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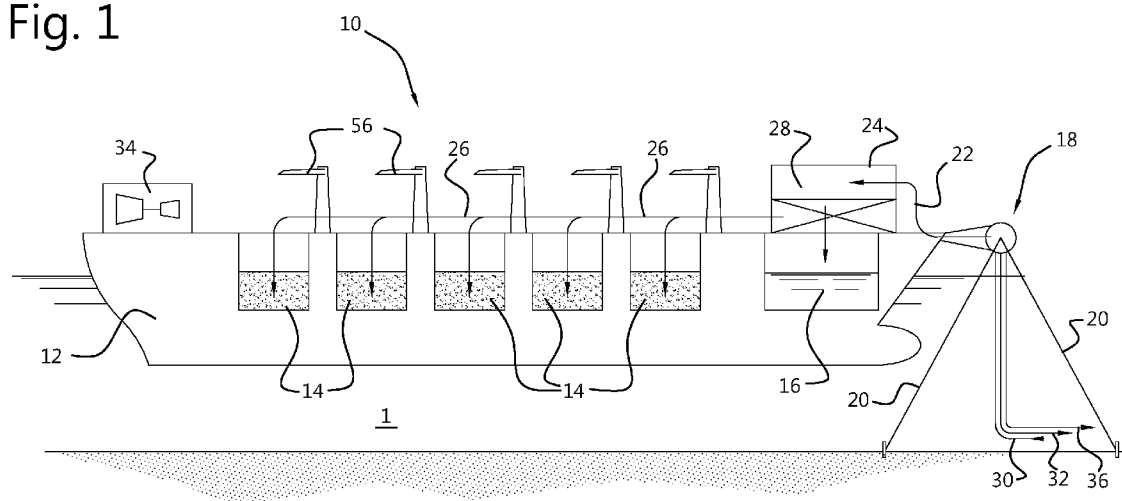
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(54) Title: FLOATING DEWATERING STORAGE AND OFFLOADING VESSEL

Fig. 1



(57) Abstract: A vessel for storage and offloading of a particulates material, to be moored at an location accessible to a bulk carrier, includes storage holds, an inlet system for receiving a slurry of particulates material mixed with liquid, a drying facility connected to the inlet system for receiving a feed from the slurry and forming the particulates based material by drying the received feed, and a loader/unloader for receiving the dried particulates material from the drying facility and loading the received material into the holds and for unloading the particulates material into a bulk carrier. The drying facility is located on a topsides structure of the vessel and includes a plurality of filter presses arranged on the topsides structure and configured to operate in parallel for drying the feed, with each filter press having an entry connected to the inlet system through a slurry conduit for receiving the feed.



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Floating Dewatering Storage and Offloading Vessel

Technical field

5 The present invention relates to a vessel for storage and offloading of a solid particulates based material. Additionally, the invention relates to a method of storage and offloading of a solid particulates based material for such a vessel.

Background

10 Onshore mining operations usually take place in areas remote from factories where minerals are processed into for example metals or chemical compounds. As a consequence large amounts of minerals must be transported from a mining location to a factory. In many cases this involves shipment of the minerals oversea in bulk carriers. The use of bulk carriers requires that a deep water harbour is to be developed near the location of the mining operations at relatively high costs.

15 To avoid the need for a construction of a deep water harbour suitable for bulk carriers, a transshipment system using transfer barges can be used to transport the minerals from the mining location to a location where bulk carriers can be moored and loaded. However, transshipment may be inefficient due to the relatively low transfer rates by the transfer barges.

20 It is an objective of the invention to overcome or mitigate the disadvantages from the prior art.

Summary

25 The objective is achieved by a vessel for storage and offloading of a solid particulates based material to be moored at an offshore location accessible to a bulk carrier, comprising: a plurality of holds within the vessel; an inlet system for receiving a slurry feed, the slurry consisting of a mixture of the solid particulates based material and liquid; a drying facility connected to the inlet system for receiving the slurry feed from the inlet system and arranged for forming a solid particulates based material product by drying the received feed, 30 and a loader/unloader for receiving the solid particulates based material product from the drying facility and loading the received product into the holds and for unloading the solid particulates based material product from the holds into the bulk carrier during side by side mooring, wherein the drying facility is located on a topsides structure of the vessel, and the drying facility comprises a plurality of filter presses arranged on the topsides structure and

configured to operate in parallel for removal of liquid from the slurry feed, in which each filter press has an entry connected to the inlet system through an associated slurry conduit for receiving the slurry feed.

