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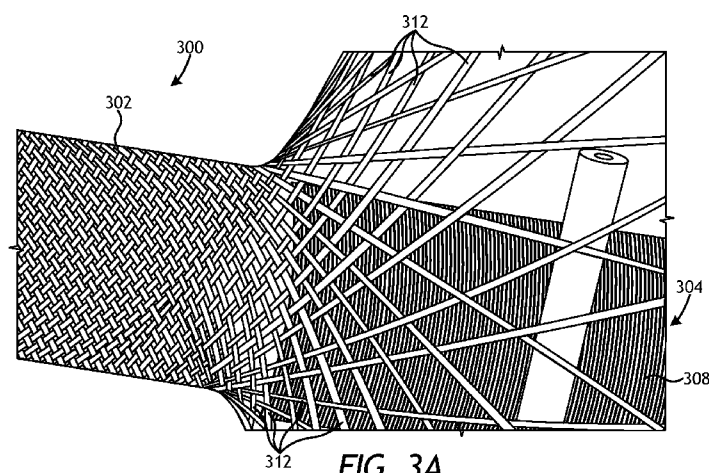


FIG. 3A

(57) Abstract: A sand control screen assembly includes a base pipe that defines an interior and one or more flow ports. A braided sand screen is disposed about the base pipe and is radially offset from the base pipe such that a production annulus is defined therebetween. The braided sand screen comprises a plurality of wires braided about the base pipe during manufacture.

BRAIDED SCREEN FOR DOWNHOLE SAND CONTROL SCREEN ASSEMBLIES

BACKGROUND

5 **[0001]** During hydrocarbon production from subsurface formations, efficient control of the movement of unconsolidated formation particles into the wellbore, such as sand, has always been a pressing concern. Such formation movement commonly occurs during production from completions in loose sandstone or following the hydraulic fracture of a formation. Formation
10 movement can also occur suddenly in the event a section of the wellbore collapses, thereby circulating significant amounts of particulates and fines within the wellbore. Production of these unwanted materials may cause numerous problems in the efficient extraction of oil and gas from subterranean formations. For example, producing formation particles may tend to plug the formation,
15 tubing, and subsurface flow lines. Producing formation particles may also result in the erosion of casing, downhole equipment, and surface equipment. These problems lead to high maintenance costs and unacceptable well downtime.

[0002] Numerous methods have been used to control the movement or production of these unconsolidated formation particles during production
20 operations. For example, one or more sand control screen assemblies are commonly included in the completion string to regulate and restrict the movement of formation particles. Such sand control screen assemblies are commonly constructed by installing one or more screen jackets on a perforated base pipe. The screen jackets typically include one or more drainage layers and
25 one or more sand screens disposed about the base pipe. The sand screens typically comprise wire wrapped screens or single or multilayer wire mesh screens.

[0003] Wire wrapped screens are fabricated by helically wrapping a wire filament about the base pipe and over a plurality of longitudinally extending ribs.
30 The wire wrapped screen is then welded at one or both ends to the base pipe for operation. Wire mesh screens commonly include a plurality of layers of a wire mesh that can be diffusion bonded or sintered together or otherwise tightly woven to form a fluid porous mesh screen in sheet form. The sheet is then subsequently wrapped around the base pipe over a plurality of longitudinally
35 extending ribs such that the ends overlap each other a short distance. An outer

shroud may then be placed over the wrapped mesh sheet to hold the mesh layer tight against the drainage layer or an inner shroud.

BRIEF DESCRIPTION OF THE DRAWINGS

5 **[0004]** The following figures are included to illustrate certain aspects of the present disclosure, and should not be viewed as exclusive embodiments. The subject matter disclosed is capable of considerable modifications, alterations, combinations, and equivalents in form and function, without departing from the scope of this disclosure.

10 **[0005]** FIG. 1 is a well system that may employ the principles of the present disclosure.

[0006] FIG. 2 is a cross-sectional side view of an exemplary sand control screen assembly.

[0007] FIGS. 3A and 3B are views of an exemplary sand control screen
15 assembly in the process of being fabricated.

DETAILED DESCRIPTION

[0008] The present disclosure is related to wellbore equipment used in operations undertaken in subterranean wells and, in particular, sand control
20 screen assemblies that include braided sand screens.

[0009] Embodiments disclosed herein provide a sand control screen assembly that includes a braided sand screen disposed about a base pipe and comprising a plurality of wires that are braided about the base pipe during manufacture. As opposed to conventional wire wrap and wire mesh sand
25 screens, the braided sand screens of the present disclosure may fit more tightly against the base pipe and is, therefore, more rigid. Moreover, the braid over the base pipe may have flexibility in varying the outer diameter of the base pipe and various rib configurations interposing the base pipe and the braided sand screen.

[0010] Referring to FIG. 1, illustrated is a well system 100 that may
30 employ the principles of the present disclosure, according to one or more embodiments of the disclosure. As depicted, the well system 100 includes a wellbore 102 that extends through various earth strata and has a substantially vertical section 104 extending to a substantially horizontal section 106. The upper portion of the vertical section 104 may have a casing string 108 cemented
35 therein, and the horizontal section 106 may extend through a hydrocarbon

bearing subterranean formation 110. In at least one embodiment, the horizontal section 106 may be arranged within or otherwise extend through an open hole section of the wellbore 102.

[0011] A tubing string 112 may be positioned within the wellbore 102 and extend from the surface (not shown). The tubing string 112 provides a conduit for fluids extracted from the formation 110 to travel to the surface. At its lower end, the tubing string 112 may be coupled to a completion string 114 arranged within the horizontal section 106. The completion string 114 serves to divide the completion interval into various production intervals adjacent the formation 110. As depicted, the completion string 114 may include a plurality of sand control screen assemblies 116 axially offset from each other along portions of the completion string 114. Each screen assembly 116 may be positioned between a pair of packers 118 that provides a fluid seal between the completion string 114 and the wellbore 102, and thereby defining corresponding production intervals.

[0012] In operation, the screen assemblies 116 serve the primary function of filtering particulate matter out of the production fluid stream such that particulates, debris, and other wellbore fines are not produced to the surface via the tubing string 112. To accomplish this, each screen assembly 116 may include one or more sand screens 120 (three shown in each interval). According to embodiments of the present disclosure, and as will be described in greater detail below, one or more of the sand screens 120 may comprise a braided screen filter positioned over and otherwise disposed about a base pipe. Contrary to conventional sand screens, which typically comprise helically wrapped or woven screens, the sand screens 120 described herein comprise a braided wire filter that is braided directly onto the base pipe during manufacture.

