may be adapted to separate and/or recycle miscible enhanced oil recovery formulation, for example by boiling the formulation, condensing it or filtering or reacting it, then re-injecting the formulation into well 212, for example by repeating the soaking cycle shown in Figures 3a and 3b from about 2 to about 5 times.

In some embodiments, miscible enhanced oil recovery formulation may be pumped into formation 206 below the fracture pressure of the formation, for example from about 40% to about 90% of the fracture pressure.

System 200 may include one or more tubulars with threaded connections.

Figure 3c:

Referring now to Figure 3c, in some embodiments of the invention, system 300 is illustrated. System 300 includes underground formation 302, formation 304, formation 306, and formation 308. Production facility 310 may be provided at the surface. Well 312 traverses formation 302 and 304 has openings at formation 306. Portions of formation 314 may be optionally fractured and/or perforated. As oil and gas is produced from formation 306 it enters portions 314, and travels up well 312 to production facility 310. Gas and liquid may be separated, and gas may be sent to gas storage 316, and liquid may be sent to liquid storage 318. Production facility 310 may be able to produce and/or store miscible enhanced oil recovery formulation, which may be produced and stored in production / storage 330. Hydrogen sulfide and/or other sulfur containing compounds from well 312 may be sent to miscible enhanced oil recovery formulation production / storage 330. Miscible enhanced oil recovery formulation may be pumped down well 332, to portions 334 of formation 306. Miscible enhanced oil recovery formulation traverses formation 306 to aid in the production of oil and gas, and then the miscible enhanced oil recovery formulation, oil and/or gas may all be produced to well 312, to production facility 310. Miscible enhanced oil recovery formulation may then be recycled, for example by boiling the formulation, condensing it or filtering or reacting it, then re-injecting the formulation into well 332.

In some embodiments, a quantity of miscible enhanced oil recovery formulation or miscible enhanced oil recovery formulation mixed with other components may be injected into well 332, followed by another component to force miscible enhanced oil recovery formulation or miscible enhanced oil recovery formulation mixed with other components across formation 306, for example air; water in gas or liquid form; water mixed with one or more salts, polymers, and/or surfactants; carbon dioxide; other gases; other liquids; and/or mixtures thereof.

System 300 may include one or more tubulars with threaded connections.

Figure 4:

Referring now to Figure 4, in some embodiments of the invention, system 700 is illustrated. System 700 includes underground formation 702, formation 704, formation 706, and formation 708; and underground formation 802, formation 804, formation 806, and formation 808. Production facility 710 is provided at the surface. Well 712 traverses formation 702 and 704 has openings at formation 706. Portions of formation 714 may be optionally fractured and/or perforated. As oil and gas is produced from formation 706 it enters portions 714, and travels up well 712 to production facility 710. Gas and liquid may be separated, and gas may be sent to gas storage 716, and liquid may be sent to liquid storage 718. Production facility 710 is able to produce carbon disulfide and/or carbon oxysulfide formulation, which may be produced and stored in carbon disulfide formulation production 730. Hydrogen sulfide and/or other sulfur containing compounds from well 712 may be sent to carbon disulfide formulation production 730. Carbon disulfide formulation is transported to well 732 by pipe 734 and pumped down well 732, to formation 806. Carbon disulfide formulation may be used in formation 806 to aid in the production of oil and gas from formation 806.

Well 732 is separated from well 712 by a distance d 740. In some embodiments, distance d 740 is from about 1 to about 1000 kilometers, for example from about 5 to about 250 kilometers, or for example from about 10 to about 100 kilometers, or for example about 50 to 75 kilometers.

System 700 may include one or more tubulars with threaded connections.

Figures 5a & 5b:

Referring now to Figure 5a, a tubular 900 is illustrated traversing formations 802 and 804, and ending in formation 806. Tubular 900 may be used as an observation well, a peripheral containment well, an injection well, and/or a production well.

Referring now to Figure 5b, tubular 900 is shown in more detail. Tubular 900 includes internal tubular 902 located within external tubular 904. Internal tubular 902 is made up of multiple sections, connected at joints 908. External tubular 904 is made up of multiple sections, connected at joints 910. Packer 906 may be provided between the exterior of tubular 902 and the interior of tubular 904. Packer may seal off an upper annular space between the exterior of tubular 902 and the interior of tubular 904 from a lower annular space, for example a production or injection zone.

Packer 906 may have one or more sealing elements on its interior surface adjacent tubular 902 and/or one or more sealing elements on its exterior surface adjacent tubular 904.

Joints 908 and/or 910 may include threaded connections.

Figure 6:

Referring now to Figure 6, tubular system 1000 with threaded tubular connection 1008 is illustrated. Tubular 1030 having pin end 1012 is threadingly engaged with tubular 1020 having box end 1010. Pin end 1012 is the male connection which fits within box end 1010 which is the female connection.

One or more seals 1014 and/or 1016 may be provided adjacent the threaded connections. Seals 1014 and/or 1016 may be o-rings or other seal configurations as are known in the art. Seals 1014 and/or 1016 may be fitted into grooves on tubulars 1020 and/or 1030. Seals 1014 and/or 1016 may be used to provide a seal between an interior and exterior of tubulars 1020 and 1030, for example to contain fluids within tubulars 1020 and 1030 and/or to keep fluids out of tubulars 1020 and 1030.

Thread compound 1018 may be provided between pin end 1012 and box end 1010. Thread compound 1018 may be used to provide lubrication between pin end 1012 and box end 1010 and/or may be used to provide a seal between an interior and exterior of tubulars 1020 and 1030, for example to contain fluids within tubulars 1020 and 1030 and/or to keep fluids out of tubulars 1020 and 1030.

Tubular system 1000 may be representative of one or more parts of well 212, 312, 332, 712, 732, and/or tubular 900, 902, and/or 904.

Thread Compound:

The thread compound may include one or more bases and one or more additives. Suitable bases include petrolatums, lubricating greases, lubricating oils, mineral oils, linseed oils, and mixtures thereof. Suitable additives include molybdenum disulfide, graphite, lead, copper, lime, zinc, elastomers, rubbers for example nitrile rubber or butyl rubber, other materials that swell in the presence of a carbon disulfide solution, and mixtures thereof.

In some embodiments, the additive is adapted to increase in volume by at least 10% when exposed to a miscible enhanced oil recovery formulation, for example by at least 25%, at least 40%, or at least 50%.

In some embodiments, the additive is adapted to increase in volume by at least 10% when exposed to a carbon disulfide formulation, for example by at least 25%, at least 40%, or at least 50%.