Advantageously, the invention provides a vessel which has a drying facility which
5 comprises a number of filter presses running in parallel according to a predetermined processing sequence, such that a continuous drying process is obtained which allows a relatively quick storage process and if required a direct offloading to the bulk carrier.

Additionally, the invention provides a vessel as an offloading terminal at an offshore
10 location reachable by a bulk carrier which removes the need for building a deep water harbour and reduces costs accordingly. Moreover, by using a soft yoke mooring arrangement the bulk carrier can be moored side by side with the vessel.

Advantageous embodiments are further defined by the dependent claims.

Brief description of drawings

15 The invention will be explained in more detail below with reference to drawings in which illustrative embodiments thereof are shown. The drawings are intended exclusively for illustrative purposes and not as a restriction of the inventive concept. The scope of the invention is only limited by the definitions presented in the appended claims.

Figure 1 shows a cross-sectional view of a vessel according to an embodiment;
20 Figure 2 shows a top view of the vessel of Figure 1, and
Figure 3 shows a schematic view of processing modules on the vessel.

Description of embodiments

Embodiments of the present invention will be described hereinafter, by way of
25 example only, with reference to the accompanying drawings which are schematic in nature and therefore not necessarily drawn to scale. In the drawings, identical or similar elements are indicated by the same reference sign.

Figure 1 shows a cross-sectional view of a vessel according to an embodiment.

At an offshore site 1 a vessel 10 according to an embodiment of the invention is
30 located at sea 1 in water with sufficient depth where a bulk carrier (not shown) can be moored. The vessel 10 consists of a hull 12 in which a number of storage holds 14, 16 is arranged.

According to an embodiment, the vessel is provided with a soft yoke 18 at the bow which is attached to the seabed by means of mooring lines 20. Alternatively, the vessel may
35 be provided with an external turret.

The mooring of the vessel 10 is configured such that side-by-side mooring with the bulk carrier can be facilitated.

Further, the vessel comprises an inlet system 22 for receiving slurry, a drying facility 24 for drying the slurry, a loader/unloader system 26 for transporting the dried slurry to the holds or from the holds to one or more holds in the bulk carrier.

In an embodiment, the power generator system comprises a gas-turbine and an electric generator driven by the gas-turbine. The gas-turbine is driven by LNG which is stored in a tank on or in the hull of the vessel.

The inlet system is arranged to receive a slurry consisting of a mixture of mineral particulates and a liquid from an onshore mining facility through a subsea pipe 30.

In an embodiment, the inlet system is arranged at the soft yoke and may comprise a swivel for coupling with the subsea pipe.

On the vessel the received slurry is dried in the drying facility to form a mineral particulates based material, i.e., liquid is removed from the slurry up to a predetermined moisture level.

After the drying the mineral particulates based material is stored into holds 14 within the vessel. When a bulk carrier is moored side-by-side with the vessel, the dried mineral particulates based material is offloaded into one or more holds of the bulk carrier by means of the loader/unloader 26, from the storage holds 14 in the vessel or directly from the drying facility 24. The loader/unloader 26 comprises a conveyor belt system and a traveling ship-loader on a top deck of the vessel (both not shown here) as will be described in more detail with reference to Figure 2.

According to an embodiment, the drying facility 24 is arranged on the top deck as a topsides structure 28 located near the inlet system at the soft yoke 18 at the bow. The drying facility comprises a plurality of filter presses (not shown) which are each configured to receive slurry in a batch and to remove liquid from the slurry batch by mechanically pressing.