[0013] It should be noted that even though FIG. 1 depicts the screen assemblies 116 as being arranged in an open hole portion of the wellbore 102, embodiments are contemplated herein where one or more of the screen assemblies 116 is arranged within cased portions of the wellbore 102. Also, even though FIG. 1 depicts a single screen assembly 116 arranged in each production interval, it will be appreciated by those skilled in the art that any number of screen assemblies 116 may be deployed within a particular production interval without departing from the scope of the disclosure. In addition, even though FIG. 1 depicts multiple production intervals separated by

the packers 118, it will be understood by those skilled in the art that the completion interval may include any number of production intervals with a corresponding number of packers 118 arranged therein. In other embodiments, the packers 118 may be entirely omitted from the completion interval, without
5 departing from the scope of the disclosure.

[0014] While FIG. 1 depicts the screen assemblies 116 as being arranged in a generally horizontal section 106 of the wellbore 102, those skilled in the art will readily recognize that the screen assemblies 116 are equally well suited for use in wells having other directional configurations including vertical
10 wells, deviated wellbores, slanted wells, multilateral wells, combinations thereof, and the like. The use of directional terms such as above, below, upper, lower, upward, downward, left, right, uphole, downhole and the like are used in relation to the illustrative embodiments as they are depicted in the figures, the upward direction being toward the top of the corresponding figure and the downward
15 direction being toward the bottom of the corresponding figure, the uphole direction being toward the surface of the well and the downhole direction being toward the toe of the well.

[0015] Referring now to FIG. 2, with continued reference to FIG. 1, illustrated is a cross-sectional view of an exemplary sand control screen
20 assembly 200, according to one or more embodiments. The sand control screen assembly 200 may be the same as or similar to any of the screen assemblies 116 described in FIG. 1 and, therefore, may be used in the well system 100 depicted therein. The screen assembly 200 may include or otherwise be arranged about a base pipe 202 that defines one or more openings or flow ports
25 204 configured to provide fluid communication between the interior 206 of the base pipe 202 and an exterior of the screen assembly 200, such as the surrounding formation 110.

[0016] The screen assembly 200 may further include a braided sand screen 208 that is positioned about the exterior of the base pipe 202. The
30 braided sand screen 208 may be the same as or similar to any of the braided sand screens 120 of FIG. 1. In some embodiments, as illustrated, the braided sand screen 208 may extend between an upper end ring 210 arranged about the base pipe 202 at its uphole end and a lower end ring 212 arranged about the base pipe 202 at its downhole end. The upper and lower end rings 210, 212
35 provide a mechanical interface between the base pipe 202 and the opposing

ends of the braided sand screen 208. Each end ring 210, 212 may be formed from a metal, such as 13 chrome, 304L stainless steel, 316L stainless steel, 420 stainless steel, 410 stainless steel, INCOLOY® 825, iron, brass, copper, bronze, tungsten, titanium, cobalt, nickel, combinations thereof, or the like. Moreover, each end ring 210, 212 may be coupled or otherwise attached to the outer surface of base pipe 202 by being welded, brazed, threaded, mechanically fastened, combinations thereof, or the like. In other embodiments, however, one or both of the end rings 210, 212 may be omitted or otherwise form an integral part of the braided sand screen 208.

[0017] In one or more embodiments, the screen assembly 200 may further include a perforated shroud 216 (shown in dashed lines) disposed about the braided sand screen 208. The shroud 216 may be configured to protect the braided sand screen 208 while running the screen assembly 200 downhole. In other embodiments, however, the shroud 216 may be omitted or, in addition thereto, a protective layer or coating of material may be applied to the outer surface of the braided sand screen 208, as will be described in more detail below.

[0018] As illustrated, the braided sand screen 208 may be radially offset a short distance from the base pipe 202 such that a production annulus 214 is defined therebetween. In some embodiments, the production annulus 214 may be defined and otherwise provided by positioning a plurality of longitudinally-extending ribs (not shown) between the base pipe 202 and the braided sand screen 208 and braiding the braided sand screen 208 about the base pipe 202 on top of the ribs. In other embodiments, however, the production annulus 214 may be defined and otherwise provided by positioning a drainage layer (not shown) between the base pipe 202 and the braided sand screen 208. As generally known in the art, a drainage layer for sand screens may include, for example, a plurality of ribs (not shown) extending longitudinally along the length of the base pipe 202 and a wire wrapped screen or perforated shroud disposed about the longitudinal ribs. In such embodiments, the braided sand screen 208 may be disposed about the exterior of the drainage layer to radially offset the braided sand screen 208 from the base pipe 202.

[0019] In exemplary operation of the screen assembly 200, fluids from the surrounding formation 110 may be drawn into the production annulus 214 via the braided sand screen 208. The braided sand screen 208 may serve as a

filter medium designed to allow the fluid derived from the formation 110 to flow therethrough but substantially prevent the influx of particulate matter of a predetermined size. As indicated by the arrows, the fluid may flow into the production annulus 214 and subsequently locate the flow ports 204, which allow
5 the fluid to flow into the interior 206 of the base pipe 202 to be subsequently produced to the surface.

[0020] The braided sand screen 208 may comprise and otherwise be made of a plurality of filaments or wires 218 woven and otherwise braided about the circumference of the base pipe 202 during manufacture of the screen
10 assembly 200. In the illustrated embodiment, the wires 218 are depicted as exhibiting a generally circular cross-section. Using circular wires 218 may prove advantageous in generating predictable voids or gaps between adjacent braided wires 218 due to the circular wire contact space. As a result, an operator may be able to design the braided sand screen 208 with wires 218 of a particular size
15 such that it prevents particulates of a specific size from passing therethrough. Using circular wires 218 may further prove advantageous since it is more susceptible to bending due to its geometry (*e.g.*, moment of inertia), which may require less force to braid around the base pipe 202. In other embodiments, however, the cross-section of one or more of the wires 218 may be polygonal
20 (*e.g.*, triangular, square, rectangular, pentagonal, etc.), without departing from the scope of the disclosure.