Seal Materials:

In some embodiments, seals 1014 and/or 1016 and packer 906 may be made of fluorinated polymers such as PTFE (polytetrafluoroethylene), fluorinated ethylene-propylene copolymers, commercially available as Teflon™ from Du Pont; fluoroelastomers such as a copolymer of vinylidene fluoride and hexafluoropropylene, commercially available as Viton™ from Du Pont, for example Viton A; or perfluoroelastomers such as a copolymer of vinylidene fluoride and hexafluoropropylene, commercially available as Kalrez™ from Du Pont, for example Kalrez AS-568 3018-1.

In some embodiments, seals 1014 and/or 1016 and packer 906 may be made of fluorocarbon polymers, perfluorocarbon polymers, fluoroelastomers, or perfluoroelastomers.

In some embodiments, seals 1014 and/or 1016 and packer 906 may be made of a fluorinated polymer, where at least about 25% of the hydrogens attached to a carbon have been replaced with a fluorine or chlorine, for example replacing at least about 50% of the hydrogens, at least about 75% of the hydrogens, or at least about 90% of the hydrogens.

Alternative Embodiments:

In some embodiments, oil and/or gas may be recovered from a formation into a well, and flow through the well and flowline to a facility. In some embodiments, enhanced oil recovery, with the use of an agent for example steam, water, a surfactant, a polymer flood, and/or a miscible agent such as a carbon disulfide formulation, a carbon oxysulfide formulation, and/or carbon dioxide, may be used to increase the flow of oil and/or gas from the formation.

In some embodiments, oil and/or gas recovered from a formation may include a sulfur compound. The sulfur compound may include hydrogen sulfide, mercaptans, sulfides and disulfides other than hydrogen disulfide, or heterocyclic sulfur compounds for example thiophenes, benzothiophenes, or substituted and condensed ring dibenzothiophenes, or mixtures thereof.

In some embodiments, a sulfur compound from the formation may be converted into a carbon disulfide formulation or a carbon oxysulfide formulation. The conversion of at least a portion of the sulfur compound into a carbon disulfide formulation may be accomplished by any known method. Suitable methods may include oxidation reaction of the sulfur compound to sulfur and/or sulfur dioxides, and by reaction of sulfur and/or sulfur dioxide with carbon and/or a carbon containing compound to form the carbon disulfide formulation. The selection of the method used to convert at least a portion of the sulfur compound into a carbon disulfide formulation is not critical.

In some embodiments, a suitable miscible enhanced oil recovery agent may be a carbon disulfide formulation. The carbon disulfide formulation may include carbon disulfide and/or carbon disulfide derivatives for example, thiocarbonates, xanthates and mixtures thereof; and optionally one or more of the following: hydrogen sulfide, sulfur, carbon dioxide, hydrocarbons, and mixtures thereof.

In some embodiments, a suitable method of producing a carbon disulfide formulation is disclosed in copending U.S. Patent Application having serial number 11/409,436, filed on April 19, 2006, having attorney docket number TH2616. U.S.

Patent Application having serial number 11/409,436 is herein incorporated by reference in its entirety.

In some embodiments, suitable miscible enhanced oil recovery agents include carbon disulfide, carbon oxysulfide, hydrogen sulfide, carbon dioxide, octane, pentane, LPG, C2-C6 aliphatic hydrocarbons, nitrogen, diesel, mineral spirits, naptha solvent, asphalt solvent, kerosene, acetone, xylene, trichloroethane, or mixtures of two or more of the preceding, or other miscible enhanced oil recovery agents as are known in the art. In some embodiments, suitable miscible enhanced oil recovery agents are first contact miscible or multiple contact miscible with oil in the formation.

In some embodiments, suitable immiscible enhanced oil recovery agents include water in gas or liquid form, air, mixtures of two or more of the preceding, or other immiscible enhanced oil recovery agents as are known in the art. In some embodiments, suitable immiscible enhanced oil recovery agents are not first contact miscible or multiple contact miscible with oil in the formation.

In some embodiments, immiscible and/or miscible enhanced oil recovery agents injected into the formation may be recovered from the produced oil and/or gas and re-injected into the formation.

In some embodiments, oil as present in the formation prior to the injection of any enhanced oil recovery agents has a viscosity of at least about 100 centipoise, or at least about 500 centipoise, or at least about 1000 centipoise, or at least about 2000 centipoise, or at least about 5000 centipoise, or at least about 10,000 centipoise. In some embodiments, oil as present in the formation prior to the injection of any enhanced oil recovery agents has a viscosity of up to about 5,000,000 centipoise, or up to about 2,000,000 centipoise, or up to about 1,000,000 centipoise, or up to about 500,000 centipoise.

Releasing at least a portion of the miscible enhanced oil recovery agent and/or other liquids and/or gases may be accomplished by any known method. One suitable method is injecting the miscible enhanced oil recovery formulation into a single conduit in a single well, allowing carbon disulfide formulation to soak, and then pumping out at least a portion of the carbon disulfide formulation with gas and/or liquids. Another suitable method is injecting the miscible enhanced oil recovery formulation into a first well, and pumping out at least a portion of the miscible enhanced oil recovery formulation with gas and/or liquids through a second well. The selection of the method used to inject at least a portion of the miscible enhanced oil recovery formulation and/or other liquids and/or gases is not critical.

In some embodiments, the miscible enhanced oil recovery formulation and/or other liquids and/or gases may be pumped into a formation at a pressure up to the fracture pressure of the formation.

In some embodiments, the miscible enhanced oil recovery formulation may be mixed in with oil and/or gas in a formation to form a mixture which may be recovered from a well. In some embodiments, a quantity of the miscible enhanced oil recovery formulation may be injected into a well, followed by another component to force carbon the formulation across the formation. For example air, water in liquid or vapor form, carbon dioxide, other gases, other liquids, and/or mixtures thereof may be used to force the miscible enhanced oil recovery formulation across the formation.

In some embodiments, the miscible enhanced oil recovery formulation may be heated prior to being injected into the formation to lower the viscosity of fluids in the formation, for example heavy oils, paraffins, asphaltenes, etc.

In some embodiments, the miscible enhanced oil recovery formulation may be heated and/or boiled while within the formation, with the use of a heated fluid or a heater, to lower the viscosity of fluids in the formation. In some embodiments, heated water and/or steam may be used to heat and/or vaporize the miscible enhanced oil recovery formulation in the formation.

In some embodiments, the miscible enhanced oil recovery formulation may be heated and/or boiled while within the formation, with the use of a heater. One suitable heater is disclosed in copending United States Patent Application having serial number 10/693,816, filed on October 24, 2003, and having attorney docket number TH2557. United States Patent Application having serial number 10/693,816 is herein incorporated by reference in its entirety.

