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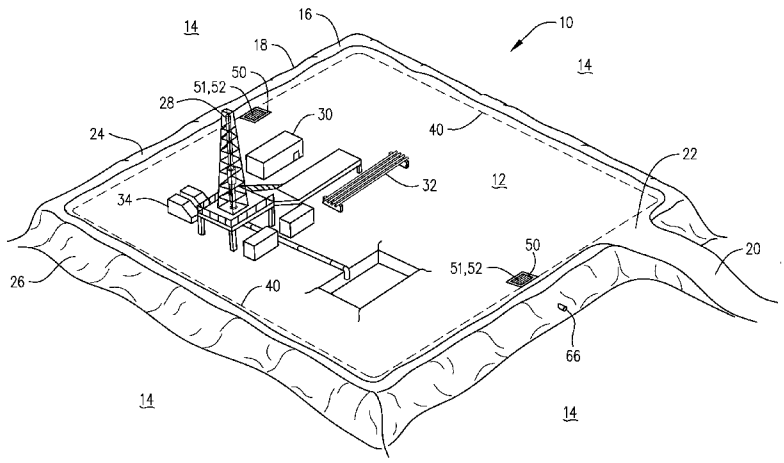


FIG. 1

(57) Abstract: A well pad drainage system is provide, which allows for the testing of drainage water collected from the surface of the well pad prior to the release or removal of the drainage water. The drainage system utilizes a French drain in association with one or more catch basins, a drainpipe for release of uncontaminated drainage water and an extraction line for removal of contaminated drainage water.

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# WELL PAD DRAIN AND CONTAINMENT RECOVERY SYSTEM

## BACKGROUND

### 1. Field of the Invention

**[0001]** The present invention relates to the field of drainage systems for well pads. More specifically, the present invention relates to the disposal of drainage fluids from well pads.

### 2. Description of Related Art

**[0002]** Oil and gas drilling and production operations are typically carried out on a well pad. A well pad is a large area, often covering several acres, that has been cleared to contain the drilling and production facilities and equipment, such as the drilling derrick, pumps, mud tank, fuel tanks, generators, offices, housing, and similar. To construct a well pad, the area is cleared of all trees and obstacles. The foundation is built up, usually from rock, gravel, sand, etc. Typically, the resultant well pad surface level is elevated from the surrounding ground surface and is surrounded by a berm. The berm is a rock and earthen raised barrier between the drill pad and the surrounding environment. The berm serves to prevent erosion of the drill pad and isolate the drill pad from the surrounding environment.

**[0003]** The design of the well pad and berm means that rain water, drainage water from equipment, and other chemicals that are released or spilled tend to collect and pool on the well pad ground surface. Additionally, if such fluids are allowed to pool for significant periods of time, they can seep through the berm or well pad ground and enter into the surrounding environment, which can be problematic when the fluids contain chemicals other than water.

## SUMMARY OF THE INVENTION

**[0004]** In accordance with one embodiment of the invention there is provided a well pad drainage system comprising a well pad, a berm, a French drain, a catch basin and a drainpipe. The well pad has a pad ground surface elevated above a surrounding ground surface. The berm is located between the pad ground surface and the surrounding ground surface. The berm surrounds

the well pad and has an inside surface adjacent to the pad ground surface and an outside surface adjacent to the surrounding ground surface. The French drain extends at least partially around and subsurface to the pad ground surface. The catch basin is in fluid flow communication to the French drain. The drainpipe is in fluid flow communication with the catch basin and in fluid flow communication with the surrounding ground surface. The drainpipe is configured for draining fluids from the catch basin to the surrounding ground surface.

**[0005]** In accordance with another embodiment there is provided a method of draining a well pad having a pad ground surface elevated above a surrounding ground surface and surrounded by a berm located between the pad ground surface and the surrounding ground surface. The method comprises:

(a) collecting drainage water in a catch basin;

(b) testing the drainage water for a predetermined threshold of contamination when a predetermined amount of drainage water has collected;

(c) draining the drainage water from the catch basin to the surrounding ground surface if the test indicates that the drainage water has less contamination than the predetermined threshold; and

(d) withdrawing the drainage water from the catch basin to a tanker truck if the test indicates that the drainage water has contamination that meets or exceeds the predetermined threshold.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]** FIG. 1 is a schematic overhead view of a well pad incorporating a well pad drainage system in accordance with an embodiment of the current invention.

**[0007]** FIG. 2 is a schematic cross-section of a well pad drainage system in accordance with an embodiment of the current invention.

**[0008]** FIG. 3 is a schematic cross-section of a French drain useable in accordance with an embodiment of the current invention.

**[0009]** FIG. 4 is a schematic overhead view of a well pad similar to FIG. 1 but incorporating a different layout pattern for the French drain.