[0021] The gauge (*e.g.*, diameter) of the wires 218 may depend on the material used to create the braided tubular structure, such as the flexibility of the particular material. Smaller gauge wires 218 may prove advantageous by
25 generating smaller gaps or holes at the braided interfaces between overlapping and/or interleaving wires 218, which may directly correspond to the size of particulates that the braided sand screen 208 is able to filter. Accordingly, in some embodiments, the gauge of the wires 218 may be selected based on the formation 110 and, more particularly, based on known particulate sizes present
30 in the formation 110. The gauge of the wires 218 may be as small as about 0.010 inches and as large as about 0.125 inches. In at least one embodiment, the gauge of one or more of the wires 218 may be about 0.0625 inches. It will be appreciated, however, that the gauge of the wires 218 may be less than 0.010 inches and greater than 0.125 inches, without departing from the scope of
35 the disclosure, and may vary between specific applications. Moreover, in some

embodiments, one or more wires 218 may exhibit a first gauge, while one or more other wires may exhibit a second gauge different from the first gauge.

[0022] The wires 218 may be made of a variety of durable materials suitable for use in downhole conditions. In at least one embodiment, the wires 218 may comprise a stainless steel, such as 316L, INCOLOY® alloy 825R, INCOLOY® alloy 25-6MO, INCOLOY® alloy 27-7MO, or INCONEL® alloy 304. In some embodiments, the wires 218 may comprise two or more materials, such as any erosion-resistant material.

[0023] In some embodiments, one or more of the wires 218 may be made of a galvanically-corrodible or dissolvable metal. In such embodiments, once the galvanically-corrodible or dissolvable metal wire 218 degrades or dissolves, the braided sand screen 208 may exhibit a known or predetermined flow rate through the remaining braided wires 218. The galvanically-corrodible metal may be configured to degrade via an electrochemical process in which the galvanically-corrodible metal corrodes in the presence of an electrolyte (e.g., brine or other salt-containing fluids present within a wellbore). Degradation by dissolving involves a degradable material that is soluble or otherwise susceptible to degradation upon contact with an aqueous or hydrocarbon fluid.

[0024] Suitable galvanically-corrodible metals include, but are not limited to, magnesium alloys, aluminum alloys, zinc alloys, and iron alloys. The rate of galvanic corrosion can be accelerated by alloying these alloys with a dopant. Suitable dopants to accelerate the corrosion rate include, but are not limited to, gold, gold-platinum alloys, silver, nickel, nickel-copper alloys, nickel-chromium alloys, copper, copper alloys (e.g., brass, bronze, etc.), chromium, tin, aluminum, iron, zinc, and beryllium. As the foregoing materials can be alloyed together or alloyed with other materials to control their rates of corrosion. Suitable galvanically-corrodible metals also include micro-galvanic metals or materials, such as nano-structured matrix galvanic materials. One example of a nano-structured matrix micro-galvanic material is a magnesium alloy with iron-coated inclusions.

[0025] Suitable galvanically-corrodible metals also include micro-galvanic metals or materials, such as a solution-structured galvanic material. An example of a solution-structured galvanic material is zirconium (Zr) containing a magnesium (Mg) alloy, where different domains within the alloy contain different percentages of Zr. This leads to a galvanic coupling between these different

domains, which causes micro-galvanic corrosion and degradation. Micro-galvanically corrodible Mg alloys could also be solution structured with other elements such as zinc, aluminum, nickel, iron, calcium, carbon, tin, silver, palladium, copper, titanium, rare earth elements, etc. Micro-galvanically-corrodible aluminum alloys could be in solution with elements such as nickel, iron, calcium, carbon, tin, silver, copper, titanium, gallium, etc.

[0026] Suitable dissolvable metals may comprise metals that dissolve in the wellbore fluid or the wellbore environment. For example, metal alloys with high composition in aluminum, magnesium, zinc, silver, or copper may be prone to dissolution in a wellbore environment. The degradable material may comprise dissimilar metals that generate a galvanic coupling that either accelerates or decelerates the degradation or dissolution rate of the wire 218. As will be appreciated, such embodiments may depend on where the dissimilar metals lie on the galvanic potential. In at least one embodiment, a galvanic coupling may be generated by embedding a cathodic substance or piece of material into an anodic structural element. For instance, the galvanic coupling may be generated by dissolving aluminum in gallium. A galvanic coupling may also be generated by using a sacrificial anode coupled to the degradable material. In such embodiments, the degradation rate of the degradable material may be decelerated until the sacrificial anode is dissolved or otherwise corroded away. In at least one embodiment, one or more of the wires 218 may comprise an aluminum-gallium alloy configured to dissolve in the wellbore environment.

[0027] In some embodiments, all or a portion of the braided sand screen 208 may be coated with a degradable material configured to degrade and otherwise dissolve at a predetermined time or in the presence of a known chemical or environment. As used herein, the term "degradable" and all of its grammatical variants (*e.g.*, "degrade," "degradation," "degrading," "dissolve," "dissolving," and the like) refers to the dissolution or chemical conversion of solid materials such that a reduced-mass solid end product results from at least one of solubilization, hydrolytic degradation, biologically formed entities (*e.g.*, bacteria or enzymes), chemical reactions (including electrochemical and galvanic reactions), thermal reactions, or reactions induced by radiation. In complete degradation, no solid end products result. In some instances, the degradation of the material may be sufficient for the mechanical properties of the material to be

reduced to a point that the material no longer maintains its integrity and, in essence, falls apart or sloughs off to its surroundings.

[0028] The conditions for degradation are generally wellbore conditions where an external stimulus may be used to initiate or effect the rate of degradation. For example, the pH of the fluid that interacts with the material may be changed by introduction of an acid or a base. The term "wellbore environment" includes both naturally occurring wellbore environments and materials or fluids introduced into the wellbore. Degradation of the degradable materials identified herein may be accelerated, rapid, or normal, degrading anywhere from about 30 minutes to about 40 days from first contact with the appropriate wellbore environment or stimulant.

[0029] Coating all or a portion of the braided sand screen 208 with a degradable material may prove advantageous in protecting the braided sand screen 208 while it is being run downhole, and also in preventing wellbore fluids from entering the braided sand screen 208 until a predetermined time. Once the degradable material degrades or otherwise dissolves, fluids from the surrounding environment may freely pass through the braided sand screen 208. Suitable degradable materials that may be used to coat the outer surface of the braided sand screen 208 include borate glass, degradable polymers (e.g., polyglycolic acid (PGA), polylactic acid (PLA), etc.), degradable rubbers, dehydrated salts, and any combination thereof. The degradable materials may be configured to degrade by a number of mechanisms including, but not limited to, swelling, dissolving, undergoing a chemical change, electrochemical reactions, undergoing thermal degradation, or any combination of the foregoing.

