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(54) Title: WELL DEPLOYED HEAT FIN FOR ESP MOTOR

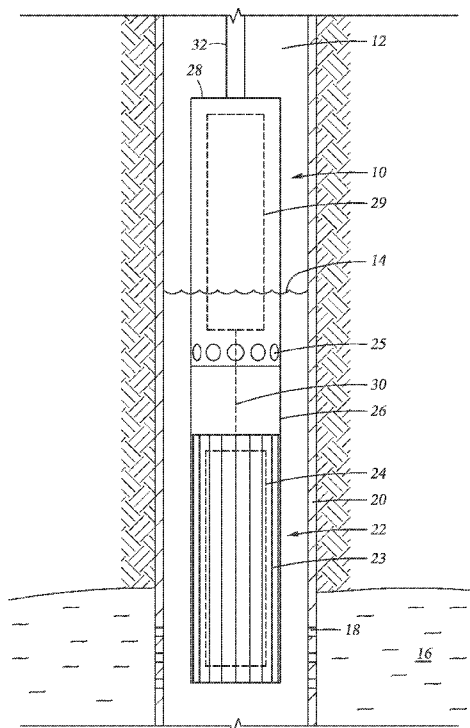


Fig. 1

(57) Abstract: An electrical submersible pumping system (ESP) for use in pumping fluids from a wellbore. The ESP includes fins on an outer portion of the ESP that transfer heat from a motor in the ESP to fluid flowing past the fins. A self removing material is provided over the fins when the ESP is deployed into the wellbore to protect the fins against being damaged when the ESP contacts a wall of the wellbore. The material can corrode, erode, melt, dissolve, disintegrate, or otherwise automatically decouple from the fins when the ESP is disposed in the wellbore.



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WELL DEPLOYED HEAT FIN FOR ESP MOTOR

BACKGROUND

1. Field of Invention

[0001] The present disclosure relates to electrical submersible pumping (ESP) systems submersible in well bore fluids. More specifically, the present disclosure concerns a method of protecting motor cooling fins during deployment of an ESP.

2. Description of Prior Art

[0002] Submersible pumping systems are often used in hydrocarbon producing wells for pumping fluids from within the well bore to the surface. These fluids are generally liquids and include produced liquid hydrocarbon as well as water. One type of system used in this application employs an electrical submersible pump (ESP). ESP's are typically disposed at the end of a length of production tubing and have an electrically powered motor. Often, electrical power may be supplied to the pump motor via an electrical cable. Typically, the pumping unit is disposed within the well bore above where perforations are made into a hydrocarbon producing zone. This placement thereby allows the produced fluids to flow past the outer surface of the pumping motor and provide a cooling effect. The motor may become overheated without the cooling effect by the transfer of heat. The prospect of overheating, even while heat is being transferred to fluid flowing adjacent the motor, limits the pumping ability of an ESP.

SUMMARY OF INVENTION

[0003] The present disclosure describes an electrical submersible pumping system (ESP) with an improved cooling system and a method of cooling an ESP. In an example embodiment, disclosed is a method of cooling an ESP that involves adding fins to an outer surface of the ESP. The fins are shielded from damage by covering or potting them with a protective layer(s) that is removed after the ESP is deployed within a wellbore. While the ESP is being lowered downhole

and inadvertently contacts a wall of the wellbore, the protective layer(s) safeguards the fins from damage. In an example embodiment, the potting or shielding material disintegrates when disposed in a wellbore and the fins conduct heat from within the ESP to fluid in the wellbore. The material can be made from wax, aluminum, zinc, beryllium, magnesium, alloys thereof, and combinations thereof. Optionally, the covering can be a protective packing encapsulated with an outer layer. Where in this example, the protective packing can be particulate material, sand, plaster, wax, and combinations thereof and the outer layer can be aluminum, zinc, beryllium, magnesium, alloys thereof, or combinations thereof. In an example embodiment, the fins are disposed on a motor section of the ESP that contains a motor for driving a pump in the ESP. After deploying the ESP with the protected fins, the motor can be started to drive the pump, and fluid can be pumped from the wellbore into production tubing attached to the pump.