**[0010]** FIG. 5. is a schematic cross-section similar to FIG. 2 but illustrating another embodiment of the well pad drainage system of the current invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0011]** Referring now to FIG. 1 a well pad 10 incorporating an embodiment of the current invention is illustrated. Well pad 10 has a pad ground surface 12, which is elevated from a surrounding ground surface 14. Generally, the pad ground surface 12 will be elevated from the surrounding ground surface 14 on all sides but can be elevated from only a portion of surrounding ground surface 14 and, hence can be elevated from surrounding ground surface 14 on only one side, two sides or three sides of the well pad 10. The amount of elevation will depend on the terrain and the particular well pad but often the pad ground surface 12 is from about 20 feet to about 40 feet above the surrounding ground surface 14. Between pad ground surface 12 and surrounding ground surface 14 is a berm 16. Berm 16 typically is a rock and earthen raised barrier between the drill pad and the surrounding environment but can include various polymer sheets to help contain spills and prevent drainage through the berm. Berm 16 has a top 18, which is raised above the pad ground surface by a suitable amount to prevent well pad erosion, isolate the drill pad from the surrounding environment and contain drainage. Typically top 18 can be from about 1 to about 5 feet above pad ground surface 12 and more typically about 2 feet to about 2.5 feet above pad ground surface 12.

**[0012]** Well pad 10 has a road 20 for entry of vehicles onto well pad 10. Typically, berm 16 can be lower at location 22 where the road meets well pad 10 or berm 16 can have a break to allow for the road access. Otherwise, berm 16 will generally be located along the perimeter of pad ground surface 12 and can surround pad ground surface 12. Berm 16 has an inside surface 24 extending from top 18 to pad ground surface 12 and, hence, is adjacent to or facing the pad ground surface 10. Berm 16 has an outside surface 26 extending from top 18 to surrounding ground surface 14 and, hence, is adjacent to or facing surrounding ground surface 14.

**[0013]** Well pad 10 can have conventional equipment and buildings located on it; such as well 28, dog house 30, pipe rack 32, compressors 34, as well as mud tanks, fuel tanks, generators, offices and other similar facilities. These facilities are generally known in the art and the ones utilize depend on the type of operation (such as drilling, production, etc.), the type of well and the needs of drilling and extracting oil and/gas from the particular formation.

**[0014]** The inventive well drainage system comprises one or more French drains 40 installed subsurface to pad ground surface 12. Pad ground surface 10 can be graded so as to direct any drainage water on pad ground surface 10 towards French drains 40. As used herein,

the term drainage water will refer to rain water, water from operations, fluids spillage or other water or fluids, which come onto pad ground surface 10. Such fluids can include oils and chemicals from the well pad operations.

**[0015]** French drains 40 are installed below the pad ground surface 12 using a layout or arrangement suitable to the grating and drainage pattern of pad 10. One layout is illustrated in FIG. 1 where French drains 40 is installed at or near the perimeter of pad ground surface 12 and, hence, will be adjacent to inside surface 24 of berm 16. An alternative embodiment is illustrated in FIG. 4 where French drains 40 is installed with drain line 40a extending partially around the perimeter of pad ground surface 12 and supplemental drain lines 40b extending across the center of well pad 10. French drains 40 can be installed on other portions of the pad ground surface 12 as needed as long as their operation will not be hampered by or interfere with heavy equipment or other facilities on the well pad 10. Generally, French drains 40 can be any suitable drainage conduit that vents drainage water, which seeps from ground surface, towards catch basin 50. Typically, French drains 40 will be a trench covered with gravel or rock or containing a perforated pipe that redirects surface and groundwater away from an area. Referring now to FIG. 3, a French drain 40 suitable for use in the invention is illustrated. French drain 40 comprises a perforated pipe 42, first gravel packing 44 and second gravel packing 46. A trench 48 is dug into the pad ground surface 12 and a layer of filter fabric 47 is introduced onto the surface of trench 48. The depth of the trench varies since trench 48 and French drain 40 will generally be sloped downward towards a catch basin. One skilled in the art can readily determine the proper depth for trench 48 based on distance to the catch basin, drainage water demands and similar. The width of trench 48 can also vary depending on the size of perforated pipe 42, number of perforated pipes 42 in trench 48, and similar, By way of example, a single perforated pipe of approximately 4 inches can have a trench of about one foot in width. Generally, perforated pipe 42 will be from 4 to 6 inch and is placed near the bottom of trench 48 surrounded by first gravel packing 44. On top of first gravel packing 44 is placed second gravel packing 46, which can be exposed at the pad ground surface level or be covered by a layer of dirt or sand. First gravel packing 44 comprises gravel or rock that on average is smaller than second gravel packing 46. Broadly, first gravel packing 44 can have an average stone size of from about ¼ inch to about 2 ½ inches in diameter and can be # 67 washed gravel, #57 washed gravel #4 washed gravel or mixtures thereof. Preferably, first gravel packing 44 can have an average stone size of from

about ¾ inch to about 1 inch in diameter and can be #57 washed gravel. The second gravel packing 46 can have an average stone size of about 1 inch to about 4 inches in diameter and can be #4 washed gravel, # 1 washed gravel or mixtures thereof. Preferably, second gravel packing 46 can have an average stone size of from about 2 ½ inches to 4 inches in diameter and can be # 1 washed gravel.