[0030] Suitable degradable plastics or polymers may include, but are not limited to, polyglycolic acid (PGA) and polylactic acid (PLA), and thiol-based plastics. A polymer is considered to be "degradable" if the degradation is due to, *in situ*, a chemical and/or radical process such as hydrolysis, oxidation, or UV radiation. Degradable polymers, which may be either natural or synthetic polymers, include, but are not limited to, polyacrylics, polyamides, and polyolefins such as polyethylene, polypropylene, polyisobutylene, and polystyrene. Suitable examples of degradable polymers that may be used in accordance with the embodiments of the present invention include polysaccharides such as dextran or cellulose, chitins, chitosans, proteins, aliphatic polyesters, poly(lactides), poly(glycolides), poly(ϵ -caprolactones),

poly(hydroxybutyrates), poly(anhydrides), aliphatic or aromatic polycarbonates, poly(orthoesters), poly(amino acids), poly(ethylene oxides), polyphosphazenes, poly(phenylactides), polyepichlorohydrins, copolymers of ethylene oxide/polyepichlorohydrin, terpolymers of epichlorohydrin/ethylene oxide/allyl glycidyl ether, and any combination thereof. Of these degradable polymers, as mentioned above, PGA and PLA may be preferred. Polyglycolic acid and polylactic acid tend to degrade by hydrolysis as the temperature increases.

[0031] Polyanhydrides are another type of particularly suitable degradable polymer useful in the embodiments of the present disclosure. Polyanhydride hydrolysis proceeds, *in situ*, via free carboxylic acid chain-ends to yield carboxylic acids as final degradation products. The degradation time can be varied over a broad range with changes in the polymer backbone. Examples of suitable polyanhydrides include poly(adipic anhydride), poly(suberic anhydride), poly(sebacic anhydride), and poly(dodecanedioic anhydride). Other suitable examples include, but are not limited to, poly(maleic anhydride) and poly(benzoic anhydride).

[0032] Suitable degradable rubbers include degradable natural rubbers (*i.e.*, cis-1,4-polyisoprene) and degradable synthetic rubbers, which may include, but are not limited to, ethylene propylene diene M-class rubber, isoprene rubber, isobutylene rubber, polyisobutene rubber, styrene-butadiene rubber, silicone rubber, ethylene propylene rubber, butyl rubber, norbornene rubber, polynorbornene rubber, a block polymer of styrene, a block polymer of styrene and butadiene, a block polymer of styrene and isoprene, and any combination thereof. Other suitable degradable polymers include those that have a melting point that is such that it will dissolve at the temperature of the subterranean formation in which it is placed.

[0033] In some embodiments, the degradable material may have a thermoplastic polymer embedded therein. The thermoplastic polymer may modify the strength, resiliency, or modulus of the component and may also control the degradation rate of the component. Suitable thermoplastic polymers may include, but are not limited to, an acrylate (*e.g.*, polymethylmethacrylate, polyoxymethylene, a polyamide, a polyolefin, an aliphatic polyamide, polybutylene terephthalate, polyethylene terephthalate, polycarbonate, polyester, polyethylene, polyetheretherketone, polypropylene, polystyrene, polyvinylidene chloride, styrene-acrylonitrile), polyurethane prepolymer,

polystyrene, poly(o- methylstyrene), poly(m-methylstyrene), poly(p-methylstyrene), poly(2,4-dimethylstyrene), poly(2,5-dimethylstyrene), poly(p-tert-butylstyrene), poly(p- chlorostyrene), poly(a-methylstyrene), co- and ter-polymers of polystyrene, acrylic resin, cellulosic resin, polyvinyl toluene, and any
5 combination thereof. Each of the foregoing may further comprise acrylonitrile, vinyl toluene, or methyl methacrylate. The amount of thermoplastic polymer that may be embedded in the degradable material forming the component may be any amount that confers a desirable elasticity without affecting the desired amount of degradation.

10 **[0034]** Referring now to FIGS. 3A and 3B, illustrated are views of an exemplary sand control screen assembly 300 in the process of being fabricated, according to one or more embodiments. Similar to the sand control screen assembly 200 of FIG. 2, the sand control screen assembly 300 may be the same as or similar to any of the screen assemblies 116 described in FIG. 1 and,
15 therefore, may be used in the exemplary well system 100 depicted therein. As illustrated, the screen assembly 300 may include a braided sand screen 302 that is in the process of being braided about the exterior of a base pipe 304. The braided sand screen 302 and the base pipe 304 may be the same as or similar to the braided sand screen 208 and base pipe 202, respectively, of FIG. 2 and
20 therefore will not be described again in detail.

[0035] FIG. 3A shows an enlarged view of the braided sand screen 302 as it is being braided onto the exterior of the base pipe 304. In the illustrated embodiment, a drainage layer 308 is depicted as being positioned about the base pipe 304 and otherwise interposing the base pipe 304 and the braided sand
25 screen 302. As indicated above, the drainage layer 308 may prove advantageous in providing a radial offset between the base pipe 304 and the braided sand screen 302 and otherwise defining the production annulus 214 (FIG. 2). In other embodiments, however, the drainage layer 308 may be replaced with a plurality of longitudinally-extending ribs that may equally help
30 defining the production annulus 214.

[0036] FIG. 3B depicts a wire braiding machine 306 that may be used to braid the braided sand screen 302 directly onto the base pipe 304 during manufacture. The wire braiding machine 306 is shown merely as an example of one machine that may be used to generate the braided sand screen 302. Those
35 skilled in the art will readily appreciate that several other types, designs, and

configurations of the wire braiding machine 306 may alternatively be used, without departing from the scope of the disclosure.

[0037] As illustrated, the wire braiding machine 306 may include a plurality of spindles 310, each having wire 312 wrapped thereon to be deployed
5 and subsequently braided into a tubular braid (*i.e.*, the braided sand screen 302) by the wire braiding machine 306. The wires 312 may be the same as or similar to the wires 218 of FIG. 2. As will be understood by those of skill in the art, a tubular braid generally comprises an equal number of wires 312 wound in the clockwise and counter-clockwise helical directions. Accordingly, as the base pipe
10 304 moves through the center of the wire braiding machine 306, the circumferentially adjacent spindles 310 may be configured to cyclically rotate with respect to one another to gradually generate a tubular braided output directly on the base pipe 304.

[0038] It should be noted that while a specific number of spindles 310
15 are depicted in FIG. 3B, the wire braiding machine 306 may alternatively comprise any number of spindles 310 required to create the braided sand screen 302 to desired specifications. Moreover, the gauge of the wires 312 may be increased or decreased to adjust the size of the gaps, voids, or holes between adjacent braided wires 312 in the braided sand screen 302. Accordingly, a
20 manufacturer may be able to intelligently optimize operation of the braided sand screen 302 by selecting a predetermined number of wires 312 and/or a predetermined size of each wire 312, and thereby dictate the size of particulate material that the braided sand screen 302 may be configured to filter.