[0004] Also disclosed herein is an electrical submersible pumping system (ESP) that in one example embodiment includes a motor section having a motor, a seal section in pressure communication with the motor, a pump section having a pump coupled with the motor, fins on an outer surface of the motor section, and a cover over the fins for shielding the fins from damage as the ESP is lowered into a wellbore. The cover is made from a material that detaches from the fins when the ESP is disposed in a designated location in the wellbore. In one example embodiment the cover is made of wax, aluminum, zinc, beryllium, magnesium, alloys thereof, or combinations thereof. The cover can be a single layer or multiple layers. Optionally, the cover is made of a protective packing encapsulated in a protective layer; where the protective packing is a substance such as particulate material, dissolvable powders, low melting point metals and polymers or other hydrocarbon materials, such as lead, tin, bismuth, lithium, or alloys of, foams,

particulates, sand, plaster, wax, or combinations thereof. In this embodiment, the outer layer is aluminum, zinc, beryllium, magnesium, alloys thereof, and combinations thereof.

BRIEF DESCRIPTION OF DRAWINGS

[0005] Some of the features and benefits of the present invention having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0006] Figure 1 is a side partial sectional view of an example embodiment of an electrical submersible pumping system (ESP) having cooling fins and disposed in a wellbore.

[0007] Figure 2 is an axial sectional view of the ESP of Figure 1 showing a protective layer over the fins.

[0008] Figure 3 is an axial sectional view of the ESP of Figure 1 having an alternative protective covering over the fins that is encapsulated with an outer layer.

[0009] Figure 4 is a side partial sectional view of the ESP of Figure 1 having a protective covering over the fin area and being lowered into a wellbore.

[0010] While the invention will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the invention to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF INVENTION

[0011] The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the illustrated embodiments set forth herein; rather, these embodiments are provided so that this

disclosure will be through and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0012] Figure 1 illustrates an example embodiment of an electrical submersible pumping system (ESP) 10 disposed in a subterranean wellbore 12; the ESP is used for pumping fluid 14 from the wellbore 12. The fluid 14 resides as connate fluid within a formation 16 shown adjacent the wellbore 12; the fluid 14 enters the wellbore 12 through perforations 18 in a casing string 20 that lines the wellbore 12. The ESP 10 includes a motor section 22 on its lower end having heat cooling fins 24 on its outer surface and extending generally axially along the length of the motor section 22. The fins 24 provide for an increased heat transfer surface area from a motor 23 within the motor section 22 to fluid 14 that flows over the housing of the motor section 22 from the perforations 18 and upward to a pump inlet 25. Also included with the ESP 10 is a seal section 26 provided on an upper end of the motor section 22. The seal section 26 localizes pressure within the ESP 10 with the pressure ambient to the ESP 10. In one example, the seal section 26 includes an internal bladder (not shown) that on one side is exposed to the ambient pressure and on the other side is dielectric fluid that makes its way between the seal section 26 and motor section 22. Also included with the ESP 10 is a pump section 28 on which the pump inlets 25 are located as well as a pump 29 that receives the fluid 14 after flowing through the pump inlets 25. The pump 29 is driven by the motor 23 by a shaft 30 coupled between the motor 23 and pump 29. After becoming pressurized by the pump 29, the fluid 14 exits the upper end of the pump section 28 where it is then pumped to the surface through attached production tubing 32.

[0013] In one embodiment, the fins 24 are relatively thin and easily damaged even by slight impact by the ESP 10 against the casing 20. This is exacerbated in deviated portions of the well.

Shown in Figure 2 is a sectional view of the motor section 22A illustrating an embodiment where the fins 24 are provided on an annular sleeve 34 shown circumscribing the motor 23. In this embodiment, the sleeve 34 with fins 24 provides housing for the motor 23 and is in contact with the cylindrical motor stators (not shown) inside the motor 23. Optionally, a thermal grease or filler 36 can be provided in the annular space between the motor 23 and inner surface of the sleeve 34. Further illustrated in Figure 2 is a covering over the fins 24 that is a protective packing 40 that extends from the spaces between each of the adjacent fins 24 and past the outer terminal end of each fin 24 to protect against direct collisions. The protective packing 40 also provides support between the fins 24 thereby enhancing integrity of the fins 24.