**[0016]** Returning now to FIG. 1 and with reference to FIG. 2, the drainage system of the current invention will be further described. French drains 40 are in fluid flow communication with one or more catch basins 50 and so the drainage water drains into catch basins 50. Each catch basin 50 has at least one inlet 54 by which it is connected to a French drain 40 and has an opening 51 covered by grate 52 at pad ground surface 12. Grate 52 allows surface drainage into catch basin 50 and allows access into catch basin 50 for maintenance and clean out purposes. Catch basin 50 has an outlet 56 by which it is connected in fluid flow communication with drainpipe 60. Additionally, catch basin 50 can have a sump 58 where sediment carried in the drainage water can collect. As can be seen from FIG. 2, catch basin 50 will generally be subsurface from pad ground surface 12 so that grate 52 is at pad ground surface 12; however, it is within the scope of the invention for a first portion of the catch basin to be subsurface and a second portion to be above the pad ground surface 12. Additionally, it is within the scope of the invention for the top of catch basin 50 to be entirely subsurface but this limits accessibility of catch basin 50. If entirely subsurface, grate 52 can be replaced with a solid door. Catch basin 50 can be a precast concrete structure; such as an inlet drain (ID) box. The size and number of catch basin 50 will depend on the estimated amount of drainage water to be stored between draining of the catch basin 50, as described further below, and can be readily determined by one skilled in the art based on the disclosure herein.

**[0017]** Drainpipe 60 is in fluid flow communication with catch basin 50, as described above. A first end 64 of drainpipe 60 can extend inside of catch basin 50. Drainpipe 60 extends through berm 16 with a second end 66 being flush with or extending out of the outside surface 26 of berm 16. The second end 66 can be lower than the first end 64 so as to promote drainage from catch basin 50 to the surrounding ground surface 14. Second end 66 can extend out of outside surface 26 at any point where drainage is suitably facilitated; typically, second end 66 can be at approximately the level of the surrounding ground surface 14; that is at or within a few feet of the surrounding ground surface 14. Rock, gravel or other means of erosion control can be

installed around the second end 66. Additionally, an anti-seep collar 68, such is known in art, can be used to ensure that drainpipe 60 is not compromised by drainage water seeping along the outside of drainpipe 60.

**[0018]** Extraction line 70 is connected in fluid flow communication to catch basin 50. Typically, extraction line 70 can be connected at a first end 72 to drainpipe 60; such as by T-connection 76. Thus, extraction line 70 is in fluid flow communication with drainpipe 60 and, via drainpipe 60, with catch basin 50. Extraction line 70 has a second end 74 extending above pad ground surface 12. Extraction line 70 is configured for connection to a tanker truck and for extraction of drainage water from catch basin 50. Thus in one embodiment, second end 74 has a quick connect for attaching to a tanker truck's hose such that drainage water can be pumped or sucked out of catch basin 50 through extraction line 70 and into the tank of the tanker truck. Locating second end 74 on the inside of berm 16 prevents the trucks from having to drive through the environment surrounding the drill pad 10 and, thus, is less intrusive to the surrounding environment.

**[0019]** Turning to FIG. 5, another embodiment of the extraction line 70 is illustrated. In FIG. 5 a hose or suction line 70a is used as the extraction line. Suction line 70a is generally a flexible tubing connected in fluid flow communication at a first end 90 to pump 98. Pump 98 is also in fluid flow communication with tank 94 of tanker truck 96. The second end 92 of suction line 70a is introduced through opening 51 of catch basin 50 and extends down into catch basin 50. The introduction can be through grate 52 or by removal of grate 52. Suction line 70a extends into catch basin 50 so that second end 92 is submerged in the drain water 100 within catch basin 50. Thus, through operation of pump 98, drainage water can be removed through suction line 70a into tank 94.

**[0020]** Returning now to FIG. 1, a valve 80 is connected to drainpipe 60, generally downstream or towards second end 66 from extraction line 70. Valve 80 has an open position allowing fluid flow from catch basin 50 to the surrounding ground surface 14 and a closed position preventing fluid flow from catch basin 50 to surrounding ground surface 14. Valve 80 can be located in a riser box 82, which can be located on well pad 10 inside the perimeter of berm 16 or located on berm 16; that is, extending vertically out of berm 16. As illustrated, riser box 82 extends through berm 16 to the top 18 but could also be located to extend through inside surface 24 or outside surface 26. Valve 80 can be switched between the open position and closed

position though riser box 82 by use of a T-bar key or similar means. Additionally, pneumatic or mechanical controls can be located above ground for switching valve 80 between the open position and closed position. Such surface controls have the advantage of making it easier to switch valve 80 and to determine the position of the valve 80. Whether surface controls are used or not, a indicator 84 is operationally connected to valve 80 such that indicator 84 displays whether valve 80 is in the open position or closed position.

