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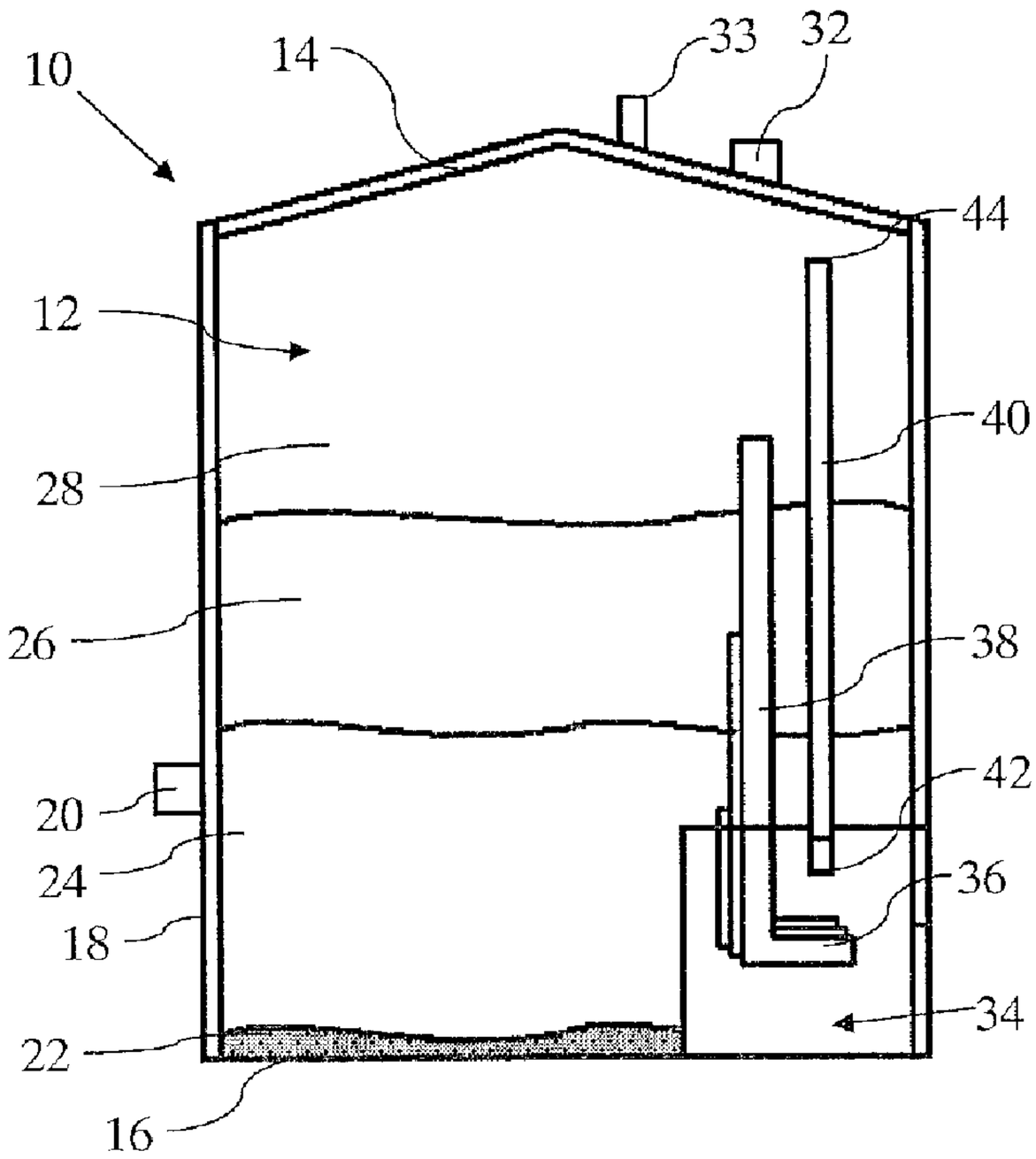
(54) **Titre : COLONNE MONTANTE A LIMITEUR DE PRESSION POUR RESERVOIR DE PRODUCTION**
(54) **Title: PRESSURE RELIEF RISER FOR A PRODUCTION TANK**



(57) **Abrégé/Abstract:**
A production tank having a tank enclosure defined by a roof, a floor and a sidewall, one or more fluid inlets and one or more fluid outlets in fluid communication with the tank enclosure, and a fluid container for receiving overflow fluids. A pressure- relief riser has

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(57) **Abrégé(suite)/Abstract(continued):**
a first end in fluid communication with the fluid container and a second end positioned below the roof and above the one or more fluid outlets, the second end being in fluid communication with the tank enclosure. A frangible seal seals the pressure-relief riser that breaks upon application of a predetermined pressure.

ABSTRACT OF THE DISCLOSURE

A production tank having a tank enclosure defined by a roof, a floor and a sidewall, one or more fluid inlets and one or more fluid outlets in fluid communication with the tank enclosure, and a fluid container for receiving overflow fluids. A pressure-relief riser has a first end in fluid communication with the fluid container and a second end positioned below the roof and above the one or more fluid outlets, the second end being in fluid communication with the tank enclosure. A frangible seal seals the pressure-relief riser that breaks upon application of a predetermined pressure.

PRESSURE RELIEF RISER FOR A PRODUCTION TANK

TECHNICAL FIELD

[0001] This relates to a pressure relief riser for a production tank.

BACKGROUND

[0002] Production tanks on well sites are used to collect fluids produced from a hydrocarbon-producing well. Damage, such as environmental damage and damage to equipment, may occur if the production tanks are not properly vented or if the production tanks are overfilled. Most tanks are designed with vents and level sensors to help reduce the risk of overfilling and to reduce pressure differentials between the inside of the tanks and the ambient pressure.

SUMMARY

[0003] According to an aspect, there is provided a production tank, comprising a tank enclosure defined by a roof, a floor and a sidewall, one or more fluid inlets in fluid communication with the tank enclosure, one or more fluid outlets in fluid communication with the tank enclosure, a fluid container for receiving overflow fluids, a pressure-relief riser having a first end in fluid communication with the fluid container and a second end positioned below the roof and above the one or more fluid outlets, the second end being in fluid communication with the tank enclosure, and a frangible seal that seals the pressure-relief riser, the frangible seal breaking upon application of a predetermined pressure.

[0004] According to another aspect, the frangible seal may be positioned toward the first end of the pressure-relief riser.

[0005] According to another aspect, the fluid container may recessed within the sidewall and may be separate from the tank enclosure, and the first end of the pressure-relief riser may be positioned within the tank enclosure.

[0006] According to another aspect, the fluid container may be outside the tank enclosure.

[0007] According to another aspect, the fluid container may be a collapsible container.

[0008] According to another aspect, the one or more fluid outlets may comprise a plurality of outlet risers that extend to a plurality of outlet heights within the tank enclosure, the second end of the pressure-relief riser being above the highest of the plurality of outlet heights.

[0009] According to an aspect, there is provided a method of relieving pressure in a production tank comprising a tank enclosure defined by a roof, a floor, and a sidewall, the production tank further comprising one or more fluid inlets in fluid communication with the tank enclosure and one or more fluid outlets in fluid communication with the tank enclosure, the method comprising the steps of mounting a pressure-relief riser to the production tank, the pressure-relief riser having a first end in fluid communication with a fluid container and a second end positioned below the roof and above the one or more fluid outlets of the production tank, the second end being in fluid communication with the tank enclosure, attaching a frangible seal to seal the pressure-relief riser, the frangible seal being designed to break upon application of a predetermined pressure, and filling the production tank with production fluids.

[0010] According to another aspect, the method may further comprise the steps of permitting fluids to enter pressure relief riser, the fluids breaking the frangible seal to break upon application of the predetermined pressure and collecting fluids within the fluid container.