In some embodiments, oil and/or gas produced may be transported to a refinery and/or a treatment facility. The oil and/or gas may be processed to produced to produce commercial products such as transportation fuels such as gasoline and diesel, heating fuel, lubricants, chemicals, and/or polymers. Processing may include distilling and/or fractionally distilling the oil and/or gas to produce one or more distillate fractions. In some embodiments, the oil and/or gas, and/or the one or more distillate fractions may be subjected to a process of one or more of the following: catalytic cracking, hydrocracking, hydrotreating, coking, thermal cracking, distilling, reforming, polymerization, isomerization, alkylation, blending, and dewaxing.

Illustrative Embodiments:

In one embodiment of the invention, there is disclosed a system for producing oil and/or gas from an underground formation comprising a first well above the formation; the first well comprises a mechanism to inject a miscible enhanced oil recovery formulation into the formation; the first well comprises a first tubular and a second tubular, the first tubular threadingly engaged with the second tubular; a thread compound disposed on at least one of a thread of the first tubular and a thread of the second tubular; the thread compound comprises an additive adapted to swell when exposed to the miscible enhanced oil recovery formulation. In some embodiments, the system also includes a second well above the formation, the second well comprising a mechanism to produce oil and/or gas from the formation. In some embodiments, the first well is at a distance of 10 meters to 1 kilometer from the second well. In some embodiments, the system also includes a mechanism for injecting an immiscible enhanced oil recovery formulation into the formation, after the miscible enhanced oil recovery formulation has been released into the formation. In some embodiments, the system also includes a miscible enhanced oil recovery formulation selected from the group consisting of a carbon disulfide formulation, a carbon oxysulfide formulation, hydrogen sulfide, carbon dioxide, octane, pentane, LPG, C2-C6 aliphatic hydrocarbons, nitrogen, diesel, mineral spirits, naptha solvent, asphalt solvent, kerosene, acetone, xylene, trichloroethane, and mixtures thereof. In some embodiments, the miscible enhanced oil recovery formulation comprises a carbon disulfide formulation, a carbon oxysulfide formulation, or mixtures thereof. In some embodiments, the system also includes an immiscible enhanced oil recovery formulation selected from the group consisting of water in gas or liquid form, air, and mixtures thereof. In some embodiments, the system also includes a miscible enhanced oil recovery formulation comprising a carbon disulfide formulation. In some embodiments, the system also includes a mechanism for producing a carbon disulfide formulation. In some embodiments, the underground formation comprises an oil having a viscosity from 100 to 5,000,000 centipoise.

In one embodiment of the invention, there is disclosed a method for producing oil and/or gas comprising lowering a first tubular into a first well; threadingly engaging the first tubular to a second tubular; lowering the second tubular into the first well; injecting a carbon disulfide formulation into a formation from the first well; wherein threadingly engaging the first tubular to the second tubular comprises placing a thread compound on at least one of a thread on the first tubular and a thread on the second tubular, the thread compound comprises an additive adapted to swell when exposed to the carbon disulfide formulation. In some embodiments, the method also includes producing oil and/or gas from the formation from a second well. In some embodiments, injecting the carbon disulfide formulation comprises injecting at least a portion of the carbon disulfide formulation into the formation in a mixture with one or more of hydrocarbons; sulfur compounds other than carbon disulfide; carbon dioxide; carbon monoxide; or mixtures thereof. In some embodiments, the method also includes heating the carbon disulfide formulation prior to injecting the carbon disulfide formulation into the formation, or while within the formation. In some embodiments, the carbon disulfide formulation is injected at a pressure from 0 to 37,000 kilopascals above the initial reservoir pressure, measured prior to when carbon disulfide injection begins. In some embodiments, the underground formation comprises a permeability from 0.0001 to 15 Darcies, for example a permeability from 0.001 to 1 Darcy. In some embodiments, any oil, as present in the underground formation prior to the injecting the carbon disulfide formulation, has a sulfur content from 0.5% to 5%, for example from 1% to 3%. In some embodiments, the method also includes converting at least a portion of the recovered oil and/or gas into a material selected from the group consisting of transportation fuels such as gasoline and diesel, heating fuel, lubricants, chemicals, and/or polymers. In some embodiments, the additive has a volume that increases by at least 20% when exposed to the carbon disulfide formulation. In some embodiments, the additive comprises an elastomer. In some embodiments, the thread compound comprises a base comprising grease and an additive comprising rubber. In some embodiments, the method also includes recovering carbon disulfide formulation from the oil and/or gas, if present, and then injecting at least a portion of the recovered carbon disulfide formulation into the formation.

Those of skill in the art will appreciate that many modifications and variations are possible in terms of the disclosed embodiments of the invention, configurations, materials and methods without departing from their spirit and scope. Accordingly, the scope of the claims appended hereafter and their functional equivalents should not be limited by particular embodiments described and illustrated herein, as these are merely exemplary in nature.

C L A I M S

1. A system for producing oil and/or gas from an underground formation comprising:

a first well above the formation;

the first well comprises a mechanism to inject a miscible enhanced oil recovery formulation into the formation;

the first well comprises a first tubular and a second tubular, the first tubular threadingly engaged with the second tubular;

a thread compound disposed on at least one of a thread of the first tubular and a thread of the second tubular;

the thread compound comprises an additive adapted to swell when exposed to the miscible enhanced oil recovery formulation.

2. The system of claim 1, further comprising:

a second well above the formation, the second well comprising a mechanism to produce oil and/or gas from the formation.

3. The system of claim 2, wherein the first well is at a distance of 10 meters to 1 kilometer from the second well.

4. The system of one or more of claims 1-3, further comprising a mechanism for injecting an immiscible enhanced oil recovery formulation into the formation, after the miscible enhanced oil recovery formulation has been released into the formation.

5. The system of one or more of claims 1-4, further comprising a miscible enhanced oil recovery formulation selected from the group consisting of a carbon disulfide formulation, a carbon oxysulfide formulation, hydrogen sulfide, carbon dioxide, octane, pentane, LPG, C2-C6 aliphatic hydrocarbons, nitrogen, diesel, mineral spirits, naptha solvent, asphalt solvent, kerosene, acetone, xylene, trichloroethane, and mixtures thereof.

6. The system of claim 5, wherein the miscible enhanced oil recovery formulation comprises a carbon disulfide formulation, a carbon oxysulfide formulation, or mixtures thereof.

7. The system of one or more of claims 1-6, further comprising an immiscible enhanced oil recovery formulation selected from the group consisting of water in gas or liquid form, air, and mixtures thereof.

8. The system of one or more of claims 1-7, further comprising a miscible enhanced oil recovery formulation comprising a carbon disulfide formulation.

9. The system of one or more of claims 1-8, further comprising a mechanism for producing a carbon disulfide formulation.

10. The system of one or more of claims 1-9, wherein the underground formation comprises an oil having a viscosity from 100 to 5,000,000 centipoise.