**[0021]** In operation, rainwater, spillage fluids and similar drain across pad ground surface 12 towards the French drains 40. Generally, small spillages of fluid will not drain across the pad ground surface but may be carried across by latter rainfall or larger spillages or release of fluids. This drainage water then seeps through second gravel packing 46, first gravel packing 44 and into perforate pipe 42. Additionally, drainage water can seep from the surrounding ground through filter fabric 47 into French drain 40.

**[0022]** The drainage water flows through perforated pipe 42 and is introduced into catch basin 50. Valve 80 is in the closed position; thus, drainage water collects in catch basin 50. The drainage water can be retained in the catch basin 50 and within French drain 40 until a predetermined amount of drainage water has collected or until it is otherwise determined that the drainage water should be disposed. Generally, this can be a predetermined set level of water in catch basin 50 and can depend on estimated rainfall or amounts of fluids that will be released onto pad ground surface 12. When a sufficient amount of drainage water has collected in catch basin 50 so that it needs to be emptied, the collected drainage water is tested to see if it is contaminated. Since the drainage water may have petroleum or chemicals that have been utilized in the drilling and production operations mixed in it, it is tested to see if it is suitable for release without further treatment. If the drainage water is below a predetermined threshold of contaminates, the drainage water is considered safe to release onto surrounding ground surface 14 without further treatment. If the drainage water has the threshold amount of contaminates or exceeds the threshold, then it is taken away in a tanker truck for further treatment. The contamination threshold depends on the types of contaminates present but can be determined from generally available waste water handling information.

**[0023]** Accordingly, if the drainage water has less than the threshold amount of contaminants, valve 80 is placed in the open position and the drainage water flows through drainage pipe 60, out second end 66 and onto surrounding ground surface 14. After release of the

drainage water, the valve is returned to the closed position so that further flow through drainage pipe 60 is prevented. However, if the contaminants in the drainage water exceed the threshold amount, a tanker truck is connected to extraction line 70 or 70a and the drainage water introduced into the tank of the tanker truck. The drainage water can then be hauled away for treatment to remove the contaminants.

**[0024]** Although the disclosed invention has been shown and described in detail with respect to a preferred embodiment, it will be understood by those skilled in the art that various changes in the form and detailed area may be made without departing from the spirit and scope of this invention as claimed. Thus, while the present invention is well adapted to carry out the object and advantages mentioned as well as those inherent therein, numerous changes may be made by those skilled in the art and such changes are encompassed within the spirit of this invention as defined by the appended claims.

What is claimed is:

1. A well pad drainage system comprising:

a well pad having a pad ground surface elevated above a surrounding ground surface;

a berm located between said pad ground surface and said surrounding ground surface wherein said berm surrounds said well pad and has an inside surface adjacent to said pad ground surface and an outside surface adjacent to said surrounding ground surface;

a French drain extending at least partially around and subsurface to said pad ground surface;

a catch basin in fluid flow communication to said French drain; and

a drainpipe in fluid flow communication with said catch basin and in fluid flow communication with said surrounding ground surface configured for draining fluids from said catch basin to said surrounding ground surface.

2. The well pad drainage system of claim 1 wherein said French drain extends around the perimeter of said pad ground surface adjacent to said inside surface of said berm.

3. The well pad drainage system of claim 1 wherein at least a portion of said catch basin is located subsurface to said pad ground surface.

4. The well pad drainage system of claim 3 wherein said drainpipe has a first end connected to said catch basin, extends through said berm and has a second end located at said outside surface of said berm.

5. The well pad drainage system of claim 4 wherein said second end of said drainpipe is at approximately ground level of said surrounding ground surface adjacent to said outside surface of said berm.

6. The well pad drainage system of claim 1 further comprising a valve connected to said drainpipe, said valve having an open position allowing fluid flow from said catch basin to said surrounding ground surface and a closed position preventing fluid flow from said catch basin to said surrounding ground surface.

7. The well pad drainage system of claim 1 wherein said catch basin has a sump configured to catch sediment.

8. The well pad of claim 1 further comprising an extraction line in fluid flow communication with said catch basin configured for extracting liquids from said catch basin to a truck

9. The well pad of claim 8 wherein said extraction line is in fluid flow communication with said catch basin and extends above said pad ground surface.

10. The well pad of claim 1 wherein said pad ground surface is graded to direct surface fluids towards said French drains.

11. A well pad drainage system comprising:

a well pad having a pad ground surface elevated above a surrounding ground surface;

a berm located between said pad ground surface and said surrounding ground surface wherein said berm surrounds said well pad and hajs an inside surface adjacent to said pad ground surface and an outside surface adjacent to said surrounding ground surface;

a French drain extending around and subsurface to the perimeter of said pad ground surface and adjacent to said inside surface of said berm and wherein said pad ground surface is graded to direct surface fluids towards said Frenph drain;

a catch basin in fluid flow communication to said French drain wherein said catch basin is subsurface to said surrounding ground surface and has a top at pad ground surface having a grate, which allows access to said catch basin;

a drainpipe having a first end connected to and in fluid flow communication with said catch basin and a second end located at said outside surface of said berm at approximately ground level of said surrounding ground surface adjacent to said outside surface of said berm so that said drainpipe extends through said berm, said drainpipe configured for draining fluids from said catch basin to said surrounding ground surface;

an extraction line in fluid flow communication with said catch basin and extending above said pad ground surface, said extraction line configured for extracting liquids from said catch basin to a truck; and

a valve connected to said drainpipe, said valve having an open position allowing fluid flow from said catch basin to said surrounding ground surface and an closed position preventing fluid flow from said catch basin to said surrounding ground surface.