[0011] According to another aspect, the predetermined pressure may comprise at least one of a fluid pressure applied by fluid within the pressure-relief riser, a pneumatic pressure within the tank enclosure, and a vacuum pressure within the tank enclosure.

[0012] According to another aspect, the frangible seal may be positioned toward the first end of the pressure-relief riser.

[0013] According to another aspect, the fluid container may be recessed within the sidewall and is separate from the tank enclosure and the first end of the pressure-relief riser may be positioned within the tank enclosure.

[0014] According to another aspect, the fluid container may be outside the tank enclosure.

[0015] According to another aspect, the fluid container may be a collapsible container.

[0016] According to another aspect, the one or more fluid outlets may comprise a plurality of outlet risers that extend to a plurality of outlet heights within the tank enclosure, the second end of the pressure-relief riser being above the highest of the plurality of outlet heights.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

FIG. 1 is a side elevation view of a production tank with a pressure-relief riser.

FIG. 2 is a side elevation view of an alternate production tank with a pressure-relief riser.

FIG. 3 is a side elevation view of the production tank of FIG. 2 releasing liquid.

FIG. 4 is a side elevation view of the production tank of FIG. 2 releasing foam.

FIG. 5 is a side elevation view of a further alternate production tank with a pressure-relief riser.

FIG. 6 is a side elevation view of the production tank of FIG. 5 with the container being filled with fluid.

FIG. 7 is a side elevation view in section of a frangible membrane.

FIG. 8 is a side elevation view in section of an alternate frangible membrane.

FIG. 9 is a side elevation view in section of a further alternate frangible membrane.

FIG. 10 is a side elevation view in section depicting an alternate position for frangible membrane.

FIG. 11 is a side elevation view of a further alternative of a production tank.

DETAILED DESCRIPTION

[0018] A production tank, generally identified by reference numeral 10, will now be described with reference to FIG. 1 through 11. While the description and drawings relate to a particular design, it will be understood that the pressure-relief mechanism described herein may be applied to other types and designs of production tanks as known in the art.

[0019] Referring to FIG. 1, production tank 10 has a tank enclosure 12 defined by a roof 14, a floor 16 and a sidewall 18. There is shown fluid inlet 20 in fluid communication with tank enclosure 12, although there may be more than one. Fluid inlet 20 is designed to be connected to a source of fluid, such as a well (not shown), and to receive the fluids produced from the well. When connected to a well, the produced fluids will include sand, water, liquid hydrocarbons, and possibly some gaseous hydrocarbons. Depending on the demands place on the well, there may be some initial separation prior to depositing the fluids into the production tank, although any separation steps taken at this time will not remove all of a single component. As shown in FIG. 1, there is a sand layer 22, a water layer 24, an oil layer 26, and a gas layer 28. Gas layer 28 may be ambient air, gaseous hydrocarbons from the production fluids, or more commonly, a mixture of both. In addition to these components, referring to FIG. 4, there may also be a layer of foam 30 that forms on top of oil layer 26. The components of produced fluids and how the components are managed are well known in the art and will not be described further.

[0020] In the oil and gas industry, production tanks are used to store fluids until the fluids can be transported. There may be more than one production tank on a site, and the production tanks will generally have more features than what is shown. In particular, there is generally a series of vents and access points on the top of a production tank, and there may be fluid level indicators or sensors, and the like. In the depicted example, production tank 10 is shown with a thief hatch 32 and a vent 33 on roof 14. Thief hatches are used to provide internal access to

tank enclosure 12, and generally include a two-way pressure relief valve to prevent over- or under-pressurization of production tank 10, as production tanks are generally designed to hold the necessary amount of fluid, but are not designed to be pressure vessels. Other vents or attachments may be provided as will be known in the art. Also shown in some embodiments is an enclosure 34 that is recessed within sidewall 18 but is isolated from tank enclosure 12. One suitable type of enclosure is sold under the name Enviro-Vault™. Generally, enclosure 34 is used to enclose connections, as shown in FIG. 1, to protect them from damage and from the elements, as the fluids in enclosure 12 are generally heated, which will also heat enclosure 12. Enclosure 34 may also be used as a liquid container, as shown in FIG. 2 and will be described in greater detail below.

[0021] As shown, production tank 10 has outlets 36 with corresponding risers 38 that extend to different heights. Outlets 36 allow an operator to withdraw fluids from different layers within enclosure 12. While three outlets 36 are depicted with risers 38 at three different heights, there may only be two, or any number as desired by the user. Referring to FIG. 1, outlets 36 are positioned within enclosure 34. Enclosure 34 acts as a fluid container for receiving overflow fluids and catching any drips or leaks that may occur while removing fluid from tank enclosure 12 through outlets 36.

[0022] Referring to FIG. 1, there is shown a pressure-relief riser 40 that extends along the height of tank 10. Pressure-relief riser 40 has a first end 42 in fluid communication with enclosure 34, which as depicted acts as a fluid container, and a second end 44 that is positioned below roof 14 and above the risers 38 of fluid outlets 36 and is in fluid communication with tank enclosure 12. Pressure-relief riser 40 is preferably positioned within enclosure 12 as shown in FIG. 1 to protect against the elements, but may also be installed outside enclosure 12, as shown in FIG. 5. This may be preferable, for example, when pressure-relief riser 40 is retro-fitted onto tank 10, or to minimize the exposure to the production fluids. Alternatively, pressure-relief riser 40 may be installed by inserting it through thief hatch 32 and mounting it to thief hatch 32. This may be beneficial as it requires fewer modifications to tank 10. In another embodiment, pressure relief riser 40 may also be installed by attaching riser 40 to thief hatch 32. Preferably, second end 44 of riser 40 will be

below the lowest vent or thief hatch on the top of production tank 10 such that any overflow first flow through riser 40. While not shown, this may be done, for example, by disconnecting thief hatch 32 from the flange to which it is connected and attach an additional riser between the flange and thief hatch 32. Second end 44 is attached to this riser.

[0023] As shown in FIG. 1, the fluid container may be an enclosure 34 similar to an Enviro-Vault™ enclosure that has a fluid containment section at the bottom. For example, enclosure 34 may be designed to hold around 1 m^3 of fluid. Enclosure 34 may be the same enclosure in which outlets 36 or other equipment are housed, or it may be a separate enclosure, as shown in FIG. 2. Other types of internal containers may also be used. Alternatively, referring to FIG. 5 and 6, the fluid container may be an external fluid container 45. This may be a separate tank that is on site, an open reservoir, or, as in the depicted example, an expandable container that can either be collapsed or rolled up when empty. Referring to FIG. 2, there may be both external fluid container 45 as well as enclosure 34, where fluid container 45 is connected by a connection point 47 that is positioned below the access point 49 of enclosure 34. Also, while not shown, there may be multiple containers 45 connected in series or in parallel. This gives operators a significant amount of variable storage that can be collapsed or stored when not required.

[0024] Second end 44 of pressure-relief riser 40 is intended to be positioned above the draw-point for outlets 36 such that it does not interfere with the normal operation of tank 10. Second end 44 is preferably high enough that it is only used under emergency circumstances. The height may vary depending on the preferences of the user, but must be positioned within enclosure 12.

[0025] Referring to FIG. 7 – 9, pressure-relief riser 40 has a pressure-responsive seal 46 that seals pressure-relief riser 40 under normal circumstances and is designed to open in emergency conditions, such as when a predetermined amount of pressure is applied to pressure-responsive seal 46. For example, pressure-responsive seal 46 may be designed to withstand a certain amount of pressure that may be due to a certain level of fluid within pressure-relief riser, a vacuum pressure being applied within enclosure 12, or a positive pressure being applied within enclosure 12. Generally speaking, vacuum or positive

pressures will be dealt with by vents 32, such as an open vent, or a thief hatch that is designed to open when the internal pressure reaches a certain level relative to ambient temperature. However, it may occur that these vents are blocked and that a backup vent is necessary to prevent or reduce potential damage or harm.