11. A method for producing oil and/or gas comprising:
lowering a first tubular into a first well;
threadingly engaging the first tubular to a second tubular;
lowering the second tubular into the first well;
injecting a carbon disulfide formulation into a formation from the first well;
wherein threadingly engaging the first tubular to the second tubular comprises placing a thread compound on at least one of a thread on the first tubular and a thread on the second tubular, the thread compound comprises an additive adapted to swell when exposed to the carbon disulfide formulation.

12. The method of claim 11, further comprising:
producing oil and/or gas from the formation from a second well.

13. The method of one or more of claims 11-12, wherein injecting the carbon disulfide formulation comprises injecting at least a portion of the carbon disulfide formulation into the formation in a mixture with one or more of hydrocarbons; sulfur compounds other than carbon disulfide; carbon dioxide; carbon monoxide; or mixtures thereof.

14. The methods of one or more of claims 11-13, further comprising heating the carbon disulfide formulation prior to injecting the carbon disulfide formulation into the formation, or while within the formation.

15. The method of one or more of claims 11-14, wherein the carbon disulfide formulation is injected at a pressure from 0 to 37,000 kilopascals above the initial reservoir pressure, measured prior to when carbon disulfide injection begins.

16. The method of one or more of claims 11-15, wherein the underground formation comprises a permeability from 0.0001 to 15 Darcies, for example a permeability from 0.001 to 1 Darcy.

17. The method of one or more of claims 11-16, wherein any oil, as present in the underground formation prior to the injecting the carbon disulfide formulation, has a sulfur content from 0.5% to 5%, for example from 1% to 3%.

18. The method of one or more of claims 12-17, further comprising converting at least a portion of the recovered oil and/or gas into a material selected from the group consisting of transportation fuels such as gasoline and diesel, heating fuel, lubricants, chemicals, and/or polymers.

19. The method of one or more of claims 11-18, wherein the additive has a volume that increases by at least 20% when exposed to the carbon disulfide formulation.

20. The method of one or more of claims 11-19, wherein the additive comprises an elastomer.

21. The method of one or more of claims 11-20, wherein the thread compound comprises a base comprising grease and an additive comprising rubber.

22. The method of one or more of claims 11-21, further comprising recovering carbon disulfide formulation from the oil and/or gas, if present, and then injecting at least a portion of the recovered carbon disulfide formulation into the formation.

Figure 1

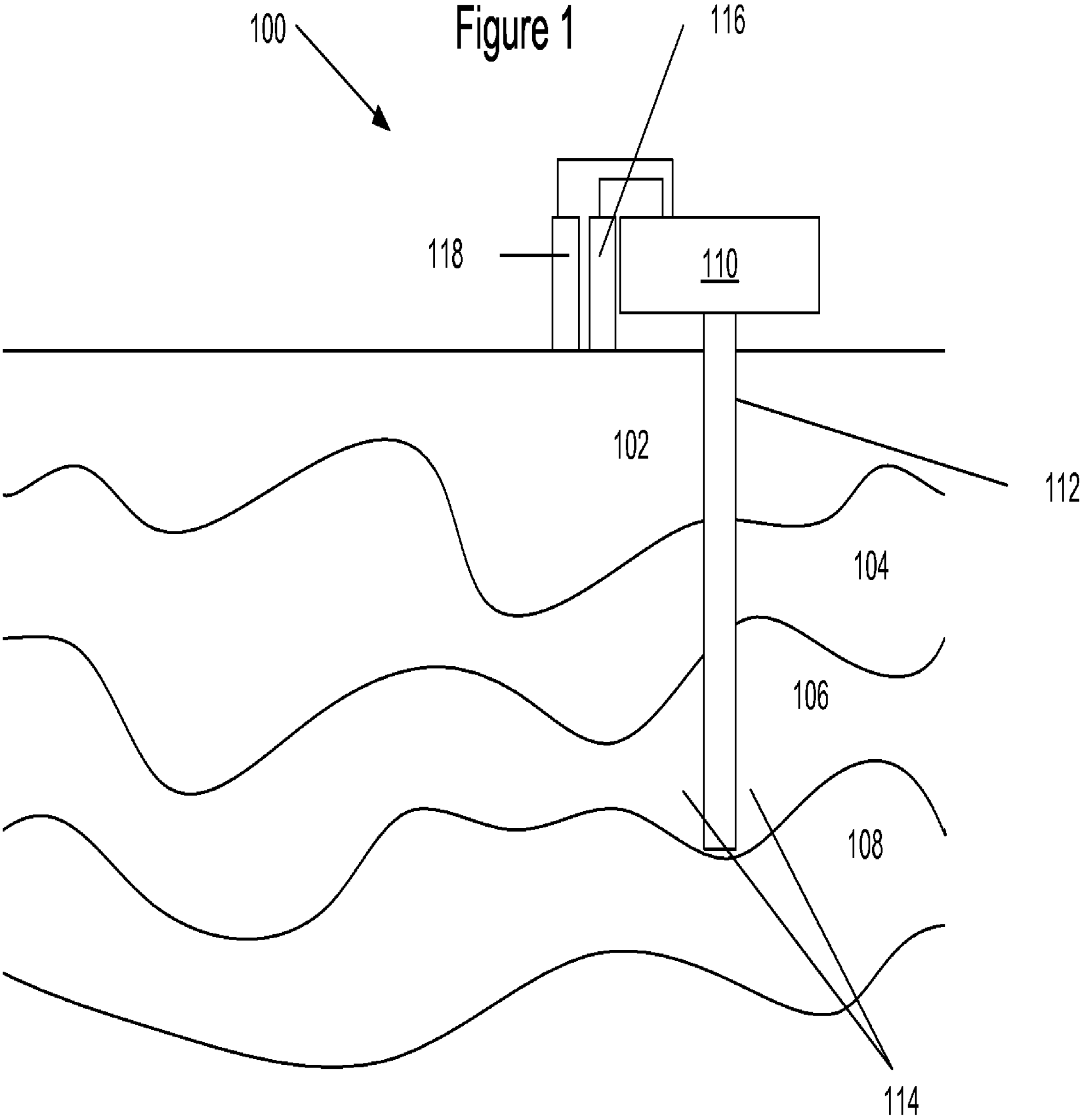
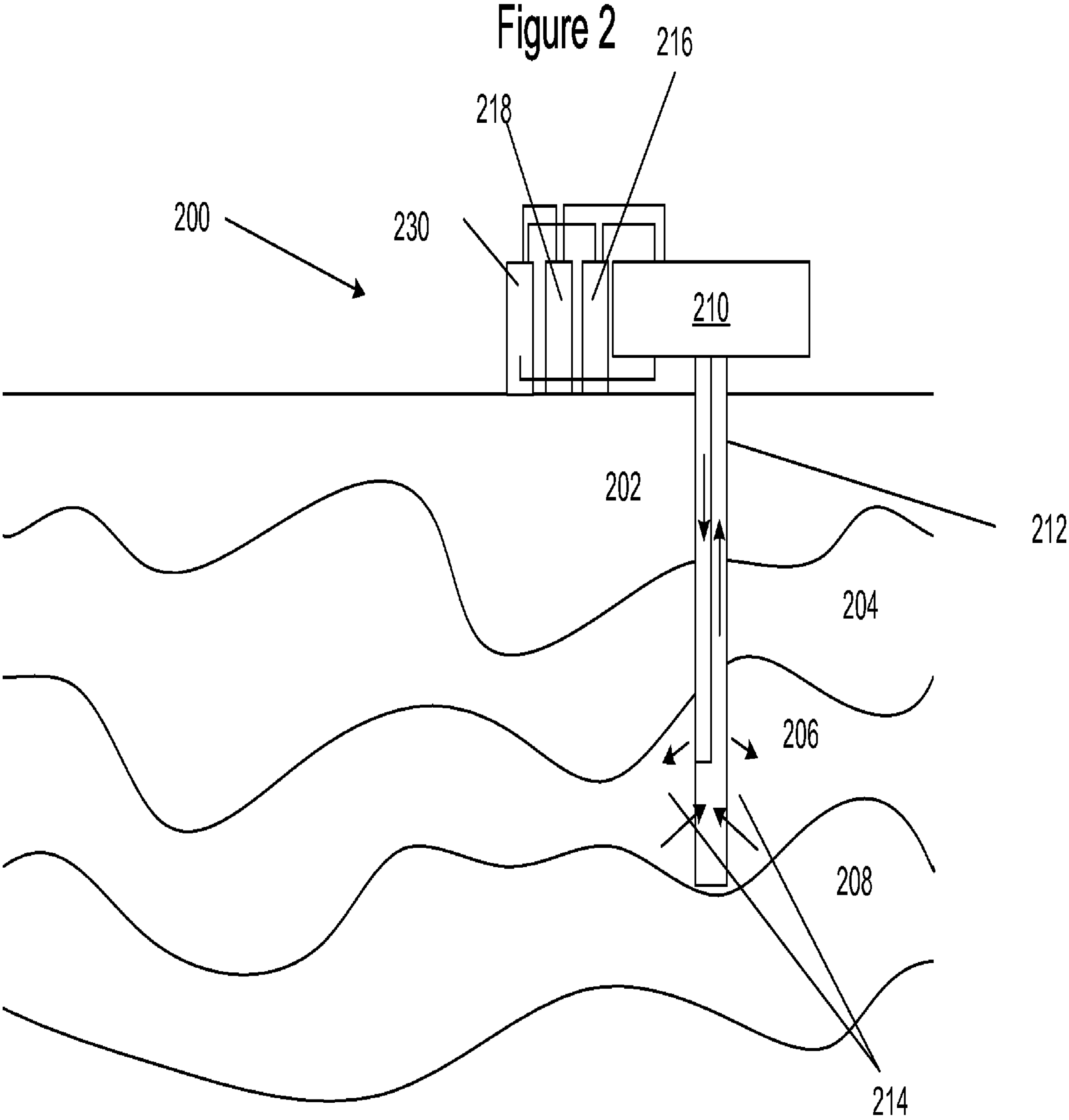