According to a further embodiment, the vessel 10 comprises a liquid collection system 16 comprising a volume for collecting the liquid removed from the slurry. From the volume the collected liquid may be returned to the onshore facilities for re-use through return subsea pipeline 32. Additionally, the liquid collection system may comprise an installation for recycling or purifying. Optionally, if the liquid is water, the liquid collection system comprises a liquid collection volume and a purification system to collect and clean-up water from the slurry before returning it to the onshore facilities.

The drying facility 24 will be described in more detail with reference to Figure 2 below.

Additionally, the vessel 10 comprises a power generator system 34 for providing electric power to any components of the inlet system, the drying facility and the loader/unloader. According to an embodiment, to improve operational conditions, the power generator can be configured to provide power to onshore activities (not shown) of the mining facility, for example to slurry pumps that drive the slurry flow through the subsea pipe 30. Power lines 36 to the onshore activities can be arranged along the soft yoke and subsea pipe on the seabed.

Figure 2 shows a top view of a layout of the top deck of the vessel of Figure 1.

On the top deck the drying facility 24 is arranged near the bow and the soft yoke 18. According to the invention the drying facility comprises a plurality of filter presses 38 which are configured for parallel operation to remove liquid from the received slurry batches and produce dried mineral particulates based material. The inlet system 22 is split into branches 44, 46 that each connect to a respective inlet 40 of one of the filter presses. Each of the filter presses 38 further has an outlet 42 for mineral particulates based material that is in communication with the loader/unloader 26. A second outlet 47 is configured to collect the liquid removed from the slurry and transferred the liquid to liquid collection volume 16.

The filter presses 38 are therefore arranged to operate in a sequence such that a substantially continuous throughput of slurry can be obtained. This improves the loading rate for the mineral particulates based material.

The sequence for each filter press involves at least three phases: a loading step for receiving the slurry feed into the filter press, a drying step for removal of liquid from the received slurry feed and an unloading step for unloading the dried slurry to the loader/unloader. By running the filter presses in a predetermined order, the different phases for the filter presses can be made to overlap. According to an embodiment, the filter presses 38 are connected to a controller 48 which controls the operational phases of each filter press to run in the predetermined order (indicated by dashed line 49).

The filter presses 38 can be arranged on the topsides structure in one or more rows and each filter press is supplied with the slurry feed by a dedicated branch or slurry conduit running between the inlet system and the respective filter press. Other arrangements of the filter presses 38 are conceivable as well.

The loader/unloader 26 on the vessel is configured for transport of the mineral particulates based material during storage into the holds and during offloading into a bulk carrier. The loader/unloader comprises at least two conveyor belts 50, 51 and a traveling ship-loader 52. A first conveyor belt 50 is at a supply end thereof coupled to the outlets 42 of the filter presses 38 and at a discharging end thereof in communication with the travelling

ship-loader 52 that handles the mineral particulates based material it receives from the first conveyor belt. The traveling ship-loader is configured to be moveable (indicated by arrows 55) and cover all holds 14 in the vessel for loading mineral particulates based material from the first conveyor belt.

5 Additionally, the traveling ship-loader 52 is configured (as shown in Figure 2) to extend (indicated by arrows 57) outside the sidewall of the hull 12 to a bulk carrier moored along the vessel for offloading to the bulk carrier.

10 A second conveyor belt 51 for offloading is provided in a longitudinal direction of the vessel 10 and extends along the holds 14 of the vessel. Above the second conveyor belt a hopper 54 is positioned next to each hold to receive mineral particulates based material from the respective hold. The mineral particulates based material is collected on the second conveyor belt from the holds by one or more cranes 56 positioned on the top deck via an additional conveyor belt 53 at each hold 14. A discharging end 58 of the second conveyor belt is in communication with the first conveyor belt 50 to transfer the material for offloading
15 via the first conveyor belt 50 and the traveling ship-loader 52.

Figure 3 shows a flow diagram for operation of the vessel.