**12.** A method of draining a well pad having a pad ground surface elevated above a surrounding ground surface and surrounded by a berm located between said pad ground surface and said surrounding ground surface, the method **comprising:**

(a) collecting drainage water in a catch basin;

(b) **testing said drainage water** for a predetermined threshold of contamination when a predetermined amount of **drainage** water has **collected;**

(c) draining said drainage water from said Catch basin to said surrounding ground surface if said test indicates that said drainage water has less contamination than said predetermined threshold; and

(d) withdrawing said drainage water from said catch basin to a tanker truck if said test indicates that said drainage water has contamination that meets or exceeds said predetermined threshold.

13. The method of claim 12 wherein said drainage water is collected through a French drain extending around the perimeter of said pad ground surface and adjacent to said berm.

14. The method of claim 13 wherein said drainage water is stored in said French drain and said catch basin until after step (b) is carried out.

15. The method of claim 13 further comprising settling sediment collected with said drainage water into a sump in said catch basin.

16. The method of claim 13 wherein said draining in step (c) is through a drainpipe in fluid flow communication with said catch basin and said surrounding ground surface and wherein a valve is connecied to said drainpipe such that draining to said surrounding ground surface is prevented when said valve is in a closed position and allowed when said valve is in an open position.

17. The method of claim 16 wherein said withdrawing in step (d) is through an extraction line wherein drainage water is removed from said catch basin to a truck located on said pad ground surface through said extraction line.