[0026] Preferably, pressure-responsive seal 46 is positioned at or toward first end of pressure-relief riser 40 to allow sufficient fluid pressure to build up within pressure-relief riser 40 to open pressure-responsive seal 46. This also allows easier access to pressure-responsive seal 46 when it is necessary to be replaced or serviced. Other positions may also be used that allow for the same function. Referring to FIG. 7 – 9, pressure-responsive seal 46 may take various forms, such as a frangible membrane, and be attached in various ways. In FIG. 7, pressure-relief riser 40 has a second part 48 that attaches, such as by threading, friction fit, etc. into the bottom of pressure relief riser 40 and frangible membrane 46 is attached between the bottom of pressure-relief riser 40 and second part 48. Referring to FIG. 8, pressure-relief riser 40 has a second part 48 that carries frangible membrane 46 as an insert. This may be designed as a disposable component that is replaced as needed. In this example, frangible membrane 46 may be integrally formed with second part 48. Alternately, a new frangible membrane 46 may be mounted within second part 48 when an existing seal breaks. Frangible membrane 46 may also be attached into pressure-relief riser 40 directly without removing or having a separate second part 48. Referring to FIG. 9, frangible membrane 46 may also be mounted to the bottom of pressure-relief riser 40, such as by using an attachment 50 that surrounds the outside of pressure-relief riser 40. An adhesive may also be used. Referring to FIG. 10, frangible membrane 46 may also be mounted to second end 44 of pressure-relief riser 40. In some circumstances, this may be preferable to prevent sour gas (H_2S) from entering pressure-relief riser 40 during normal operation. In some embodiments, it may be useful to form frangible membrane 46 from a material that weakens when in contact with hydrocarbons. This may be useful, for example, when frangible membrane 46 is at the top of riser 40 and is not exposed to the same hydrostatic pressure that may be applied when at the bottom of riser 40, or when the foam is unable to apply sufficient hydrostatic pressure even when frangible membrane 46 is at the bottom, but hydrocarbons are still present, indicating a dangerous situation.

[0027] In the above examples, pressure-openable seal 46 is in the form of a frangible piece of material such as plastic or rubber that breaks under a certain amount of pressure. In other examples, pressure-responsive seal 46 may be a connection that releases under a predetermined pressure, such as shear pins. Alternatively, it may be a connection that involves a resilient lock that opens under pressure that can merely be reset once opened. Preferably, pressure-openable seal is a frangible connection as this is generally less prone to mechanical failure that may prevent it from opening when necessary.

[0028] As noted previously, the purpose of pressure-openable seal is to prevent a build-up of pressure within enclosure 12 or to prevent an overflow of liquid or foam from enclosure 12. It may be particularly useful to manage the level of foam, as known systems of measuring levels in production tanks may be less likely to detect the presence of foam. As any pressure within enclosure 12 will be present in the gas layer 28, it will be communicated along pressure-relief riser 40 to pressure-responsive seal 46, which is open to atmospheric pressure on the other side. As the pressure differential becomes too great, seal 46 will open, either in or out. In other situations, referring to FIG. 3, if oil layer 26 becomes too high, it will overflow into pressure-relief riser 40 and the column of fluid pressure will eventually cause seal 46 to open as shown, and fluid will be collected in enclosure 34. Generally speaking, however, this will be a rare occurrence, as production tanks will often be equipped with level sensors that prevent additional fluid from being pumped into the production tank. In other situations, referring to FIG. 4, a foam layer 30 may form on top of the liquid in production tank 10. Preferably, seal 46 is also designed to open under the pressure that may be applied by a sufficient amount of foam that may enter through pressure-relief riser 40. In some embodiments, as shown, pressure relief riser 40 may have internal baffles 52 to help break the foam or at least reduce the gas content in the foam. This will have the benefit of increasing the density of the fluid in riser 40 and therefore the pressure against seal 46.

[0029] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the

possibility that more than one of the elements is present, unless the context clearly requires that there be one and only one of the elements.

[0030] The scope of the following claims should not be limited by the preferred embodiments set forth in the examples above and in the drawings, but should be given the broadest interpretation consistent with the description as a whole.

What is Claimed is:

1. A production tank, comprising:

a tank enclosure defined by a roof, a floor and a sidewall;

one or more fluid inlets in fluid communication with the tank enclosure;

one or more fluid outlets in fluid communication with the tank enclosure;

a fluid container for receiving overflow fluids;

a pressure-relief riser having a first end in fluid communication with the fluid container and a second end positioned below the roof and above the one or more fluid outlets, the second end being in fluid communication with the tank enclosure; and

a frangible seal that seals the pressure-relief riser, the frangible seal breaking upon application of a predetermined pressure.

2. The production tank of claim 1, wherein the frangible seal is positioned toward the first end of the pressure-relief riser.

3. The production tank of claim 1, wherein:

the fluid container is recessed within the sidewall and is separate from the tank enclosure; and

the first end of the pressure-relief riser is positioned within the tank enclosure.

4. The production tank of claim 1, wherein the fluid container is outside the tank enclosure.

5. The production tank of claim 4, wherein the fluid container is a collapsible container.

6. The production tank of claim 1, wherein the one or more fluid outlets comprise a plurality of outlet risers that extend to a plurality of outlet heights within the tank enclosure, the second end of the pressure-relief riser being above the highest of the plurality of outlet heights.

7. A method of relieving pressure in a production tank comprising a tank enclosure

defined by a roof, a floor, and a sidewall, the production tank further comprising one or more fluid inlets in fluid communication with the tank enclosure and one or more fluid outlets in fluid communication with the tank enclosure, the method comprising the steps of:

mounting a pressure-relief riser to the production tank, the pressure-relief riser having a first end in fluid communication with a fluid container and a second end positioned below the roof and above the one or more fluid outlets of the production tank, the second end being in fluid communication with the tank enclosure;

attaching a frangible seal to seal the pressure-relief riser, the frangible seal being designed to break upon application of a predetermined pressure; and

filling the production tank with production fluids.

8. The method of claim 7, further comprising the steps of:

permitting fluids to enter pressure relief riser, the fluids breaking the frangible seal to break upon application of the predetermined pressure; and

collecting fluids within the fluid container.

9. The method of claim 7, wherein the predetermined pressure comprises at least one of a fluid pressure applied by fluid within the pressure-relief riser, a pneumatic pressure within the tank enclosure and a vacuum pressure within the tank enclosure.

10. The method of claim 7, wherein the frangible seal is positioned toward the first end of the pressure-relief riser.

11. The method of claim 7, wherein:

the fluid container is recessed within the sidewall and is separate from the tank enclosure; and

the first end of the pressure-relief riser is positioned within the tank enclosure.

12. The method of claim 7, wherein the fluid container is outside the tank enclosure.

13. The method of claim 12, wherein the fluid container is a collapsible container.

14. The method of claim 7, wherein the one or more fluid outlets comprise a plurality of outlet risers that extend to a plurality of outlet heights within the tank enclosure, the second end of the pressure-relief riser being above the highest of the plurality of outlet heights.