[0039] In some embodiments, the wire braiding machine 306 may be
25 configured to generate a "standard weave" braid where one wire 312 crosses over and another wire 312 crosses under. In other embodiments, the wire braiding machine 306 may be configured to generate a derivative "basket weave" where multiple wires 312 cross over and an equal number of wires 312 cross under. It will be readily appreciated, however, that the wire braiding
30 machine 306 may be configured to generate any type of tubular braid or weave, without departing from the scope of the disclosure, as long as the resulting braided sand screen 302 is sequentially braided directly about the exterior of the base pipe 304 during manufacture.

[0040] Since the wire braiding machine 306 may be fully automated,
35 the braiding process to create the braided sand screen 302 may be less time

consuming than fabricating a wire wrap screen (*i.e.*, a direct wrap screen), which may equate to cost savings during manufacture. The braiding process may also be more precise, which may also aid in reducing manufacturing costs and time. Moreover, using wires 312 that exhibit a circular-cross-sectional shape, as
5 opposed to triangular wires typically used in wire wrap screens, may save on costs since circular wire is less expensive than triangular wire.

[0041] Embodiments disclosed herein include:

[0042] A. A sand control screen assembly that includes a base pipe that defines an interior and one or more flow ports, and a braided sand screen
10 disposed about the base pipe and radially offset from the base pipe such that a production annulus is defined therebetween, wherein the braided sand screen comprises a plurality of wires braided about the base pipe during manufacture.

[0043] B. A method that includes introducing a sand control screen assembly into a wellbore adjacent a formation penetrated by the wellbore, the
15 sand control screen assembly having a base pipe and a braided sand screen disposed about the base pipe and radially offset therefrom such that a production annulus is defined between the base pipe and the braided sand screen, drawing a fluid from the formation and into the production annulus via the braided sand screen, wherein the braided sand screen comprises a plurality
20 of wires braided about the base pipe during manufacture of the sand control screen assembly, and flowing the fluid into an interior of the base pipe via one or more flow ports defined in the base pipe.

[0044] C. A method of manufacturing that includes moving a base pipe of a sand control screen assembly longitudinally through a center of a wire
25 braiding machine that provides a plurality of spindles, wherein each spindle includes wire wrapped thereon and the base pipe defines one or more flow ports, deploying the wire from each spindle as the plurality of spindles cyclically rotate, and braiding the wire from each spindle about the base pipe as the base pipe moves longitudinally with respect to the wire braiding machine and thereby
30 generating a braided sand screen positioned about the base pipe.

[0045] Each of embodiments A, B, and C may have one or more of the following additional elements in any combination: Element 1: further comprising a perforated shroud disposed about the braided sand screen. Element 2:
35 wherein the production annulus is provided by positioning a plurality of longitudinally-extending ribs between the base pipe and the braided sand screen

and the braided sand screen is braided about the base pipe on top of the plurality of longitudinally-extending ribs. Element 3: wherein the production annulus is provided by positioning a drainage layer between the base pipe and the braided sand screen and the braided sand screen is braided about the base pipe on top of the drainage layer. Element 4: wherein at least one of the plurality of wires exhibits a circular cross-section. Element 5: wherein at least one of the plurality of wires exhibits a polygonal cross-section. Element 6: wherein a first wire of the plurality of wires exhibits a first gauge and a second wire of the plurality of wires exhibits a second gauge different from the first gauge. Element 7: wherein the plurality of wires comprises stainless steel. Element 8: wherein at least one wire of the plurality of wires comprises a galvanically-corrodible or dissolvable metal. Element 9: further comprising a degradable material applied to all or a portion of the braided sand screen. Element 10: wherein the degradable material comprises a material selected from the group consisting of borate glass, a degradable polymer, a degradable rubber, a dehydrated salt, and any combination thereof.

[0046] Element 11: wherein the sand control screen assembly further includes a perforated shroud disposed about the braided sand screen, the method further comprising flowing the fluid through the perforated shroud. Element 12: wherein at least one wire of the plurality of wires comprises a galvanically-corrodible or dissolvable metal, the method further comprising degrading the at least one wire upon subjecting the at least one wire to a wellbore environment. Element 13: wherein the sand control screen assembly further includes a degradable material applied to all or a portion of the braided sand screen, the method further comprising degrading the degradable material upon subjecting the degradable material to a wellbore environment.

[0047] Element 14: wherein a plurality of longitudinally-extending ribs interposes the base pipe and the braided sand screen, and wherein braiding the wire from each spindle about the base pipe comprises braiding the wire from each spindle directly onto the plurality of longitudinally-extending ribs, and forming a production annulus between the base pipe and the braided sand screen. Element 15: wherein a drainage layer interposes the base pipe and the braided sand screen, and wherein braiding the wire from each spindle about the base pipe comprises braiding the wire from each spindle directly onto the drainage layer, and forming a production annulus between the base pipe and the

braided sand screen. Element 16: wherein at least one wire of the plurality of spindles comprises a galvanically-corrodible or dissolvable metal. Element 17: further comprising applying a degradable material applied to all or a portion of the braided sand screen, wherein the degradable material comprises a material
5 selected from the group consisting of borate glass, a degradable polymer, a degradable rubber, a dehydrated salt, and any combination thereof.

[0048] By way of non-limiting example, exemplary combinations applicable to A, B, and C include: Element 9 with Element 10.

[0049] Therefore, the disclosed systems and methods are well adapted
10 to attain the ends and advantages mentioned as well as those that are inherent therein. The particular embodiments disclosed above are illustrative only, as the teachings of the present disclosure may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of
15 construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular illustrative embodiments disclosed above may be altered, combined, or modified and all such variations are considered within the scope of the present disclosure. The systems and methods illustratively disclosed herein may suitably be practiced in the absence
20 of any element that is not specifically disclosed herein and/or any optional element disclosed herein. While compositions and methods are described in terms of "comprising," "containing," or "including" various components or steps, the compositions and methods can also "consist essentially of" or "consist of" the various components and steps. All numbers and ranges disclosed above may
25 vary by some amount. Whenever a numerical range with a lower limit and an upper limit is disclosed, any number and any included range falling within the range is specifically disclosed. In particular, every range of values (of the form, "from about a to about b," or, equivalently, "from approximately a to b," or, equivalently, "from approximately a-b") disclosed herein is to be understood to
30 set forth every number and range encompassed within the broader range of values. Also, the terms in the claims have their plain, ordinary meaning unless otherwise explicitly and clearly defined by the patentee. Moreover, the indefinite articles "a" or "an," as used in the claims, are defined herein to mean one or more than one of the elements that it introduces. If there is any conflict in the
35 usages of a word or term in this specification and one or more patent or other

documents that may be incorporated herein by reference, the definitions that are consistent with this specification should be adopted.

