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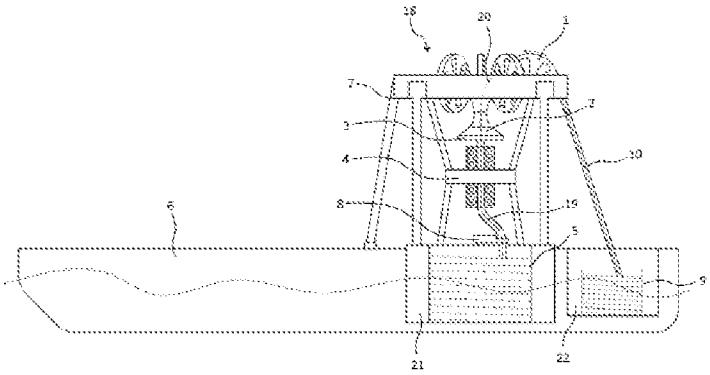
(54) Title **Floating cable factory**

(56) References Cited: WO 2015/112007 A1, WO 2015/110778 A1, EP 0919458 A1, EP 1189322 A1, US 005813106 A, EP 2085308 A2

(57) Abstract

Floating cable factory, comprising a production vessel (6), a super structure (18) on said production vessel (6) for receipt and combination of single core cables (20), several cable supply tanks (22) with feeder turrets (9) for providing said single core cables (20) to the super structure (18), and at least one main cable tank (21) with a center turret (5), said main cable tank (21) is placed centrally below the super structure (18) for receipt of a main cable (19) wound in the super structure (18).



Field of the invention

The present invention relates to a floating cable factory, for production of for instance subsea umbillicals, comprising a cable production vessel, and a super structure on said production vessel for receipt and combination of single core cables.

Subsea umbillicals are designed for the transmission of power, fluids, electrical and optical control to offshore installations. Subsea production umbilicals include many different components to suit a mix of power and control functions needed offshore and subsea as thermoplastic hoses or steel tubes provide hydraulic valve control functions and low voltage cables are used for communications.

The power cable/conductor is made up of wires of metal and an insulation layer made of either EPR (ethylene propylene rubber) or XLPE (cross-linked polyethylene). The power cables are twisted together into a helix with plastic hoses or steel tubes and fiber optics in a vertical or horizontal bundling machine. The process of twisting enables the composite bundles to be bent much tighter than if the function were straight, enabling the power cable or umbilical to be shipped and installed with greater ease.

A strength member can be added as a steel wire and as a layer of steel wires forming an armor on the outside of the bundle. Fill members as ropes or plastic material can be added to fill the internal gaps and petroleum gels can add water resistance. The outer coiled steel or aluminum layer provides mechanical protection, tensile strength and impact protection.

An outer sheath encases all the other layers. A sheath is frequently made from a continuously extruded thermoplastic material such as polyethylene, which has the physical strength and moisture resistance capabilities.

Most global production facilities utilize horizontal lay up machines. Some few manufacturers utilize vertical machines, mainly so-called EZ production principle or non-helical.

Prior art

WO 2015/112007 A1 discloses a method for manufacturing a subsea pipeline and spooling said pipeline onto a reel or a carousel of a pipe laying vessel at a spool

base. The method comprises connecting pipes end-to-end at a pipeline assembly station to form a continuous pipeline stalk. The continuous pipeline stalk is spooled directly from the pipe assembly station onto a floating intermediate pipeline storage device that is adjacent the pipeline assembly station and the stalk is temporarily stored thereon. The pipeline stalk is later spooled from the floating intermediate temporary pipeline storage device onto the reel of the pipe laying vessel. The floating intermediate pipeline storage device is a carousel pipeline storage device which has an annular floating base that is assembled from multiple barges which are interconnected in an annular array and having an above waterline carousel.

US 005813106 discloses a method and apparatus for manufacturing and laying out an umbilical, and EP 2085308 A2 discloses an apparatus with a floating container for a cable.