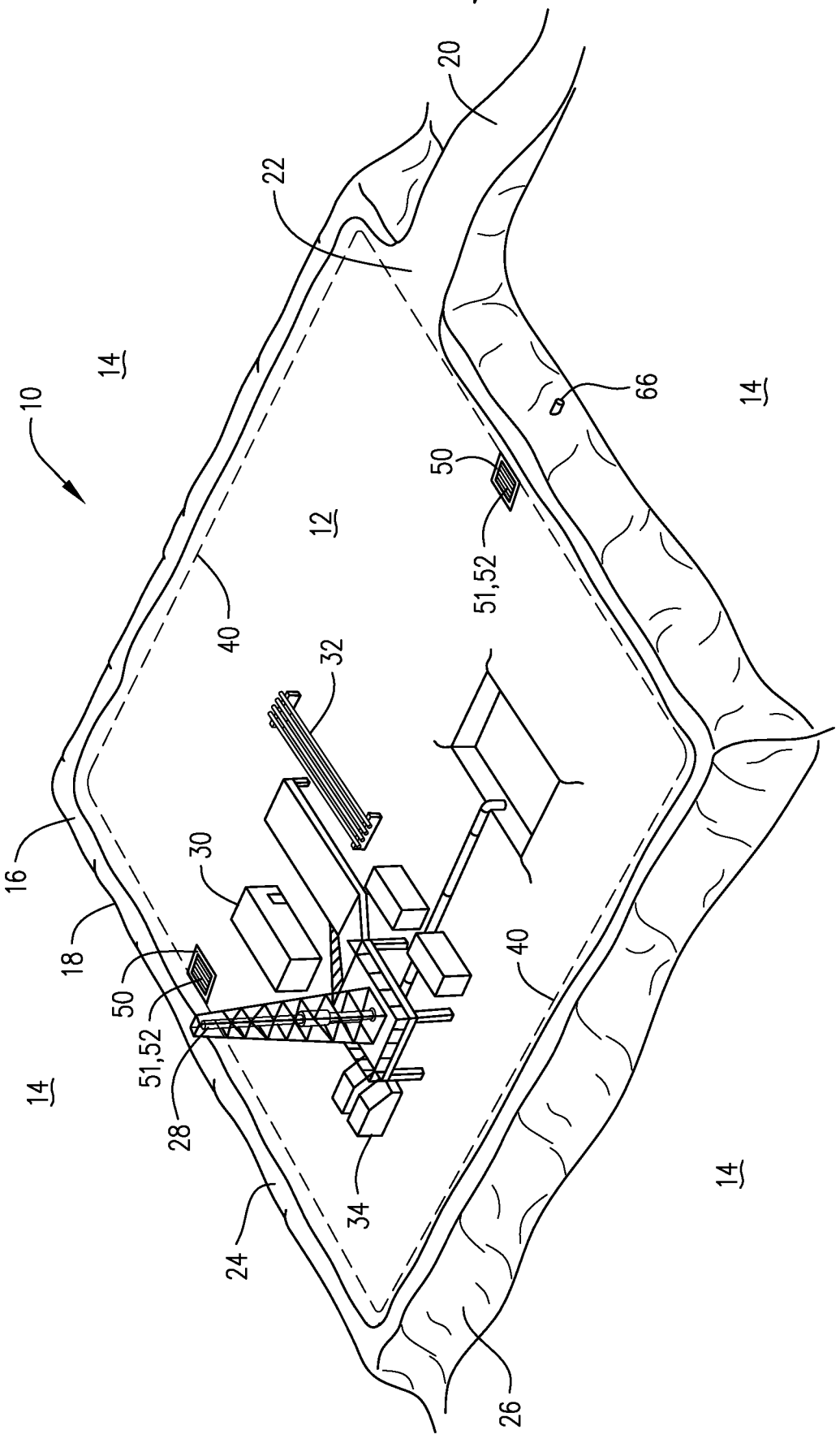


Fig. 1

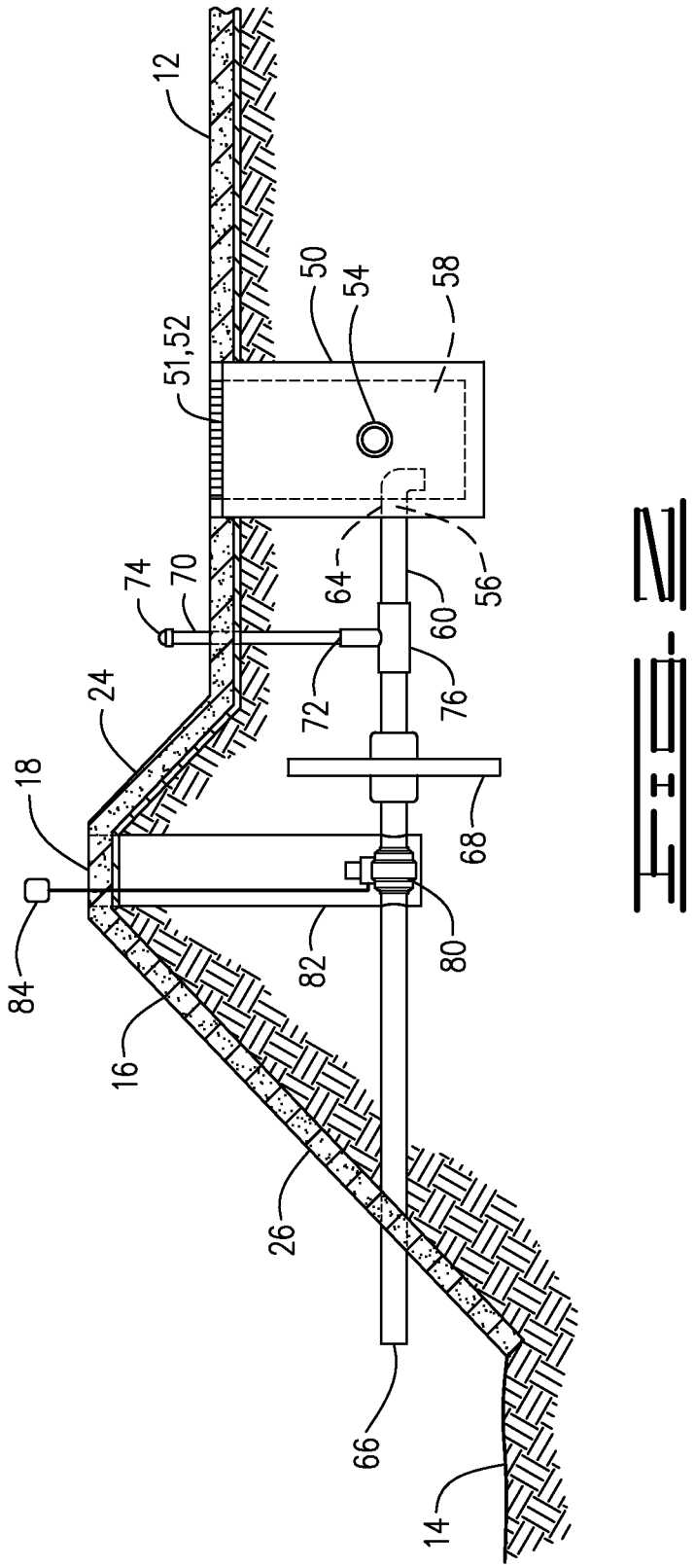


FIG. 2