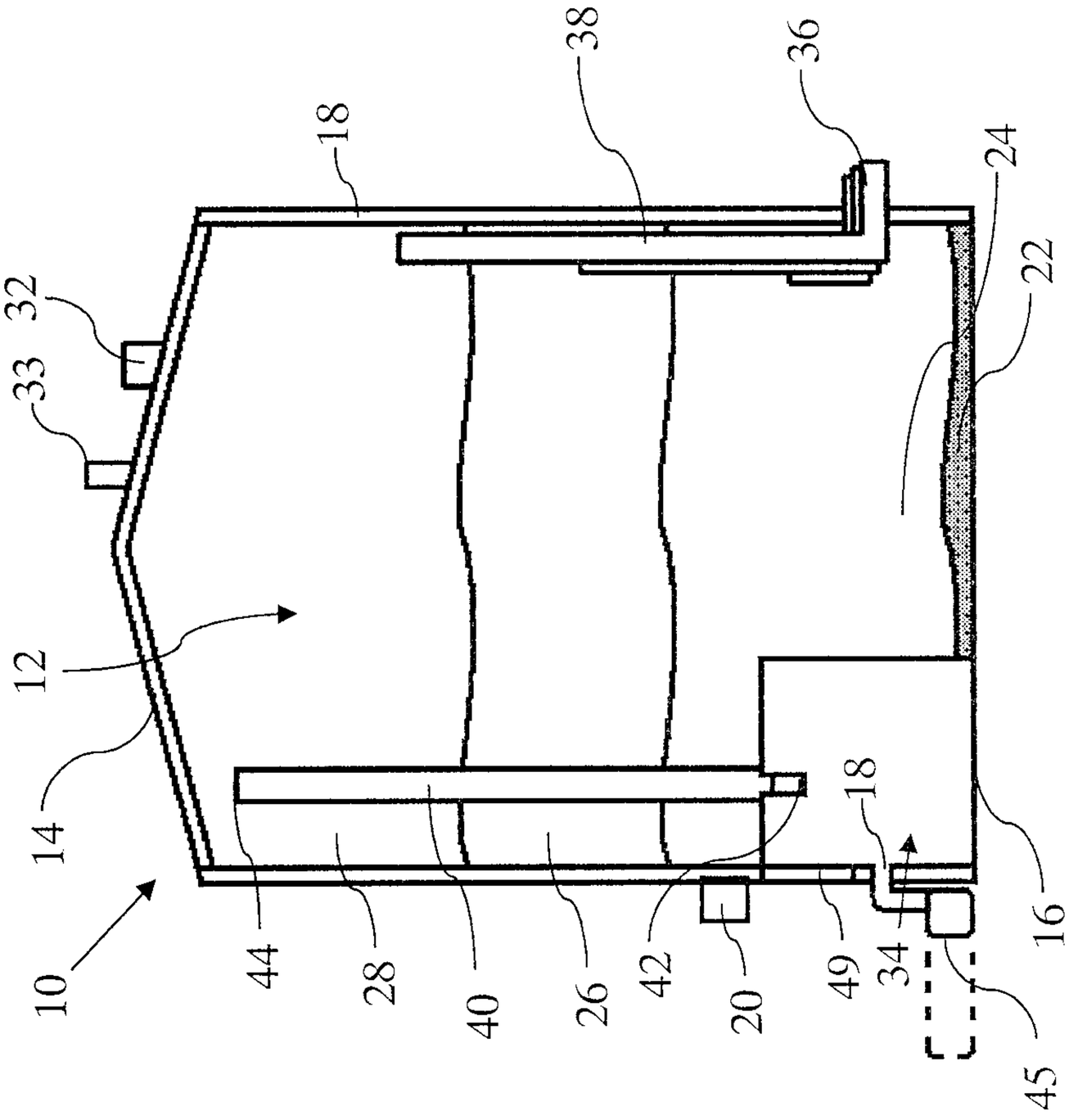
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FIG. 2

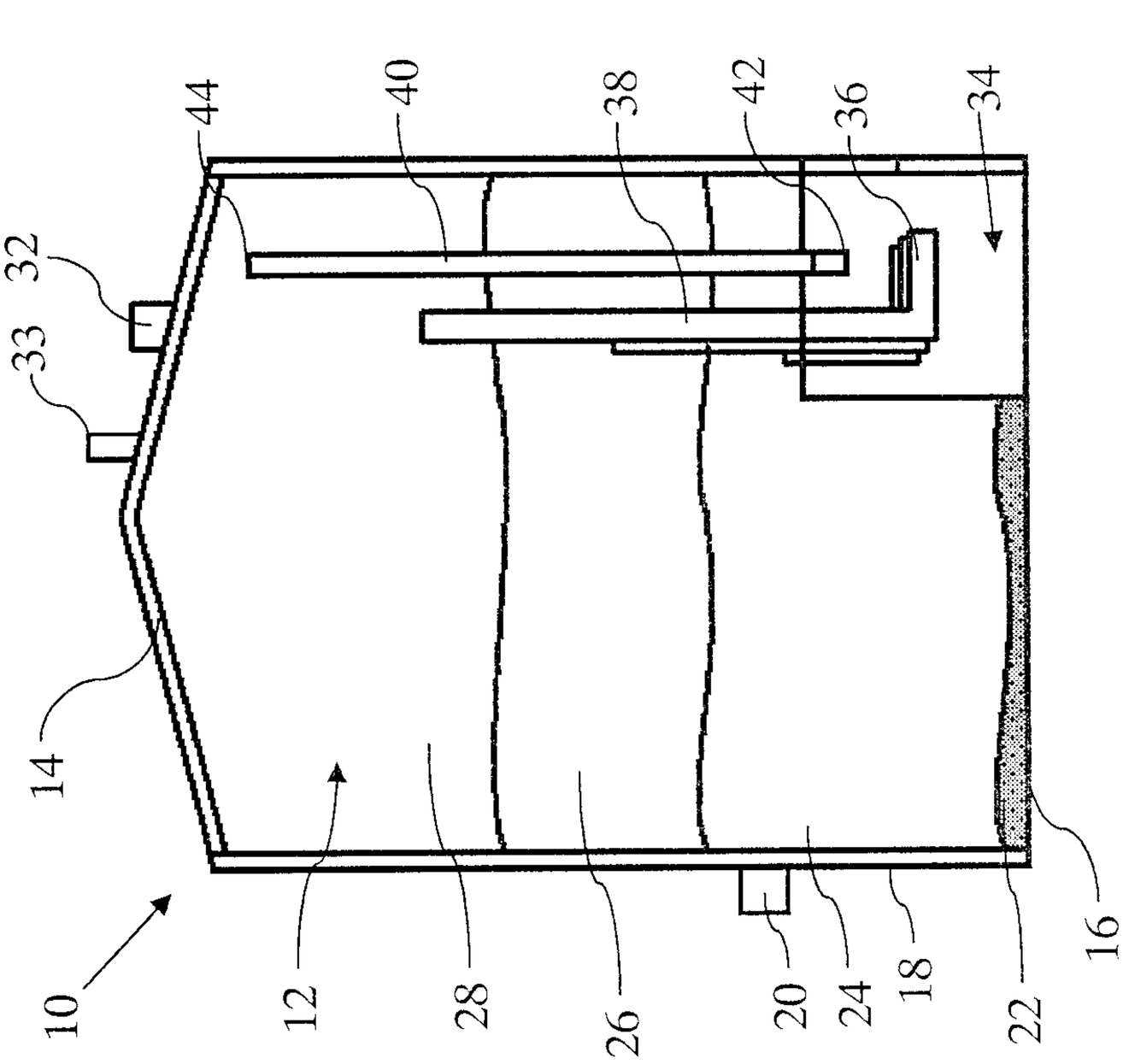
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FIG. 1