Figure 2



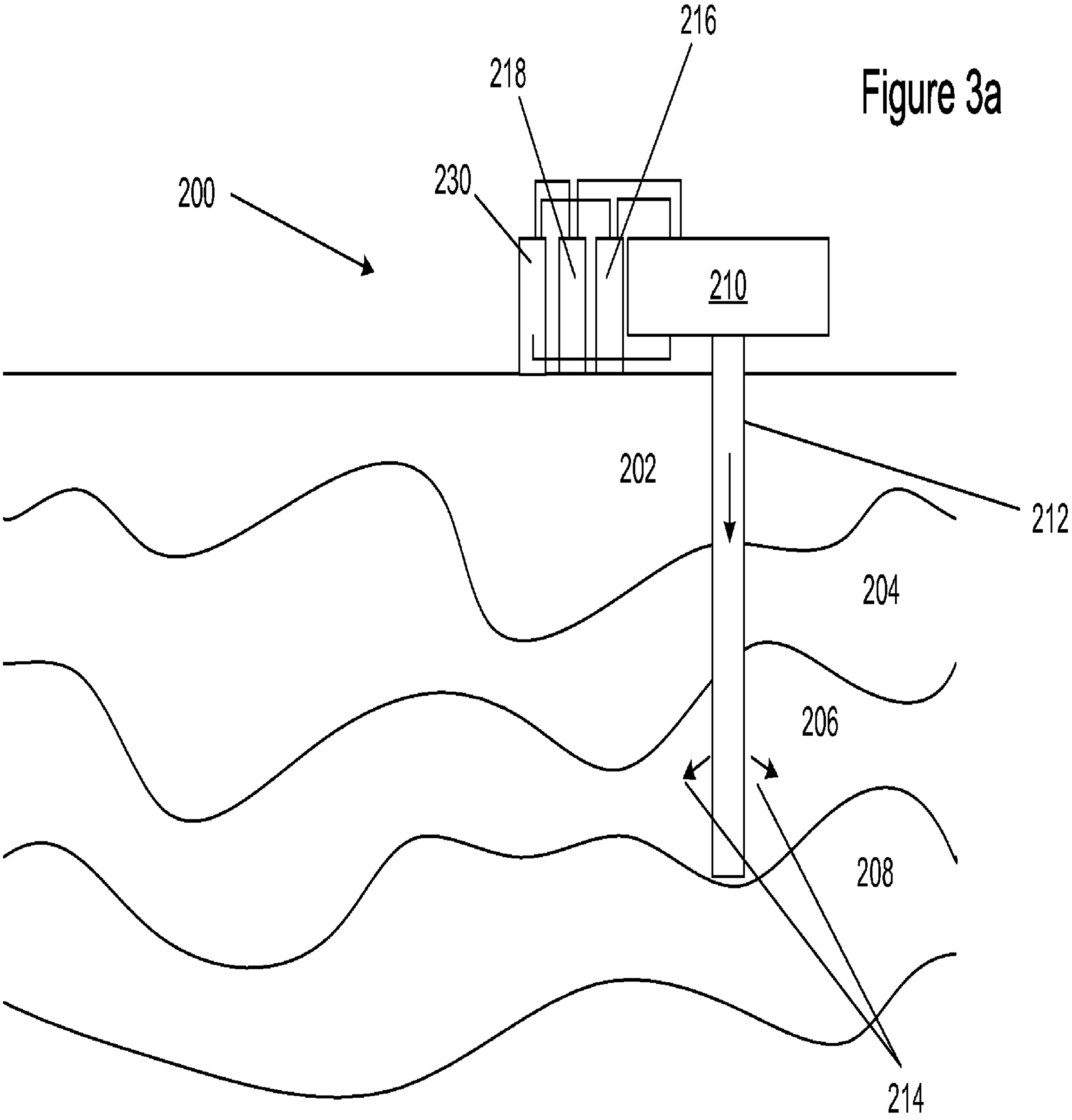

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Figure 3a
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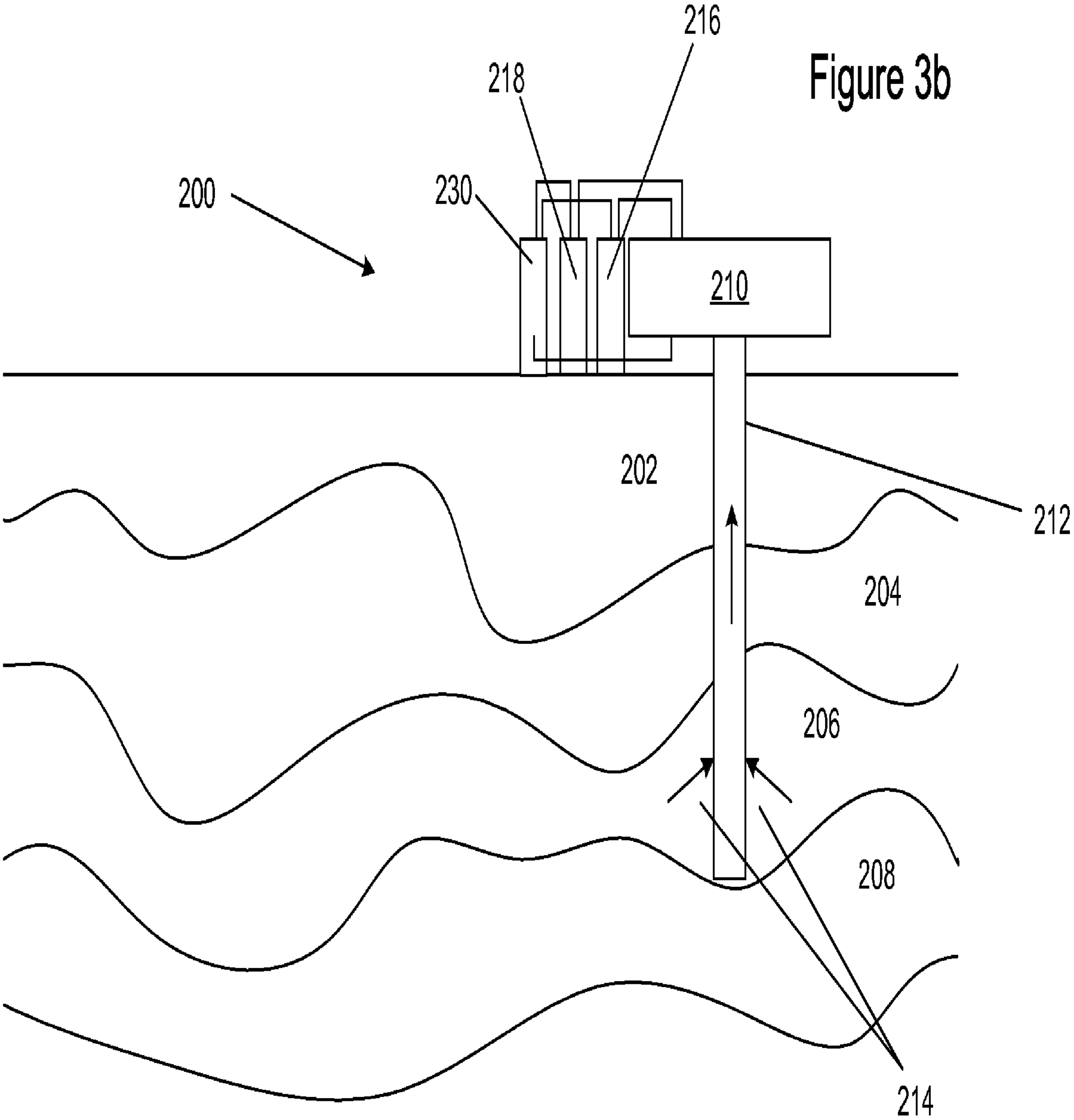
Figure 3b