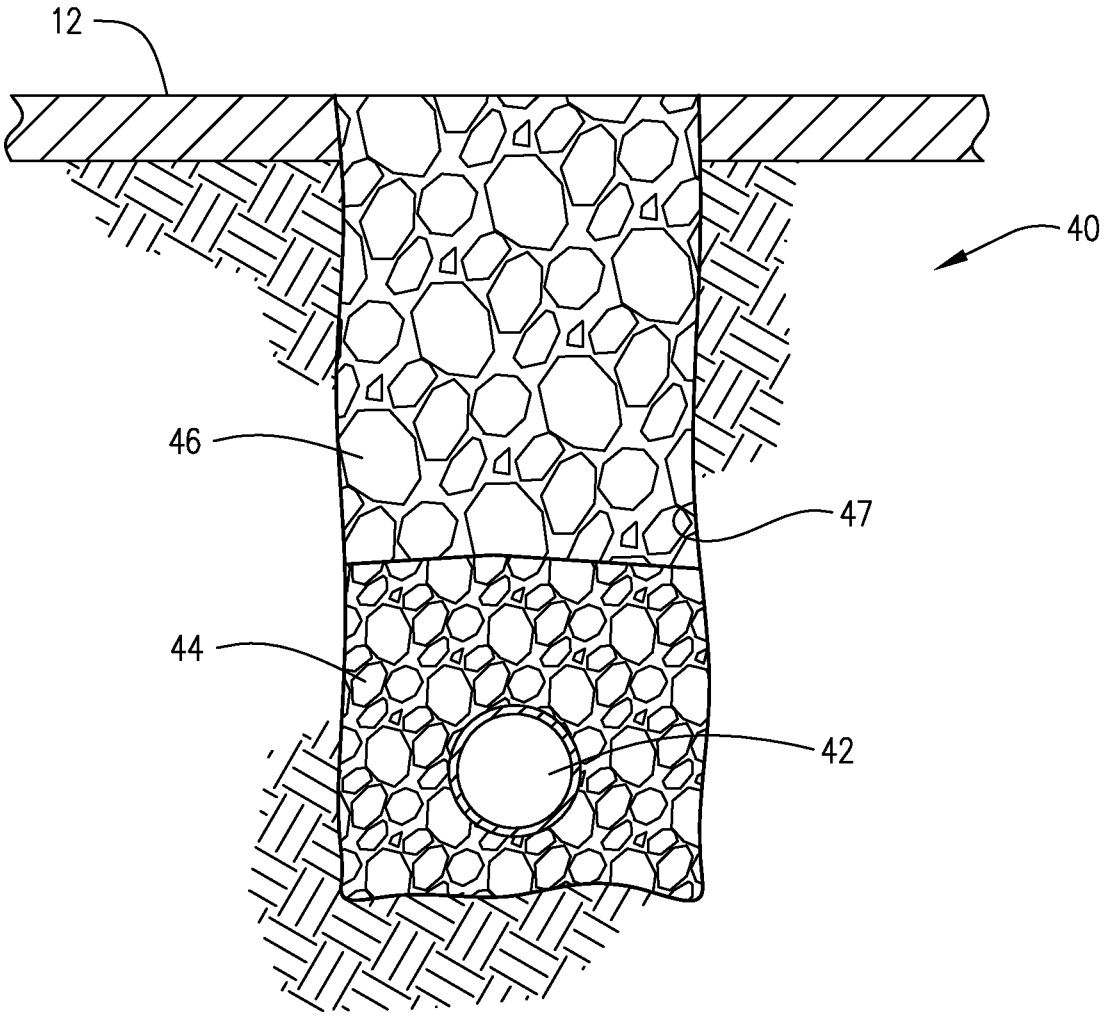


FIG. 3

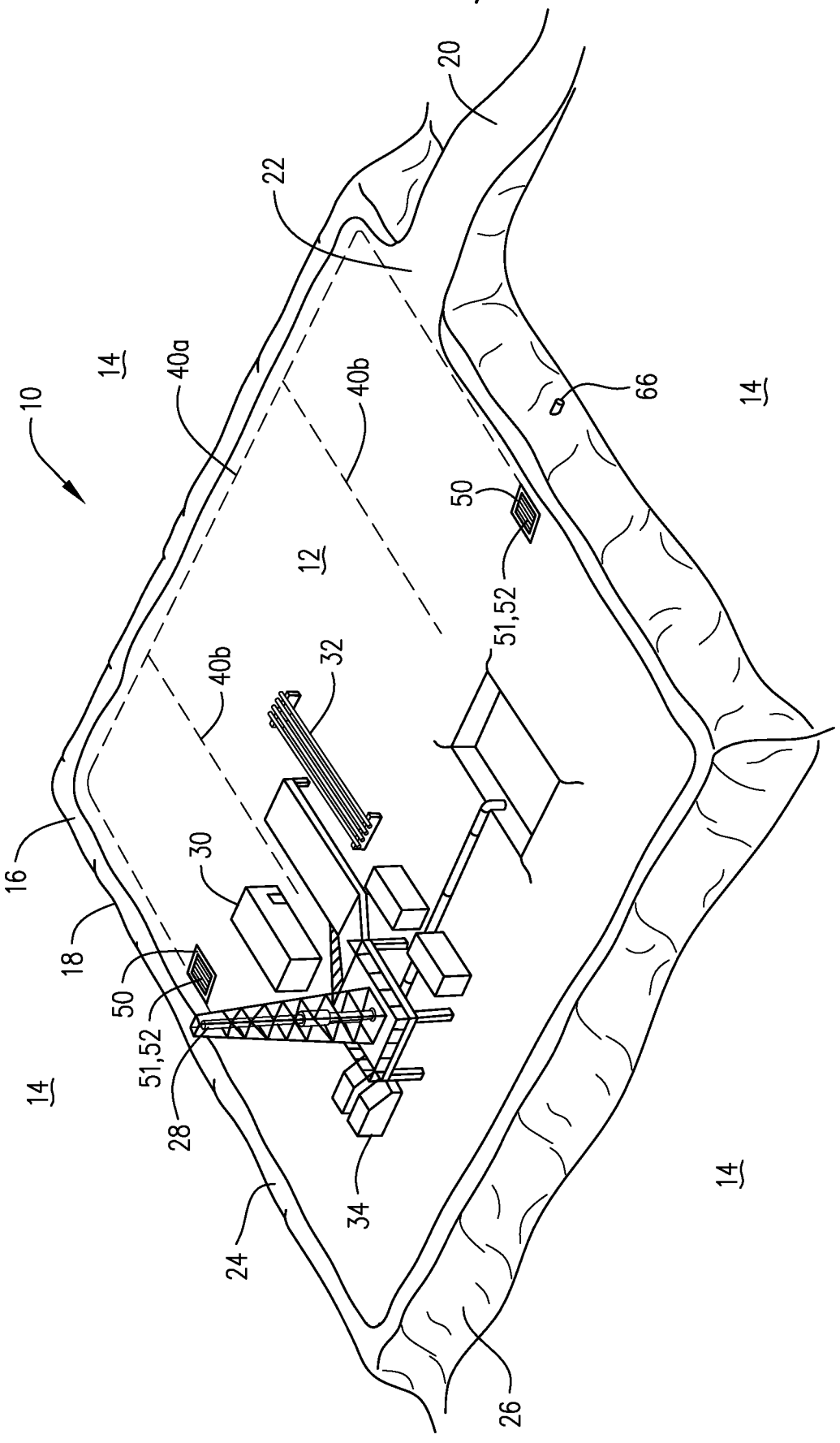


Fig. 4