[0014] The protective packing 40 can be applied over the fins 24 prior to deploying the ESP 10 within the wellbore 12 to guard the fins 24 from damage due to collisions or other contact between the ESP 10 and casing 12. The protective packing 40 can be made from a material that self-removes over time, such as through disintegration or dissolving when in the wellbore. Example self-removal times range from a few hours to 2-3 days. The disintegrating material may be one that quickly corrodes and may contain aluminum, zinc, beryllium, magnesium, alloys of these materials, and combinations thereof. Optionally, the protective packing 40 may be a single or multi-layered structured material, such as aluminum with a less active material coupled directly to the fins 24, such as steel, or a more active alloy or pure layer, such as magnesium coupled with the aluminum. Additionally, the sleeve 34 can be formed by an extrusion process to facilitate manufacturing.

[0015] Referring now to Figure 3, illustrated is a side sectional view of an alternate embodiment of a motor section 22B. In this example, the sleeve 34 with fins 24 is shown on the outer surface of the motor 23 along with the layer of thermal grease or filler 36 between the motor 23 and

sleeve 34. However, an alternate protective covering over the fins 24 includes a protective packing 40A that is in contact with the fins and extending from between adjacent fins and up above or past the terminal ends of the fins 24. Over the protective packing 40A is a protective layer 42 that encapsulates the protective packing 40A in place over the fins 24. In an alternative, the protective packing 40A is between the adjacent fins 24 and the protective layer 42 contacts the terminal ends of the fins 24. In one example, the protective packing 40A may include plaster, sand, or some other particulate matter. Once the protective layer 42 is removed, the protective packing 40A can fall away or erode, such as from the fluid 14 flowing past the fins 24. Additionally, the packing 40A and/or layer 42 can be dissolved or disintegrated such as by a chemical reaction or corrosion. Chemical and/or electrical current application can accelerate the chemical reaction or corrosion. The protective layer 42 may be formed from a dissolving or disintegrating material such as that described above in reference to the protective layer 40 of Figure 2.

[0016] Figure 4 illustrates in a side partial sectional view an example of the ESP 10A being lowered within a wellbore 12. In this example, the ESP 10A includes a protective packing 40 or optionally having a protective layer 42 over the motor section 22A. As previously discussed, the presence of the protective packing 40 and/or protective layer 42 guards against damage or other degradation to the fins 24 while the ESP 10 is being lowered within the wellbore 12. When at a designated location in the wellbore 12, wellbore conditions and/or the flow of fluid 14 removes the protective packing and/or protective layer 42. By lowering the ESP 10 in the wellbore 12 without damaging the fins 24, effective heat transfer may occur during pumping operations thereby cooling the motor 29 once the protective packing 40 and/or protective layer 42 is removed from the ESP 10A. Also, the protective layer may allow for thinner fins which may be

more economical to produce. In an alternative embodiment, the ESP 10 may be activated before the packing 40 or layer 42 is removed. In an example, fluid flow from the ESP 10 may be used for removing the packing 40 and/or layer 42.

[0017] It is to be understood that the invention is not limited to the exact details of construction, operation, exact materials, or embodiments shown and described, as modifications and equivalents will be apparent to one skilled in the art. In the drawings and specification, there have been disclosed illustrative embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation. For example, the packing 40 and layer 42 can be made of a single layer or multiple layers. Accordingly, the invention is therefore to be limited only by the scope of the appended claims.