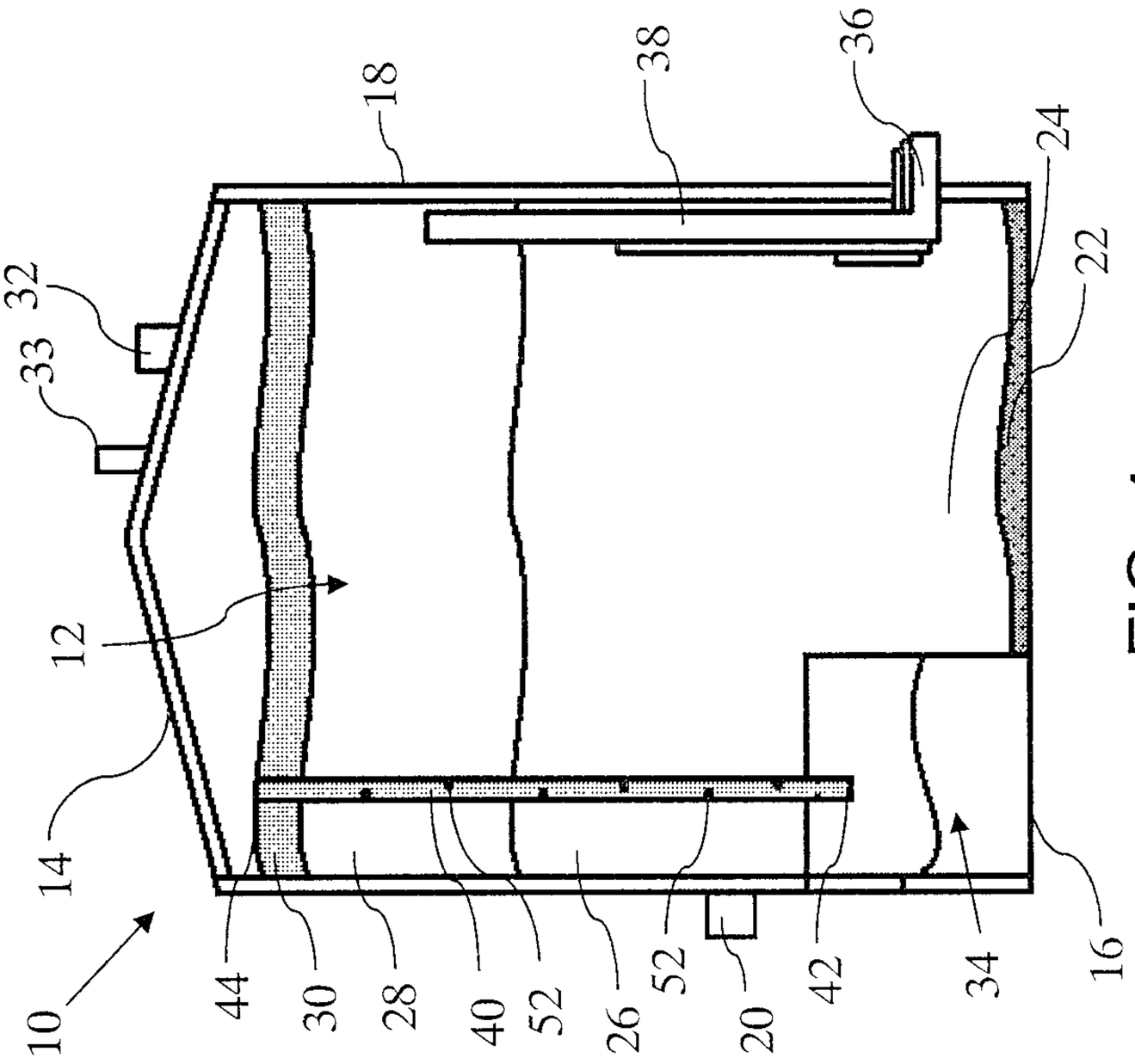
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FIG. 4

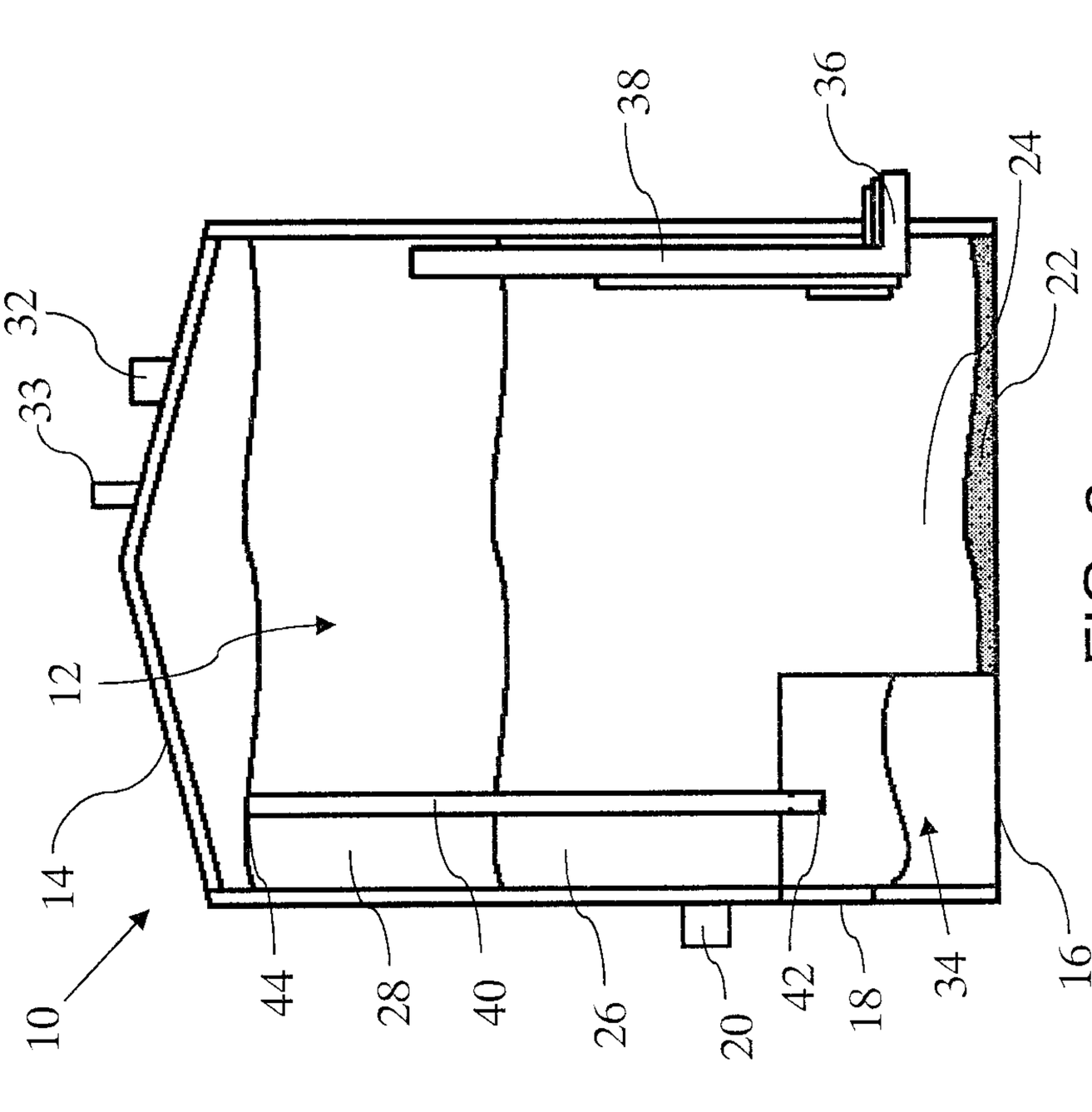
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FIG. 3