20 In an onshore facility 60 a mixing device 62 produces a slurry that comprises mineral particulates and a liquid (e.g. water). The slurry is pumped 64 through a subsea pipeline 30 to the inlet system 22 of the vessel 10 that is moored at a suitable location 1 offshore. The inlet system is arranged to receive and distribute the slurry to the drying facility that comprises a plurality of filter presses 38 that are configured to run in parallel to each other according to a predetermined sequence order. The filter presses are each arranged to remove the liquid from the slurry. The liquid is pumped to a liquid collection system 16 which may comprise purification and clean subsystems 66. In an embodiment, the collected liquid
25 is returned to the onshore facility 60 for water treatment 68 and/or re-use through a return subsea pipeline 32. The dried mineral particulates based material that is produced in the filter presses is transferred to the loader/unloader 26 to be stored in holds of the vessel and/or offloaded to a bulk carrier.

30 The invention has been described with reference to the preferred embodiment. Obvious modifications and alterations will occur to the skilled person upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims.

Claims

1. A vessel for storage and offloading of a solid particulates based material to be moored at an offshore location accessible to a bulk carrier, comprising:
a plurality of holds within the vessel;
5 an inlet system for receiving a slurry, the slurry consisting of a mixture of the solid particulates based material and liquid;
a drying facility connected to the inlet system for receiving a slurry feed from the received slurry and forming the solid particulates based material by drying the received feed, and
10 a loader/unloader for receiving the dried solid particulates based material from the drying facility and loading the received material into the holds and for unloading the solid particulates based material from the holds into the bulk carrier during side by side mooring;
wherein:
15 the drying facility is located on a topsides structure of the vessel:
the drying facility comprises a plurality of filter presses arranged on the topsides structure and configured to operate in parallel for removal of liquid from the slurry feeds, in which each filter press has an entry connected to the inlet system through an associated slurry conduit for receiving the slurry feed.
20
2. The vessel according to claim 1, wherein each filter press comprises an outlet for transferring the solid particulates based material from the filter press to the loader/unloader.
- 25 3. The vessel according to claim 1 or 2 wherein the drying facility is arranged with a controller for operating each of the filter presses in a predetermined order.
4. The vessel according to claim 3, wherein each filter press is configured to perform operational steps comprising a loading step for receiving the slurry feed into the filter
30 press, a drying step for removal of liquid from the received slurry feed and an unloading step for unloading the dried slurry to the loader/unloader and
the controller is arranged to run the filter presses according to the operational steps in a sequential predetermined order such that during operation at least one of the filter presses is in the loading step, at least another filter press is in the drying step and at

least one other filter press is in the unloading step.

5. The vessel according to claim 3 or claim 4, wherein the inlet system comprises distribution means for distributing the received slurry to each filter press, and the controller is configured to control the distribution means to generate a flow of the slurry feeds to each filter press in accordance with the sequential predetermined order.
5
6. The vessel according to any one of the preceding claims, wherein the inlet system is arranged for connection with a subsea pipe for receiving slurry supplied by an onshore slurry production facility.
10
7. The vessel according to any one of the preceding claims, comprising a liquid collecting system for receiving liquid removed from the slurry by the filter presses.
15
8. The vessel according to claim 7, further comprising a liquid treatment system for liquid received in the liquid collecting system.
9. The vessel according to either claim 7 in combination with claim 6, or claim 8 in combination with claim 6, wherein the liquid collecting system is arranged for returning the received liquid to the onshore slurry production facility by a returning subsea pipe.
20
10. The vessel according to any one of the preceding claims, comprising a power generator system for supplying power to at least the drying facility and the loader/unloader.
25
11. The vessel according to claim 10 and claim 6, wherein the power generator system is further arranged for supplying power to the onshore slurry production facility.
30
12. The vessel according to any one of the preceding claims, wherein the loader/unloader comprises a conveyor belt system and a traveling ship-loader each arranged on the top deck of the vessel; the traveling ship-loader being configured to:
35
 - be moveable along the length of the vessel,
 - be positioned over each of the holds in the vessel during storage and,

- extend outside the hull for offloading to a bulk carrier moored along the vessel.