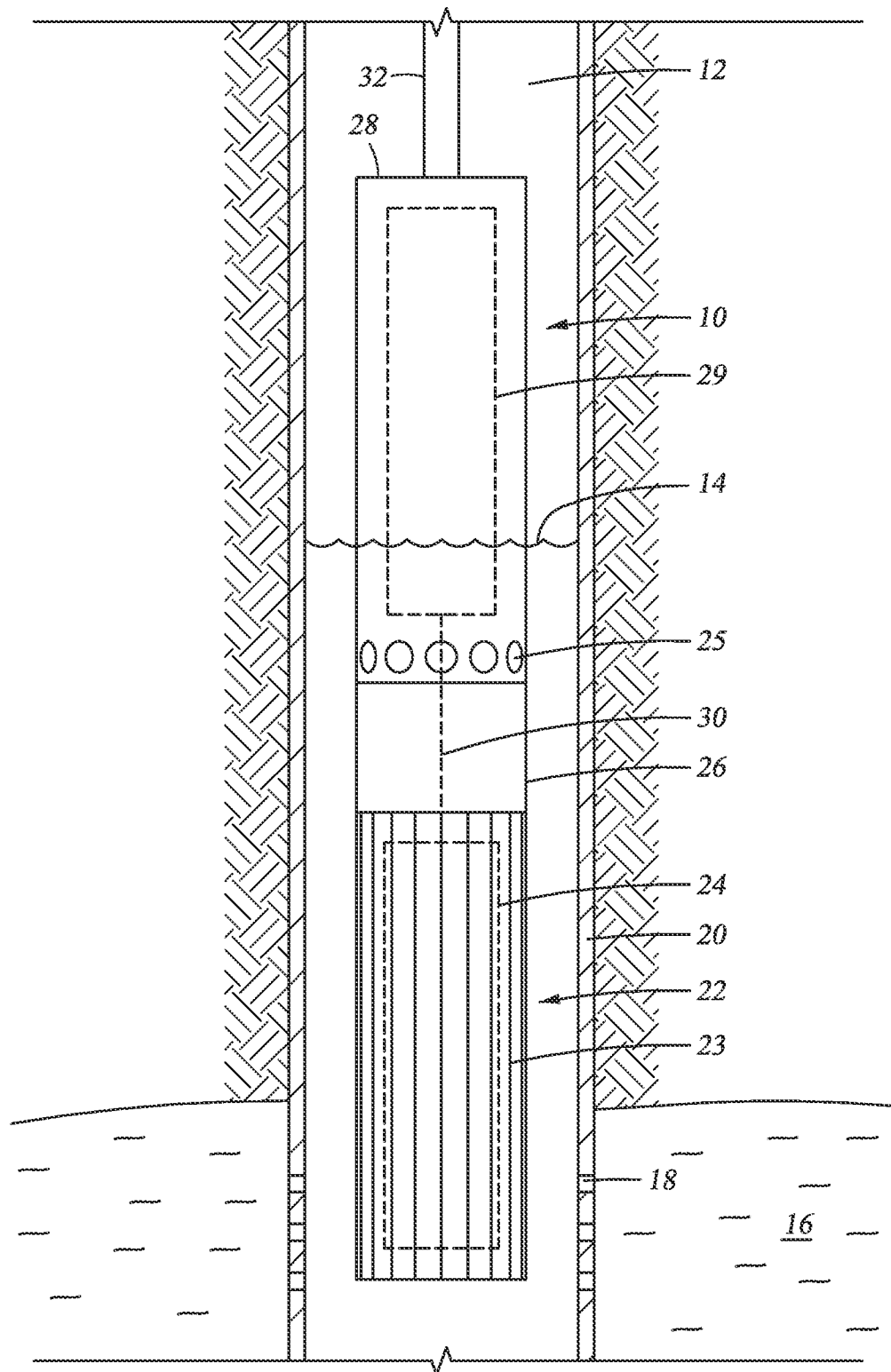
CLAIMS

1. A method of cooling an electrical submersible pumping system (ESP) comprising:
 - a. providing fins on an outer surface of the ESP;
 - b. shielding the fins from damage by covering the fins with a protective layer of a self removing material; and
 - c. deploying the ESP with the protective layer into a wellbore, so that when the ESP contacts a wall of the wellbore, the protective layer safeguards the fins from damage.
2. The method of claim 1, wherein the material disintegrates when disposed in a wellbore and the fins conduct heat from within the ESP to fluid in the wellbore.
3. The method of claim 1, wherein the material comprises a substance selected from the group consisting of wax, aluminum, zinc, beryllium, magnesium, alloys thereof, and combinations thereof.
4. The method of claim 1, wherein the protective layer comprises a protective packing encapsulated with an outer layer.
5. The method of claim 4, wherein the protective packing comprises a substance selected from the list consisting of particulate material, dissolvable powders, wax, sand, plaster, and combinations thereof.
6. The method of claim 4, wherein the outer layer comprises a substance selected from the group consisting of aluminum, wax, zinc, beryllium, magnesium, alloys thereof, and combinations thereof.

7. The method of claim 1, wherein the fins are disposed on a motor section of the ESP that contains a motor for driving a pump in the ESP.
8. The method of claim 7, further comprising actuating the motor to drive the pump and pumping fluid from the wellbore into production tubing attached to the pump.
9. An electrical submersible pumping system (ESP) comprising:
 - a motor section having a motor;
 - a seal section in pressure communication with the motor;
 - a pump section having a pump coupled with the motor;
 - fins on an outer surface of the motor section; and
 - a cover over the fins for shielding the fins from damage as the ESP is lowered into a wellbore and for automatically detaching from the ESP when the ESP is disposed in a designated location in the wellbore.
10. The ESP of claim 9, wherein the cover comprises a substance selected from the group consisting of aluminum, zinc, wax, beryllium, magnesium, alloys thereof, and combinations thereof.
11. The ESP of claim 9, wherein the cover comprises a protective packing encapsulated in an outer layer.
12. The ESP of claim 11, wherein the protective packing comprises a substance selected from the list consisting of particulate material, wax, sand, plaster, and combinations thereof.