[0050] As used herein, the phrase "at least one of" preceding a series of items, with the terms "and" or "or" to separate any of the items, modifies the list as a whole, rather than each member of the list (*i.e.*, each item). The phrase "at least one of" allows a meaning that includes at least one of any one of the items, and/or at least one of any combination of the items, and/or at least one of each of the items. By way of example, the phrases "at least one of A, B, and C" or "at least one of A, B, or C" each refer to only A, only B, or only C; any combination of A, B, and C; and/or at least one of each of A, B, and C.

CLAIMS

What is claimed is:

1. A sand control screen assembly, comprising:
a base pipe that defines an interior and one or more flow ports; and
a braided sand screen disposed about the base pipe and radially offset from the base pipe such that a production annulus is defined therebetween, wherein the braided sand screen comprises a plurality of wires braided about the base pipe during manufacture.
2. The sand control screen assembly of claim 1, further comprising a perforated shroud disposed about the braided sand screen.
3. The sand control screen assembly of claim 1, wherein the production annulus is provided by positioning a plurality of longitudinally-extending ribs between the base pipe and the braided sand screen and the braided sand screen is braided about the base pipe on top of the plurality of longitudinally-extending ribs.
4. The sand control screen assembly of claim 1, wherein the production annulus is provided by positioning a drainage layer between the base pipe and the braided sand screen and the braided sand screen is braided about the base pipe on top of the drainage layer.
5. The sand control screen assembly of claim 1, wherein at least one of the plurality of wires exhibits a circular cross-section.
6. The sand control screen assembly of claim 1, wherein at least one of the plurality of wires exhibits a polygonal cross-section.
7. The sand control screen assembly of claim 1, wherein a first wire of the plurality of wires exhibits a first gauge and a second wire of the plurality of wires exhibits a second gauge different from the first gauge.
8. The sand control screen assembly of claim 1, wherein the plurality of wires comprises stainless steel.
9. The sand control screen assembly of claim 1, wherein at least one wire of the plurality of wires comprises a galvanically-corrodible or dissolvable metal.
10. The sand control screen assembly of claim 1, further comprising a degradable material applied to all or a portion of the braided sand screen.
11. The sand control screen assembly of claim 10, wherein the degradable material comprises a material selected from the group consisting of

borate glass, a degradable polymer, a degradable rubber, a dehydrated salt, and any combination thereof.

12. A method, comprising:

introducing a sand control screen assembly into a wellbore adjacent a formation penetrated by the wellbore, the sand control screen assembly having a base pipe and a braided sand screen disposed about the base pipe and radially offset therefrom such that a production annulus is defined between the base pipe and the braided sand screen;

drawing a fluid from the formation and into the production annulus via the braided sand screen, wherein the braided sand screen comprises a plurality of wires braided about the base pipe during manufacture of the sand control screen assembly; and

flowing the fluid into an interior of the base pipe via one or more flow ports defined in the base pipe.

13. The method of claim 12, wherein the sand control screen assembly further includes a perforated shroud disposed about the braided sand screen, the method further comprising flowing the fluid through the perforated shroud.

14. The method of claim 12, wherein at least one wire of the plurality of wires comprises a galvanically-corrodible or dissolvable metal, the method further comprising degrading the at least one wire upon subjecting the at least one wire to a wellbore environment.

15. The method of claim 12, wherein the sand control screen assembly further includes a degradable material applied to all or a portion of the braided sand screen, the method further comprising degrading the degradable material upon subjecting the degradable material to a wellbore environment.

16. A method of manufacturing, comprising:

moving a base pipe of a sand control screen assembly longitudinally through a center of a wire braiding machine that provides a plurality of spindles, wherein each spindle includes wire wrapped thereon and the base pipe defines one or more flow ports;

deploying the wire from each spindle as the plurality of spindles cyclically rotate; and

braiding the wire from each spindle about the base pipe as the base pipe moves longitudinally with respect to the wire braiding machine and thereby generating a braided sand screen positioned about the base pipe.

17. The method of claim 16, wherein a plurality of longitudinally-extending ribs interposes the base pipe and the braided sand screen, and wherein braiding the wire from each spindle about the base pipe comprises:

braiding the wire from each spindle directly onto the plurality of longitudinally-extending ribs; and

forming a production annulus between the base pipe and the braided sand screen.

18. The method of claim 16, wherein a drainage layer interposes the base pipe and the braided sand screen, and wherein braiding the wire from each spindle about the base pipe comprises:

braiding the wire from each spindle directly onto the drainage layer; and

forming a production annulus between the base pipe and the braided sand screen.

19. The method of claim 16, wherein at least one wire of the plurality of spindles comprises a galvanically-corrodible or dissolvable metal.

20. The method of claim 16, further comprising applying a degradable material applied to all or a portion of the braided sand screen, wherein the degradable material comprises a material selected from the group consisting of borate glass, a degradable polymer, a degradable rubber, a dehydrated salt, and any combination thereof.