Objects of the present invention

The system for umbillicals and subsea cable production according to the invention utilizes known technology in a new and innovative configuration creating a new methodology and production technology for producing long umbillicals and subsea cables.

The utilization of floating turrets and a floating factory enables the production of much longer continuous length subsea cables than present global capabilities.

The benefit of the floating cable factory is significantly longer continuous process cables without welding joints, significantly simplified logistics and processing and significantly cost reduction.

The floating factory can also be moved close to marked.

It is also an object of the invention to provide a floating cable factory in where cable tanks easily can be driven in or out from a production tower.

Summary of the invention

The present invention relates to a floating cable factory, comprising:

- a cable production vessel,
- a super structure on said production vessel for receipt and combination of single core cables,

- several cable supply tanks with feeder turrets for providing said single core cables to the super structure, said cable supply tanks are placed floating in or adjacent the production vessel,
- at least one main cable tank with a center turret, said main cable tank is placed floating in a slot in the production vessel and centrally below the super structure for receipt of a main cable wound in the super structure,
- said superstructure comprises a vertical turntable frame equipped with several vertical turn wheels supporting the single core cables received from the feeder turrets in the cable supply tanks,
- said superstructure comprises a collecting guide for receipt of the single core cables from the vertical turn wheels, and a distribution and turn restrictor wheel placed downstream of the collecting guide, and
- said superstructure comprises a rotational pull assembly placed downstream of the distribution and turn restrictor wheel.

Further, the center turret can be placed rotational and floating in the main cable tank.

Further, said feeder turrets can be placed rotational and floating in each cable supply tank.

One or more cable supply tanks can be placed floating in a slot in the production vessel.

A rotational distribution guide can be placed above the main cable tank.

Said main cable tank can be driven in or out of the production vessel. Said cable supply tanks can also be driven in or out of the production vessel, or be driven to or away from the production vessel.

Each cable supply tank can comprise a rotational feeder guide for guiding of the single core cable from the feeder turret.

In a second embodiment, the floating cable factory may further comprise a final product line assembly with one or more extruders, water cooling, gas super cooling and pulling units for finalizing the cable, and a floating final product export tank for receipt of the final assembled main cable.

The final product export tank can comprise a rotational and floating turret for receipt of the final assembled main cable.

The main cable can be supplied from the main cable tank and to the final product line assembly.

Description of the figures

Embodiments of the present invention will now be described, by way of example only, with reference to the following figures, wherein:

Figure 1 is a simplified cross-sectional side view of the invention, along the line A-A in figure 2.

Figure 2 is a simplified top view of the invention.

Figure 3 is a simplified cross-sectional side view of a second embodiment of the invention, along the line A-A in figure 4.

Figure 4 is a simplified top view of the second embodiment of the invention.

Description of preferred embodiments of the invention

A main cable tank 21 with a center turret 5 is placed in a slot 23 of a production vessel 6 with a production tower or super structure 18. The vessel 6 can be a ship, barge, or other floating installation.

Required number of cable supply tanks 22 with feeder turrets 9 is placed in selected positions around the production vessel 6. The cable supply tanks 22 comprises single core cables 20 for production of for instance an umbilical. The cable supply tanks 22 are labeled A,B,C,D,E,F,G,H in figures 2 and 4.

Individual single core cables, hoses or tubes 20 are pulled out of the rotational feeder turrets 9 and over vertical turn wheels 1 in the super structure 18. The single core cables 20 are thereafter led down through a collecting guide 2 with a distribution and turn restrictor wheel 3, and through a rotating pull assembly 4. From the rotating pull assembly 4 the wounded main cable 19 is led through a rotational distribution guide 8 and into the rotating center turret 5 in the main cable tank 21.