13. The ESP of claim 11, wherein the outer layer comprises a substance selected from the group consisting of aluminum, zinc, beryllium, magnesium, alloys thereof, and combinations thereof.

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*Fig. 1*

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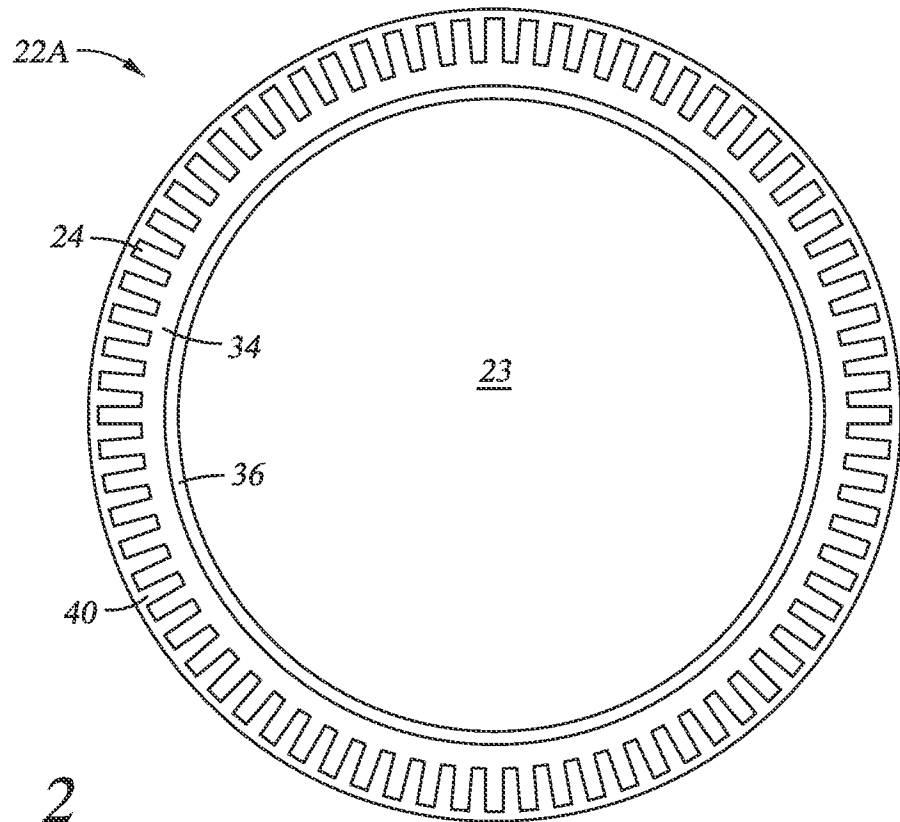