13. The vessel according to claim 12, wherein the conveyor belt system comprises a first conveyor belt and at least a second conveyor belt;

5 the first conveyor belt extending between the outlets of the drying facility and the ship-loader;

the second conveyor belt extending along the length of the vessel and arranged for receiving mineral particulates based material from one or more of the holds during offloading;

10 a discharging end of the second conveyor belt being in communication with the first conveyor belt for transfer of the mineral particulates based material from the one or more holds to the ship-loader.

14. The vessel according to any one of the preceding claims, wherein the vessel is
15 arranged for mooring in coastal waters near an onshore mining facility, using either a soft yoke mooring arrangement or an external turret mooring arrangement.

15. A method for storage and offloading of a solid particulates based material at an offshore location comprising:

20 providing a vessel with a plurality of holds, an inlet system for receiving a slurry consisting of a mixture of the solid particulates based material and liquid;

a drying facility connected to the inlet system for receiving a slurry feed from the received slurry and forming the solid particulates based material by drying the received feed, and a loader/unloader for receiving the dried solid particulates based
25 material from the drying facility and loading the received material into the holds and for unloading the solid particulates based material from the holds;

providing the drying facility on a topsides structure with a plurality of filter presses, the method further comprising:

30 receiving the slurry feed through the inlet system and distributing the slurry feed to the plurality of filter presses;

operating the filter presses in parallel in a predetermined order with

at least a first filter press running a loading step for receiving the slurry feed,

at least a second filter press running a drying step for removal of liquid from the received slurry feed and

at least a third filter press running an unloading step for unloading the dried slurry feed to the loader/unloader.