The vertical turn wheels 1, the rotational pull assembly 4, the rotational center turret 5, the rotational feeder turret 9, the hose or tube 10 for the single core cable 20, and rotational feeder guide 11 are electronically controlled by one unique control system

where all units automatically adjust speed, pull and rotation. Each and every unit is tuned and can adjust itself automatically.

The rotational center turret 5 is placed floating in the main cable tank 21, and can be turning clockwise. The rotational feeder turret 9 can likewise be placed floating in each cable supply tank 22, and can be turning anti-clockwise.

The floating cable factory can also comprise a final product line assembly, as shown in figures 3 and 4. A guide arm 14 guides the main cable 19 out of the main cable tank 21. It is possible that the main cable tank 21 can be omitted and the main cable 19 can be led from the super structure directly to the final product line assembly.

Several pulling units 17 can be used to pull the main cable 19 along the final product line. The final product line assembly further comprises several units, such as extruders 12, gas super cooling 16 and water cooling 15, or other equipment, to prepare and coat the final main cable 19.

After the preparing and finalizing of the main cable 19, the main cable 19 is fed by a guide arm 14 to a turret 13 in a final product export tank 24. The final product export tank 24 is floating next to the production vessel 6. The turret 13 can be placed rotational and floating in the final product export tank 24, similar to the feeder turret 9 and center turret 5.

After the bundling is complete and the main tank 21 with the center turret 5 is filled with the bundled cable/umbilicals 19, the bundled cable 19 will be pulled out of the center turret 5 assisted by the guiding arm 14 and into the extruderline for installing the outer sheet and finally guided 14 into the turret 13 of the floating export tank 24.

The floating export tank 24 can for instance keep more than 4000 ton of final product (cable/ umbilical). This tank 24 can be floated into special modified transport- or installation-ships.

The main cable 19 can as mentioned be an umbilical. An umbilical is a thick, complex and normally reinforced cable wound together of steel pipes and several thinner cables for power, fiber, communication, hydraulics, chemistry, and/or other cables, for surveillance and control of subsea wells. The single cables 20 can thus be any of the latter.

Claims

1. Floating cable factory, comprising:
- a cable production vessel (6),
- a super structure (18) on said production vessel (6) for receipt and combination of single core cables (20), characterized by
- several cable supply tanks (22) with feeder turrets (9) for providing said single core cables (20) to the super structure (18), said cable supply tanks (22) are placed floating in or adjacent the production vessel (6),
- at least one main cable tank (21) with a center turret (5), said main cable tank (21) is placed floating in a slot (23) in the production vessel (6) and centrally below the super structure (18) for receipt of a main cable (19) wound in the super structure (18),
- said superstructure (18) comprises a vertical turntable frame (7) equipped with several vertical turn wheels (1) supporting the single core cables (20) received from the feeder turrets (9) in the cable supply tanks (22),
- said superstructure (18) comprises a collecting guide (2) for receipt of the single core cables (20) from the vertical turn wheels (1), and a distribution and turn restrictor wheel (3) placed downstream of the collecting guide (2), and
- said superstructure (18) comprises a rotational pull assembly (4) placed downstream of the distribution and turn restrictor wheel (3).

2. Floating cable factory according to claim 1, characterized in that the center turret (5) is placed rotational and floating in the main cable tank (21).

3. Floating cable factory according to claim 1, characterized in that said feeder turrets (9) are placed rotational and floating in each cable supply tank (22).

4. Floating cable factory according to claim 1, characterized in that one or more cable supply tanks (22) are placed floating in the slot (23) in the production vessel (6).

5. Floating cable factory according to claim 1, characterized in that a rotational distribution guide (8) is placed above the main cable tank (21).

6. Floating cable factory according to claim 1, characterized in that said main cable tank (21) can be driven in or out of the production vessel (6).

7. Floating cable factory according to claim 1, characterized in that said cable supply tanks (22) can be driven in or out of the production vessel (6), or be driven to or away from the production vessel (6).