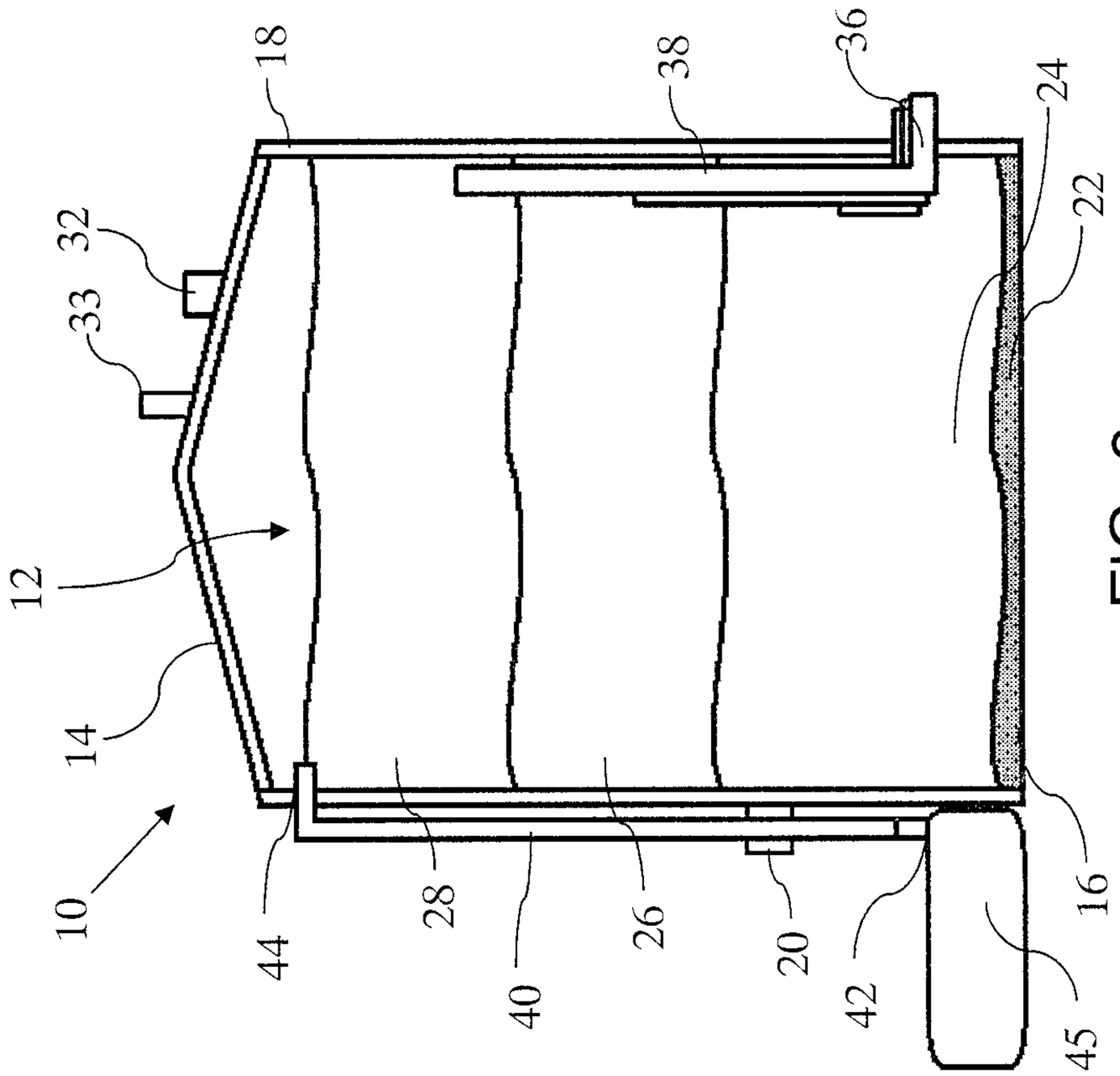
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FIG. 6

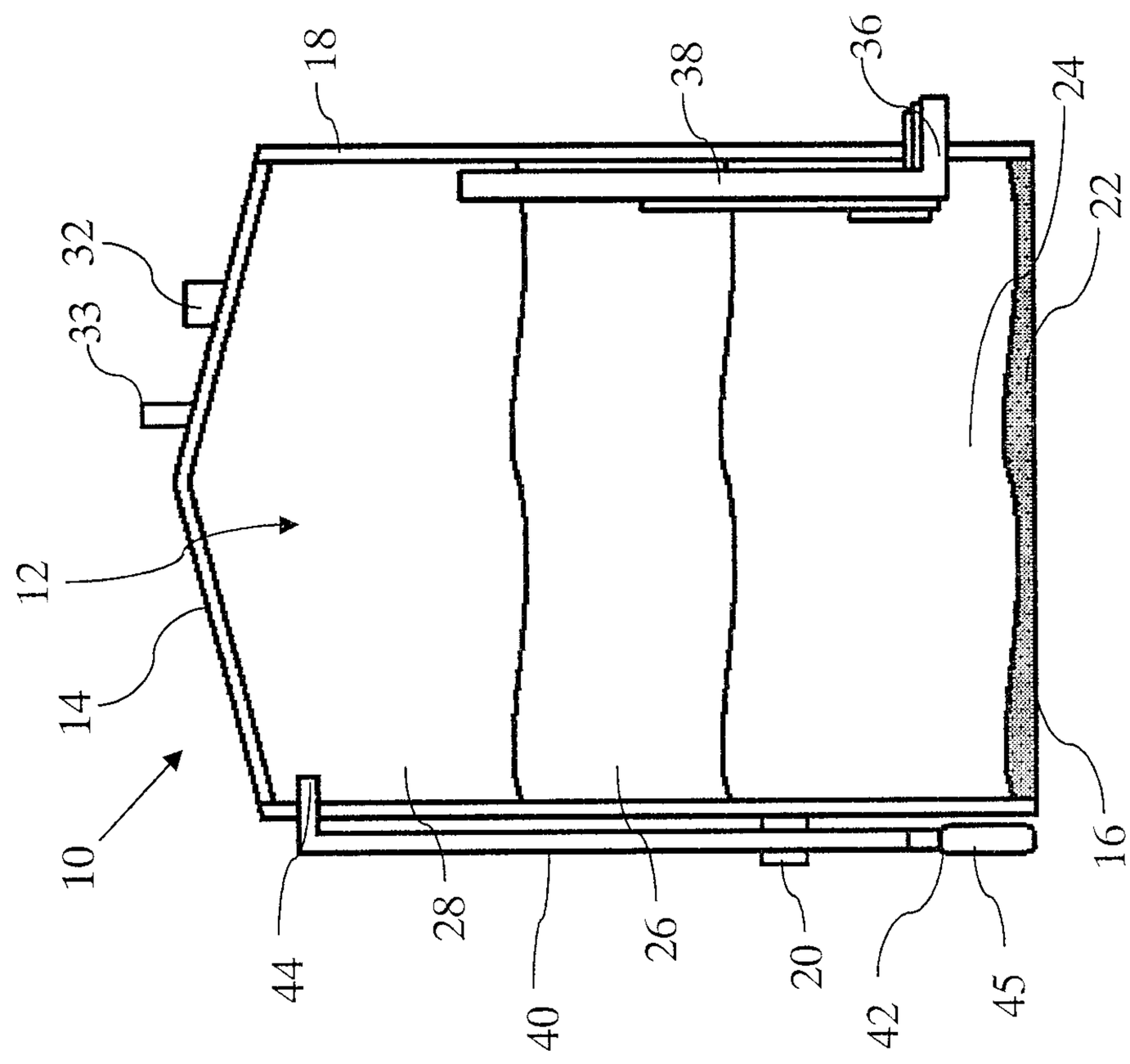
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FIG. 5