Fig. 2

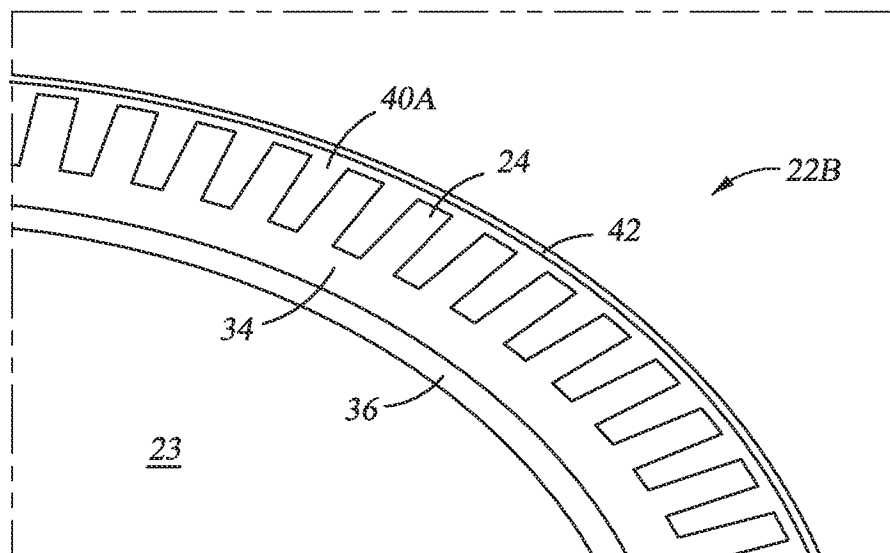
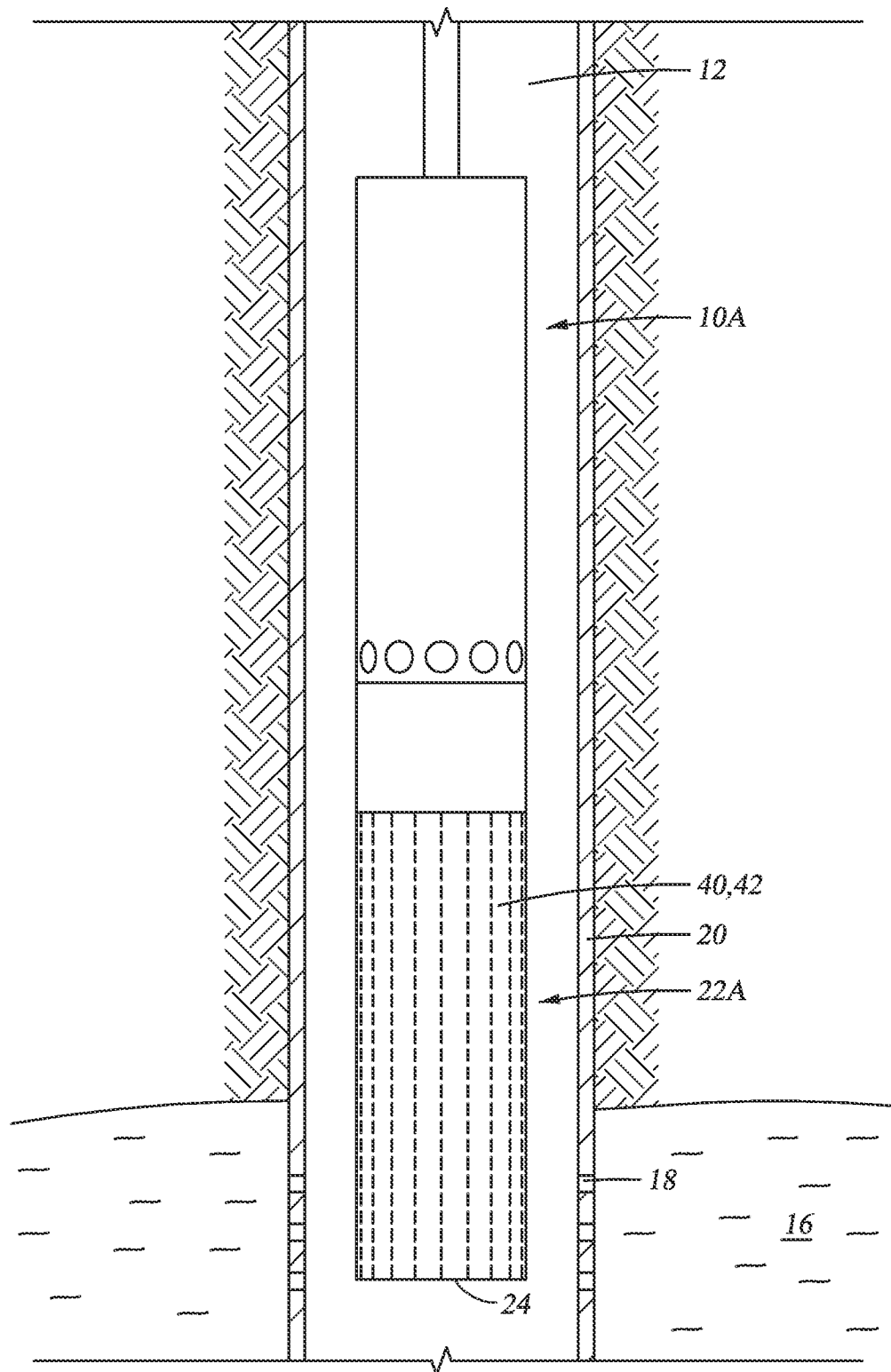


Fig. 3

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*Fig. 4*