Fig. 1

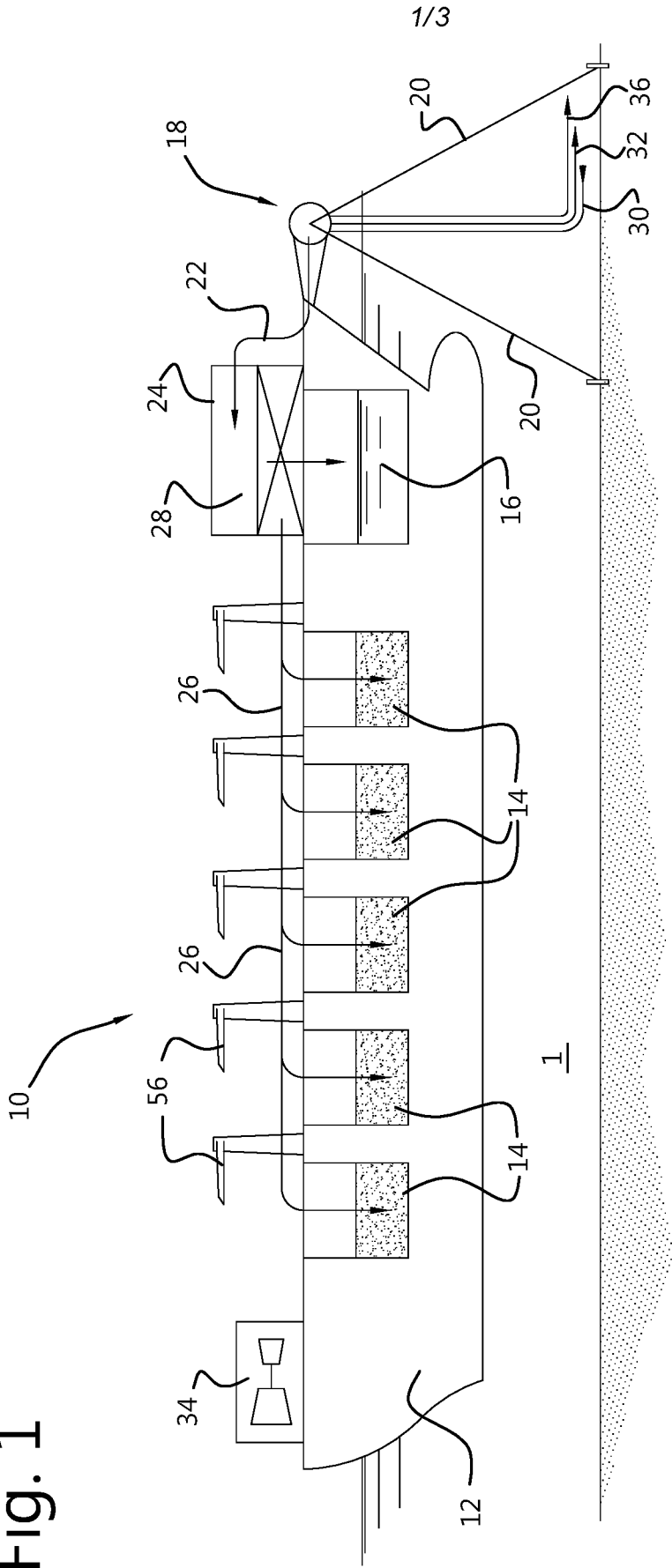


Fig. 2

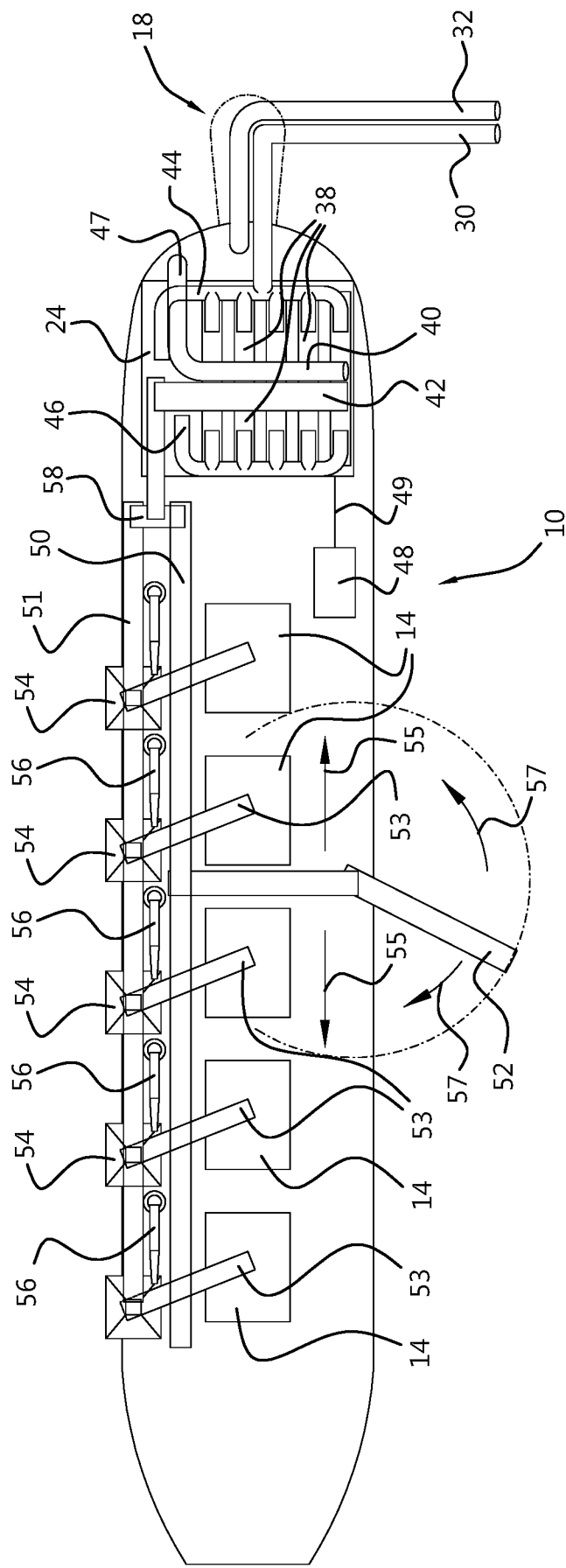


Fig. 3