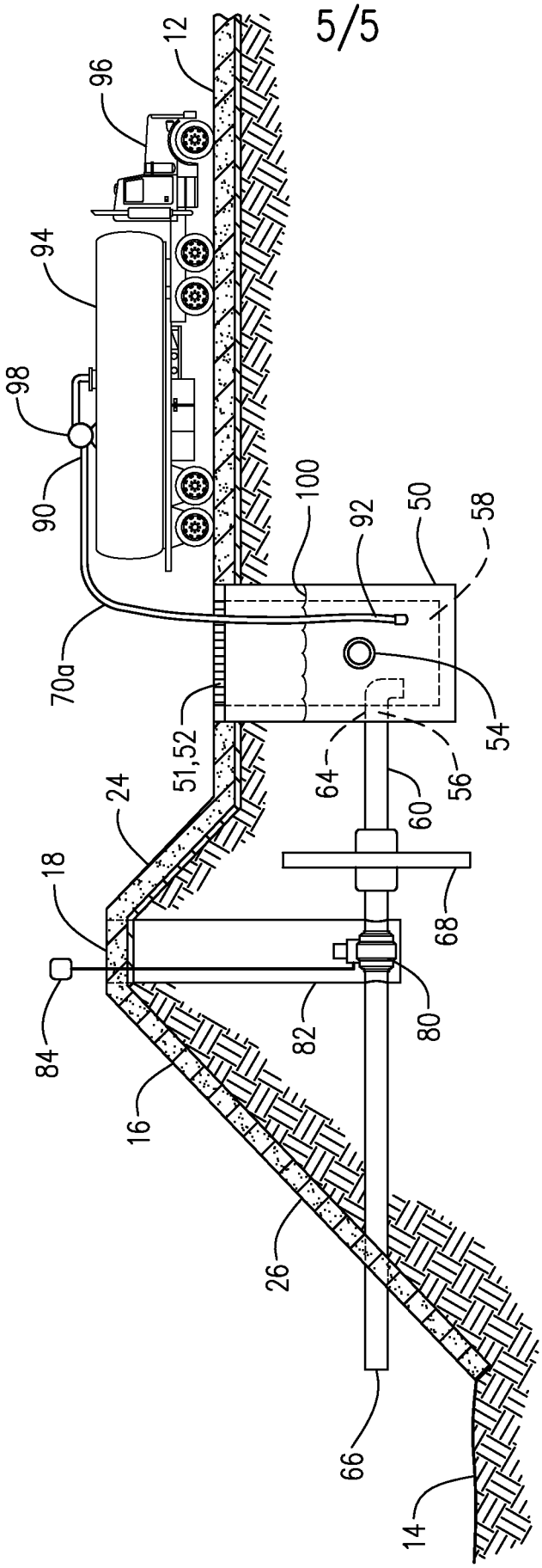
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FIG. 5