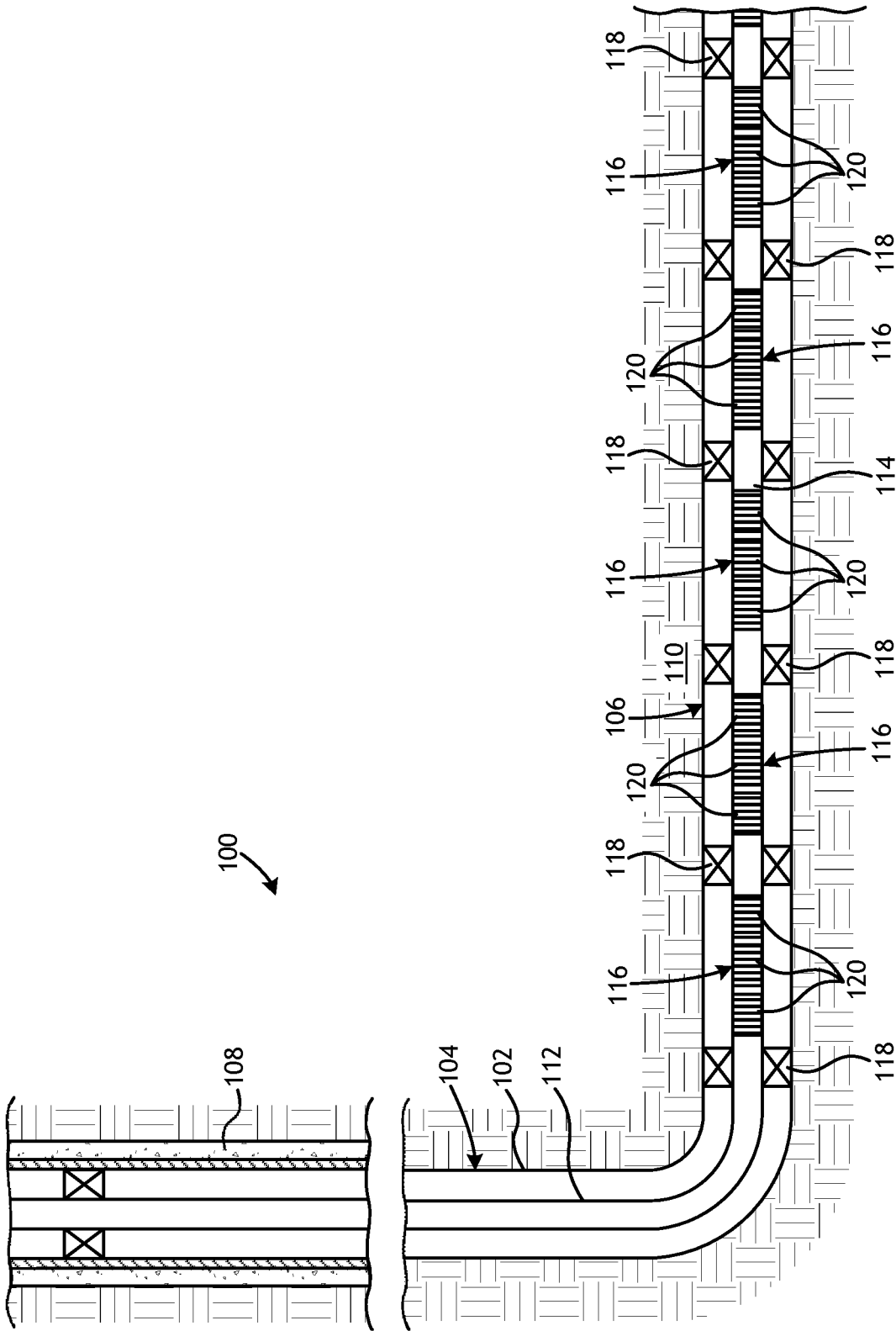


FIG. 1

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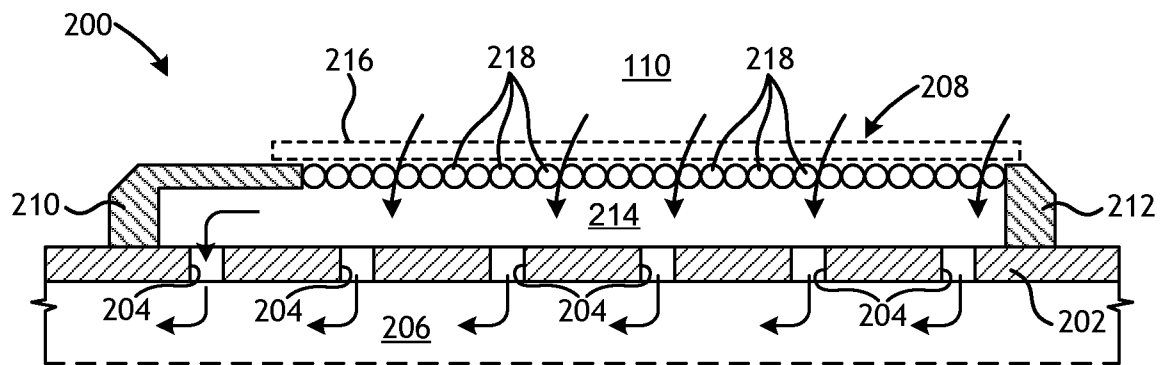