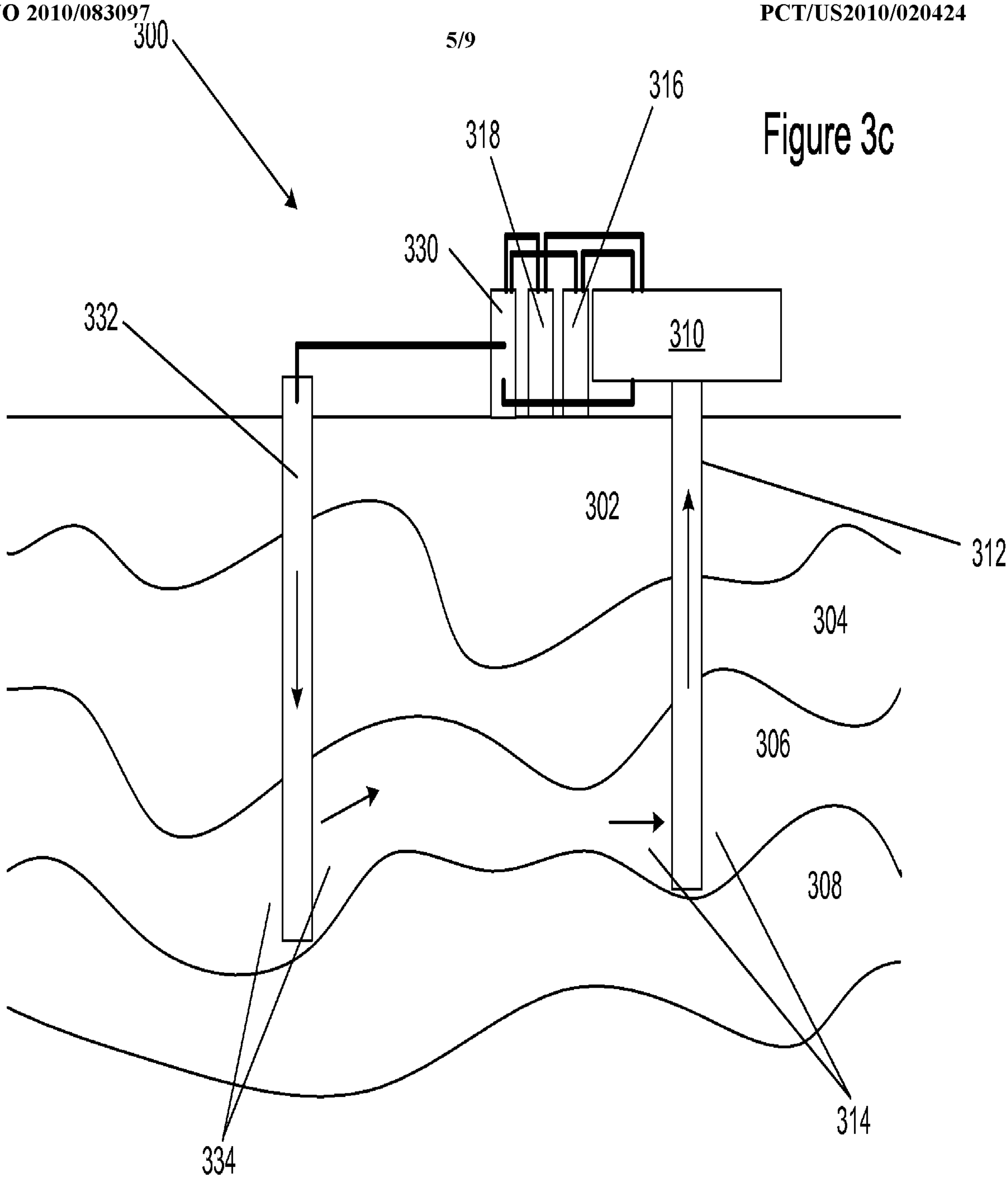


Figure 3c

Figure 4

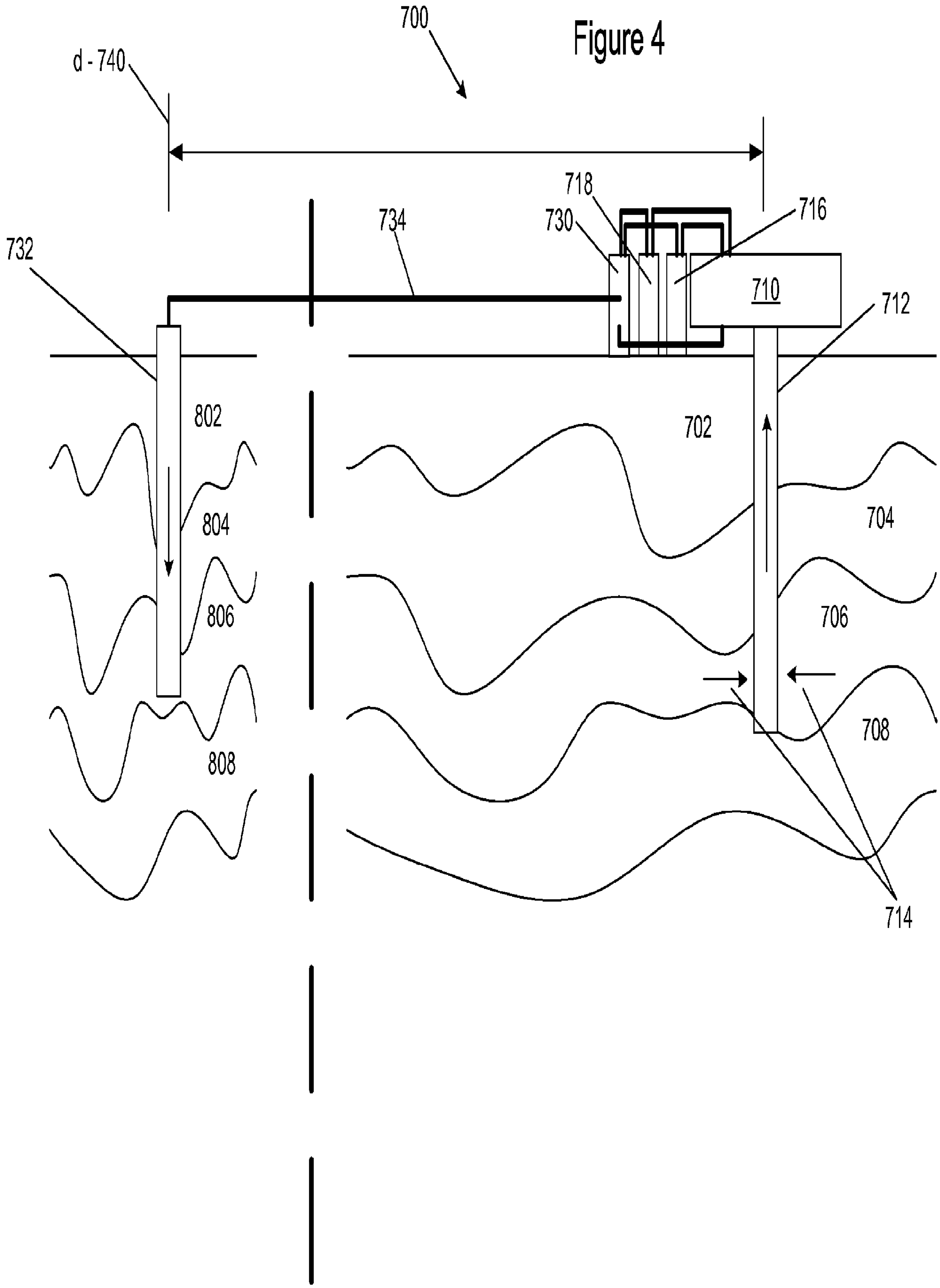

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