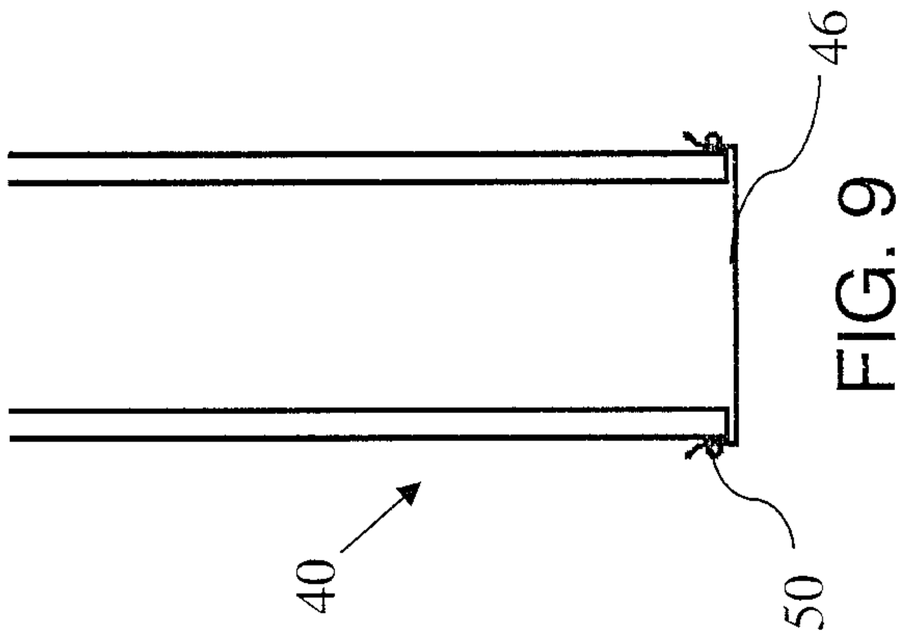
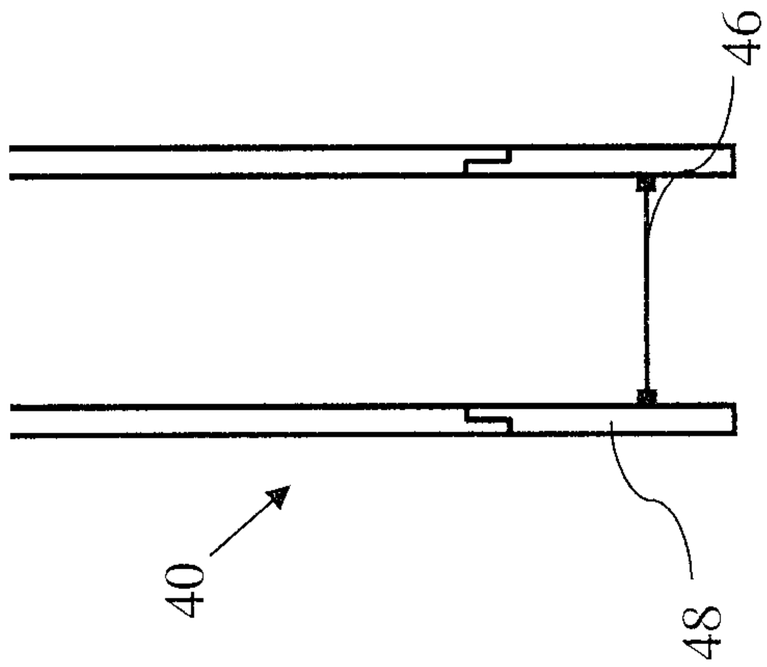


FIG. 9



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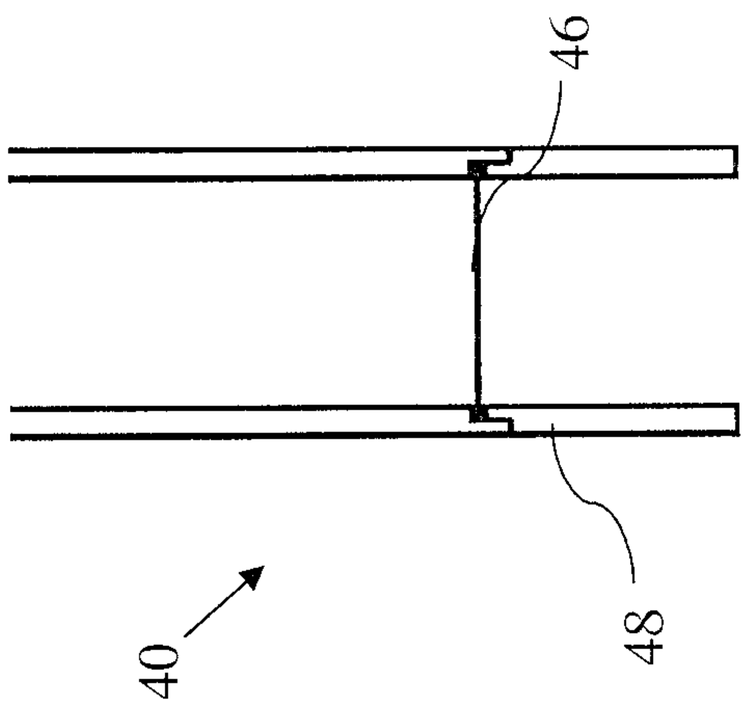