FIG. 2

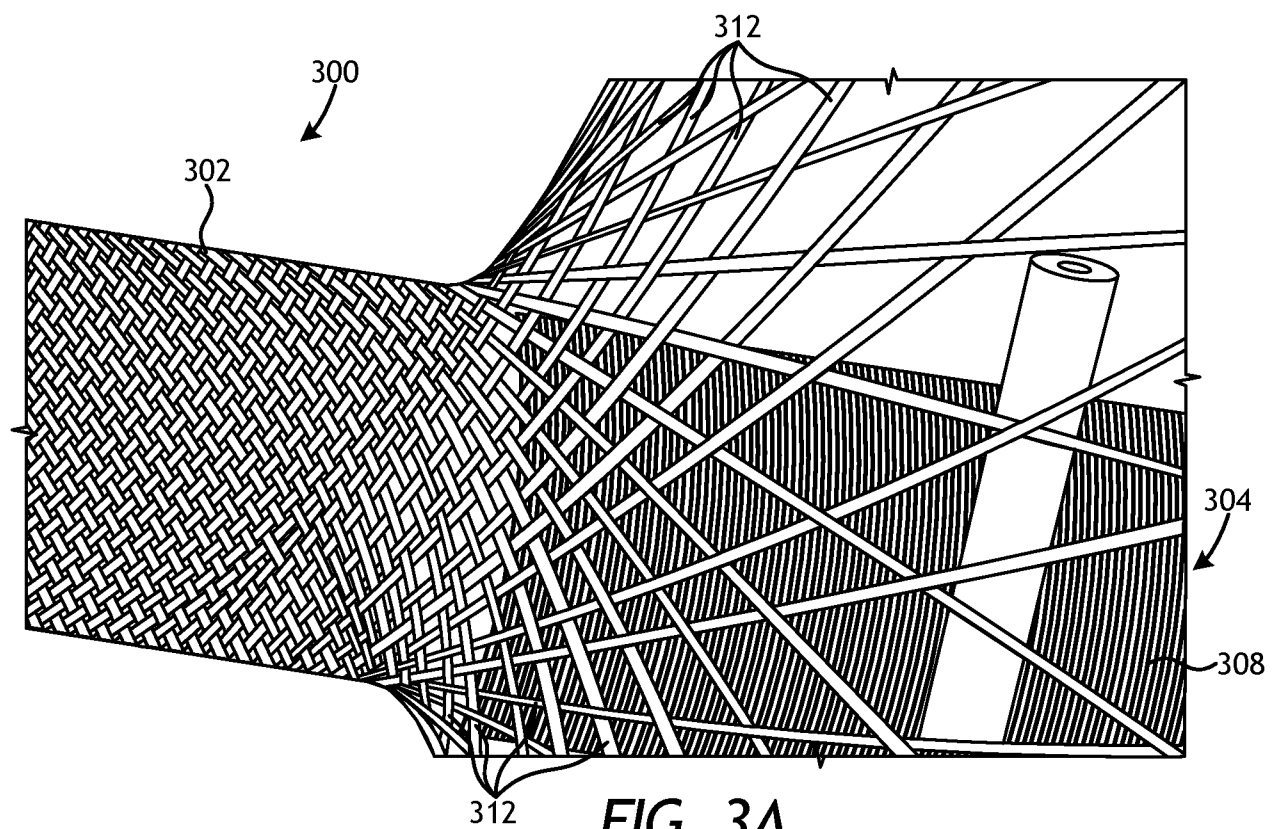


FIG. 3A

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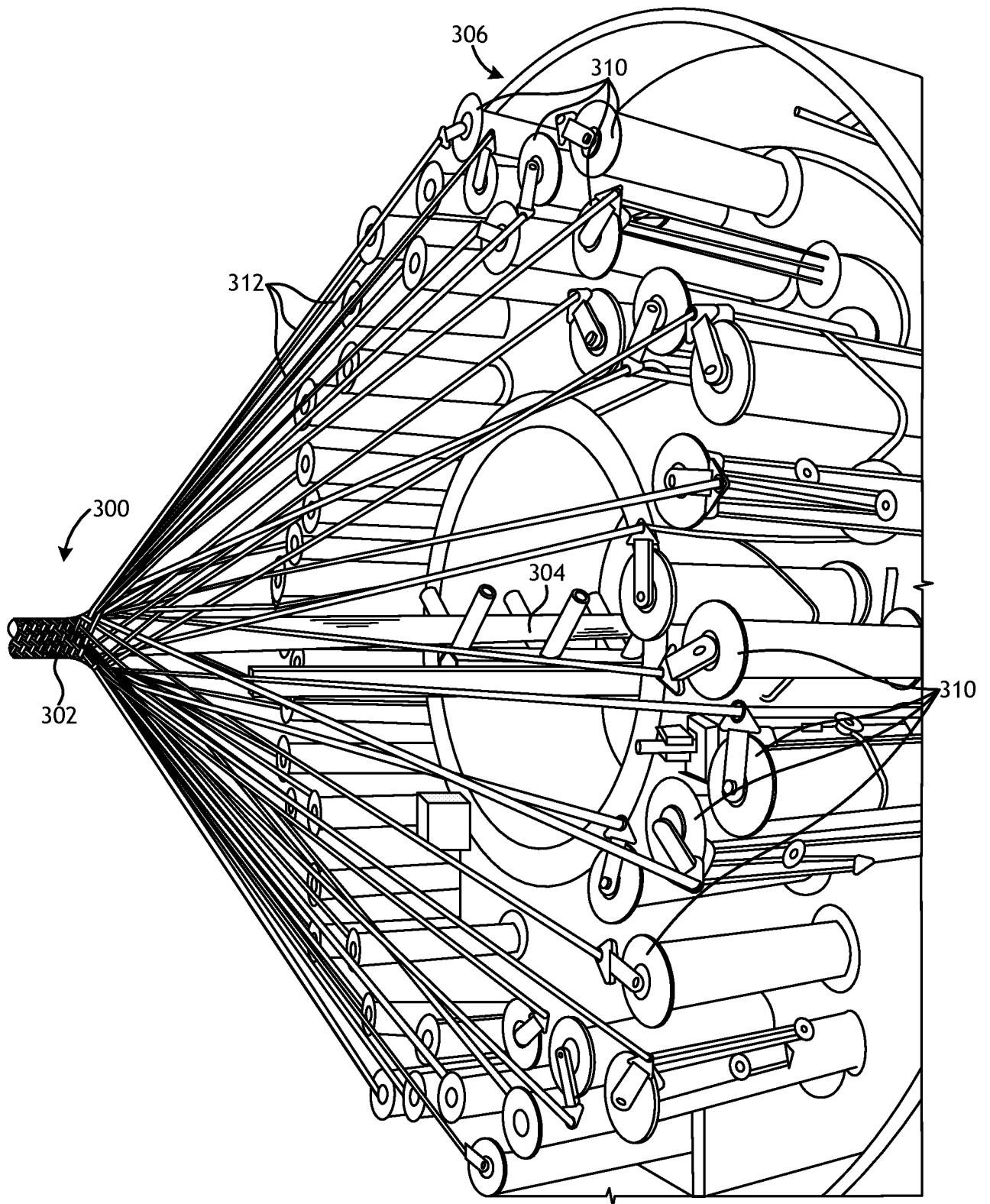


FIG. 3B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/031485**A. CLASSIFICATION OF SUBJECT MATTER****E21B 43/02(2006.01)i, E21B 43/08(2006.01)i, E21B 17/00(2006.01)i**

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 43/02; E03B 3/18; D04C 3/06; E21B 43/04; C09K 8/68; D04C 3/22; E21B 43/08; E21B 17/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: wellbore, braided sand control screen, base pipe, opening, degradable, spindle and coating

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012-0152528 A1 (GRECI, STEPHEN MICHAEL) 21 June 2012 See paragraphs [0023]-[0031], claim 1 and figures 1-2.	1-20
Y	US 2004-0144535 A1 (KALMAN et al.) 29 July 2004 See paragraphs [0016]-[0025], [0044] and figure 1.	1-20
Y	US 2014-0274820 A1 (WANN, STEVEN R.) 18 September 2014 See paragraphs [0062]-[0065].	9-11, 14-15, 19-20
Y	US 4304169 A (CIMPRICH et al.) 08 December 1981 See column 3, lines 33-36, column 4, lines 37-49 and figures 1-3	16-20
A	US 2005-0126779 A1 (ARTERBURY, BRYANT ALAN) 16 June 2005 See paragraphs [0009]-[0011] and figures 1-7.	1-20

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

06 January 2016 (06.01.2016)

Date of mailing of the international search report

08 January 2016 (08.01.2016)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/031485

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