Figure 5a

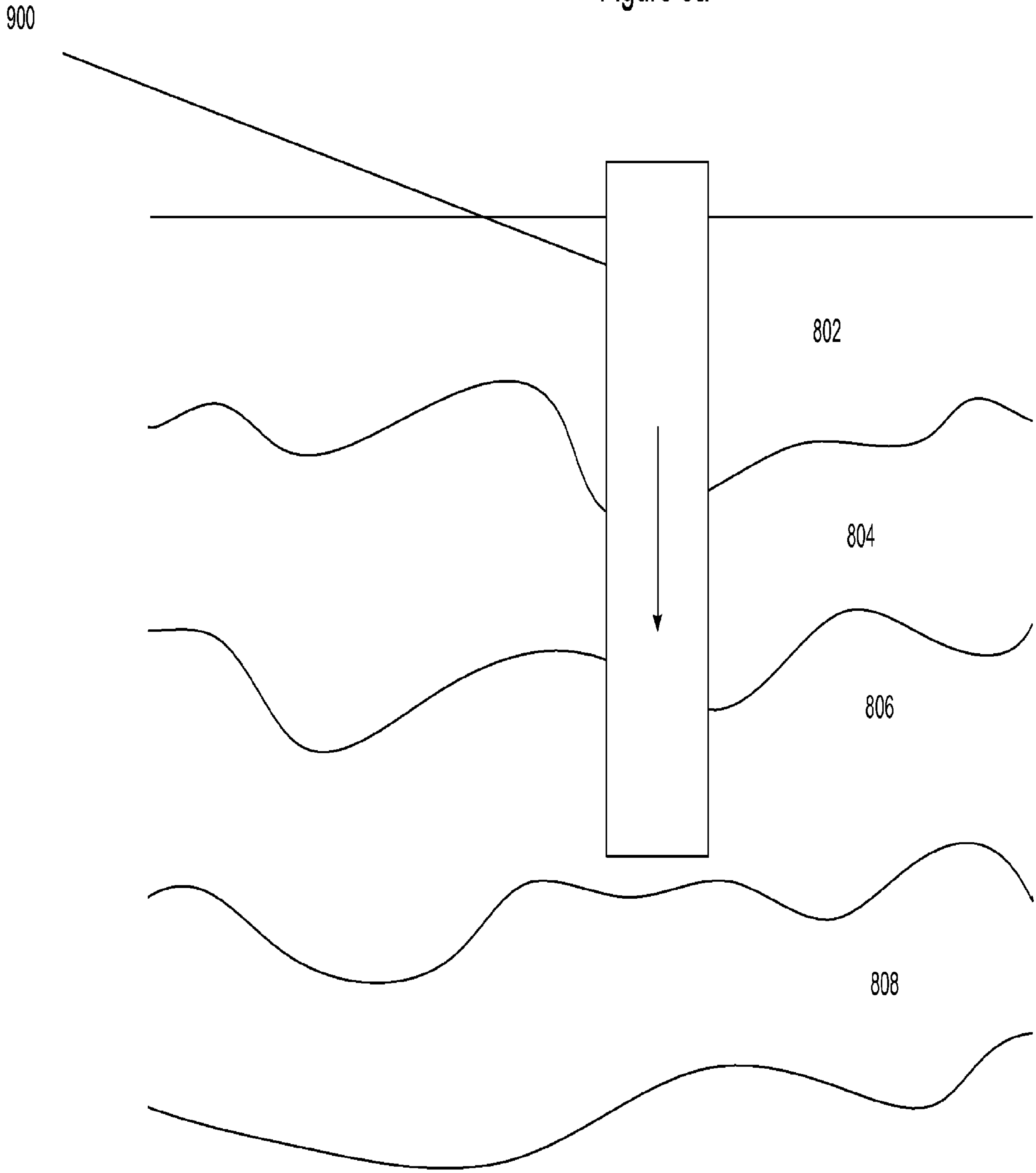

Figure 5b

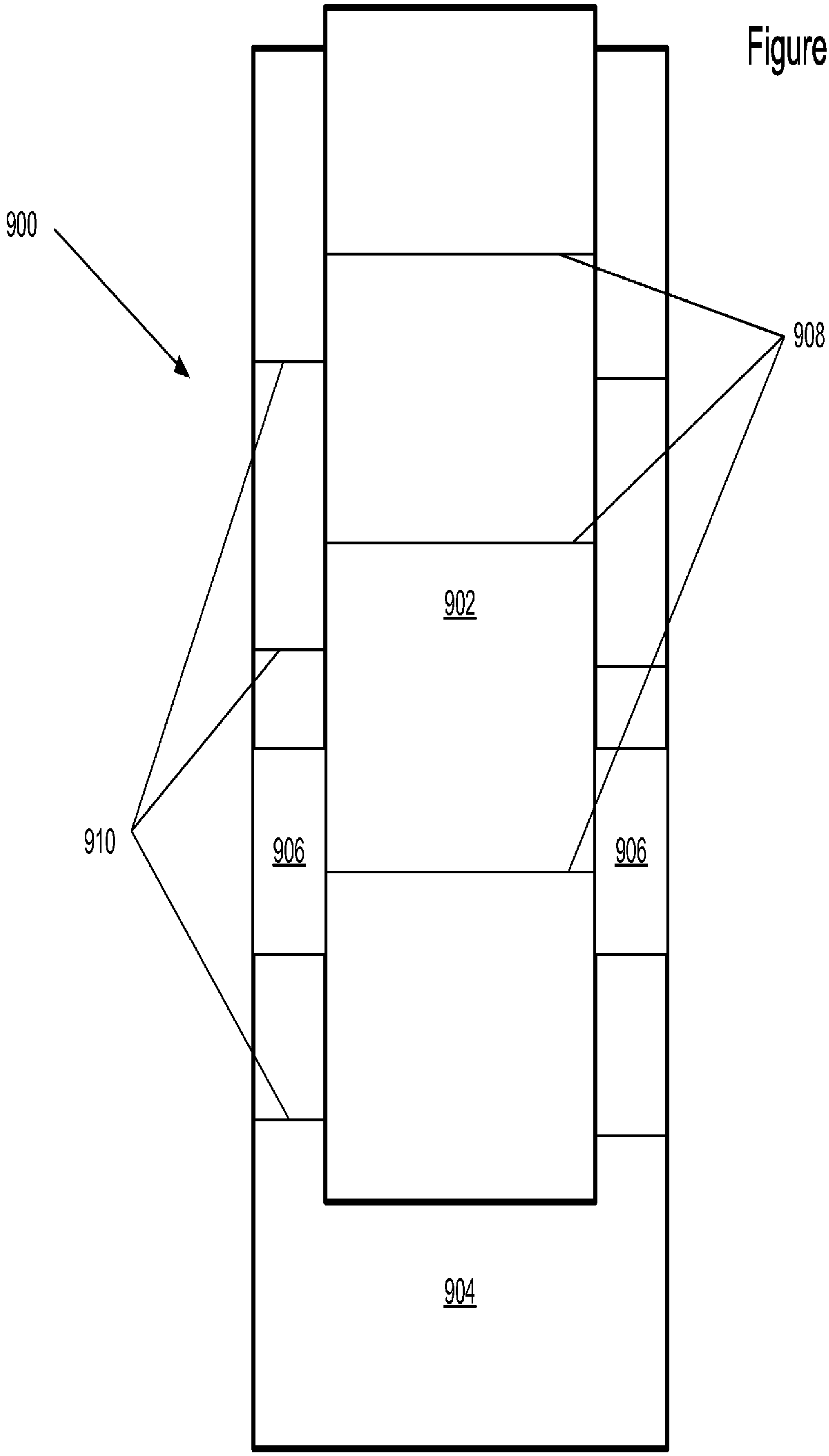

Figure 6