FIG. 7

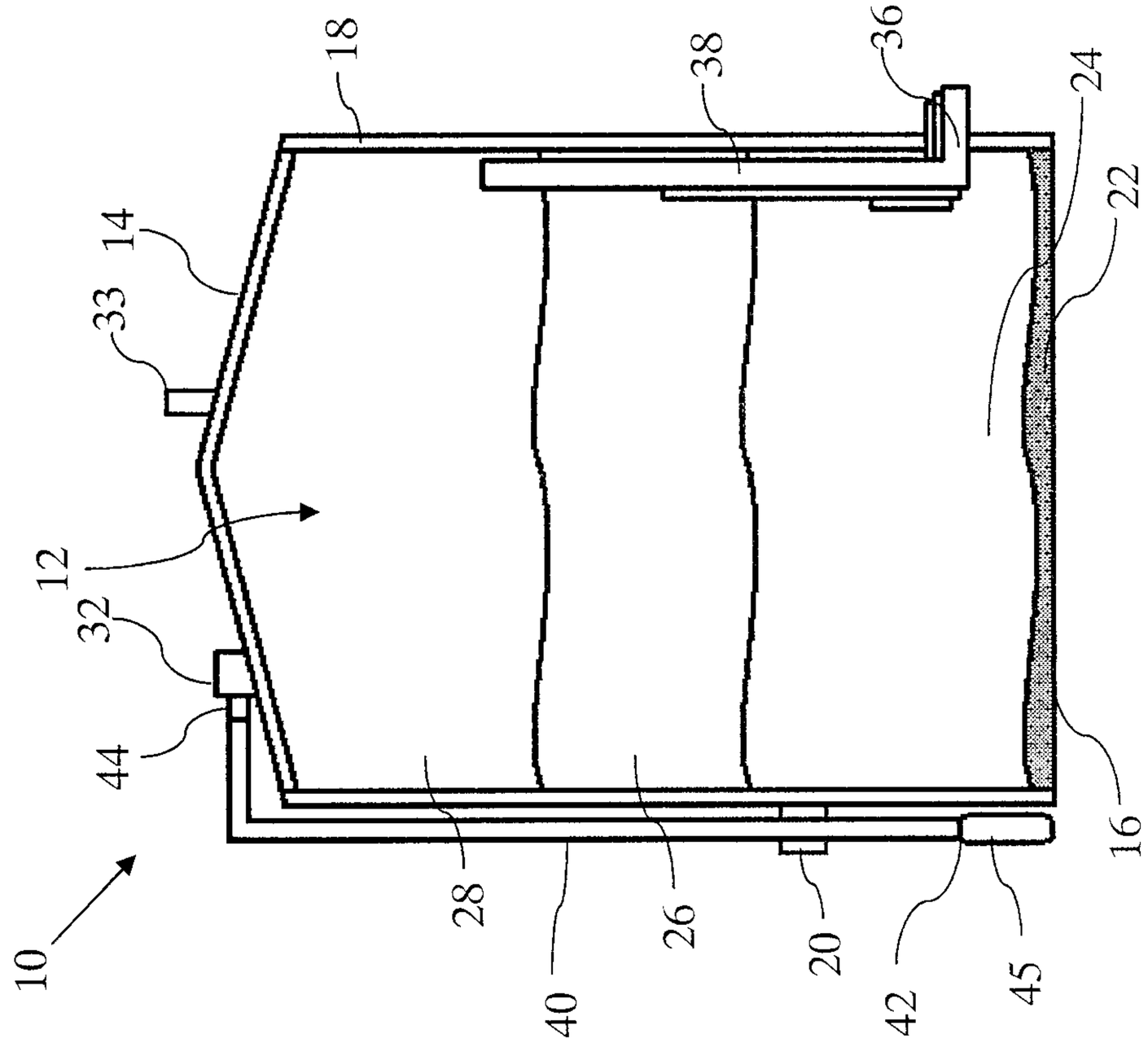


FIG. 11

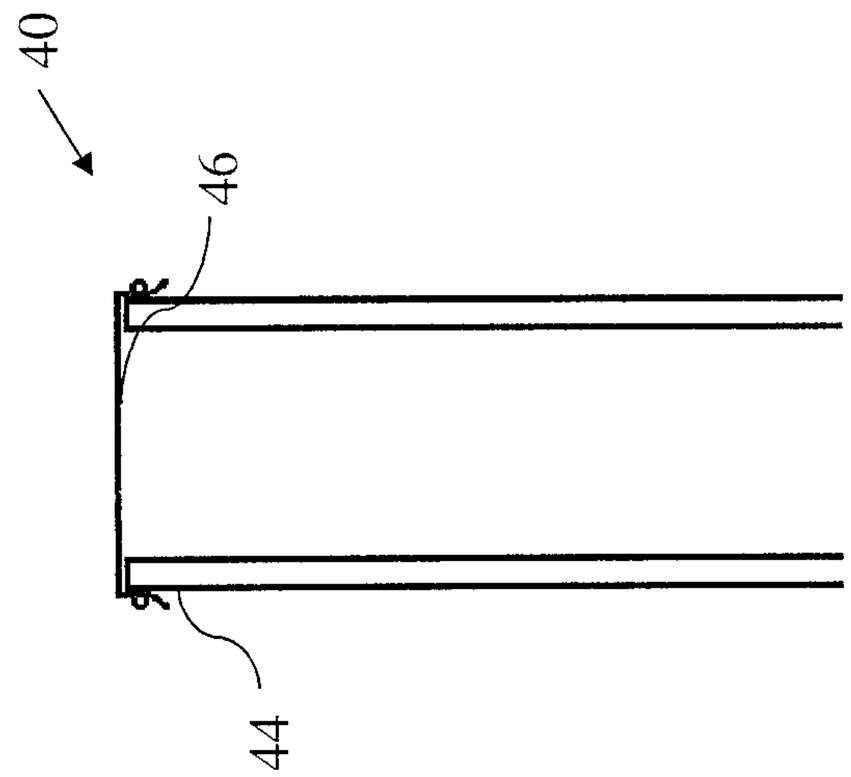
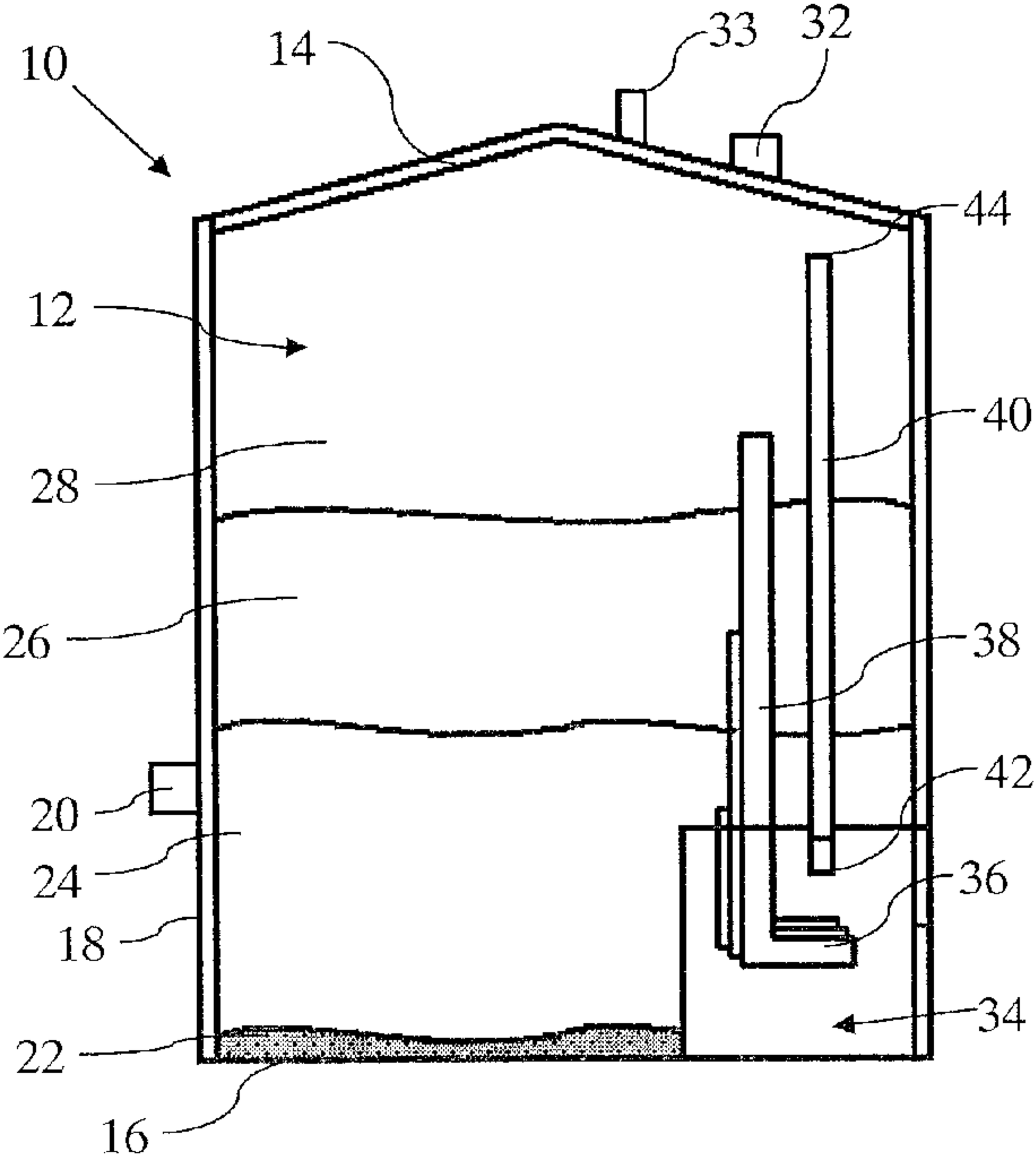


FIG. 10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