8. Floating cable factory according to claim 1, characterized in that each cable supply tank (22) comprises a rotational feeder guide (11) for guiding of the single core cable (20) from the feeder turret (9).

9. Floating cable factory according to claim 1, characterized by further comprising a final product line assembly with one or more extruders (12), water cooling (15), gas super cooling (16), and pulling units (17) to prepare a final assembled main cable (19), and a floating final product export tank (24) for receipt of the final assembled main cable (19).

10. Floating cable factory according to claim 9, characterized in that the final product export tank (24) comprises a rotational and floating turret (13) for receipt of the final assembled main cable (19).

11. Floating cable factory according to claim 9, characterized in that the main cable (19) is supplied from the main cable tank (21) and to the final product line assembly.

Patentkrav

1. Flytende kabelfabrikk, omfattende:
- et kabelproduksjonsfartøy (6),
- en overbygning (18) på nevnte produksjonsfartøy (6) for mottak og sammenstilling av enkjernekabler (20), karakterisert ved
- flere kabelforsyningstanker (22) med matedreieskiver (9) for forsyning av nevnte enkjernekabler (20) til overbygningen (18), der kabelforsyningstankene (22) er plassert flytende i eller tilstøtende produksjonsfartøyet (6),
- minst en hovedkabeltank (21) med en senterdreieskive (5), der hovedkabeltanken (21) er plassert flytende i en spalte (23) i produksjonsfartøyet (6) og sentralt under overbygningen (18) for mottak av en hovedkabel (19) viklet i overbygningen (18),
- nevnte overbygning (18) omfatter en vertikal dreiebordramme (7) utstyrt med flere vertikale dreiehjul (1) som understøtter enkjernekablene (20) mottatt fra matedreieskivene (9) i kabelforsyningstankene (22),
- nevnte overbygning (18) omfatter en samleører (2) for mottak av enkjernekablene (20) fra de vertikale dreiehjulene (1), og et fordelings- og dreiebegrenserhjul (3) plassert nedstrøms av samleføreren (2), og
- nevnte overbygning (18) omfatter en roterende trekkesammenstilling (4) plassert nedstrøms av fordelings- og dreiebegrenserhjulet (3).

2. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at senterdreieskiven (5) er plassert roterbar og flytende i hovedkabeltanken (21).

3. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at nevnte materdreieskiver (9) er plassert roterbar og flytende i hver kabelforsyningstank (22).

4. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at en eller flere kabelforsyningstanker (22) er plassert flytende i spalten (23) i produksjonsfartøyet (6).

5. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at en roterbar fordelingsfører (8) er plassert over hovedkabeltanken (21).

6. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at hovedkabeltanken (21) kan drives inn eller ut av produksjonsfartøyet (6).

7. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at nevnte kabelforsyningstanker (22) kan drives inn eller ut av produksjonsfartøyet (6), eller drives til eller vekk fra produksjonsfartøyet (6).

8. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved at hver kabelforsyningstank (22) omfatter en roterbar matefører (11) for å lede enkjernekablene (20) fra matedreieskiven (9).

9. Flytende kabelfabrikk i samsvar med krav 1, karakterisert ved videre å omfatte en sluttproduktlinje-sammenstilling med en eller flere ekstrudere (12), vannkjøling (15), gassuperkjøling (16), og trekkeenheter (17) for å lage en sluttsammenstilt hovedkabel (19), og en flytende sluttprodukt-utføringstank (24) for mottak av den sluttsammenstilte hovedkabelen (19).

10. Flytende kabelfabrikk i samsvar med krav 9, karakterisert ved at sluttprodukt-utføringstanken (24) omfatter en roterbar og flytende dreieskive (13) for mottak av den sluttsammenstilte hovedkabelen (19).

11. Flytende kabelfabrikk i samsvar med krav 9, karakterisert ved at hovedkabelen (19) tilføres fra hovedkabeltanken (21) og til sluttproduktlinje-sammenstillingen

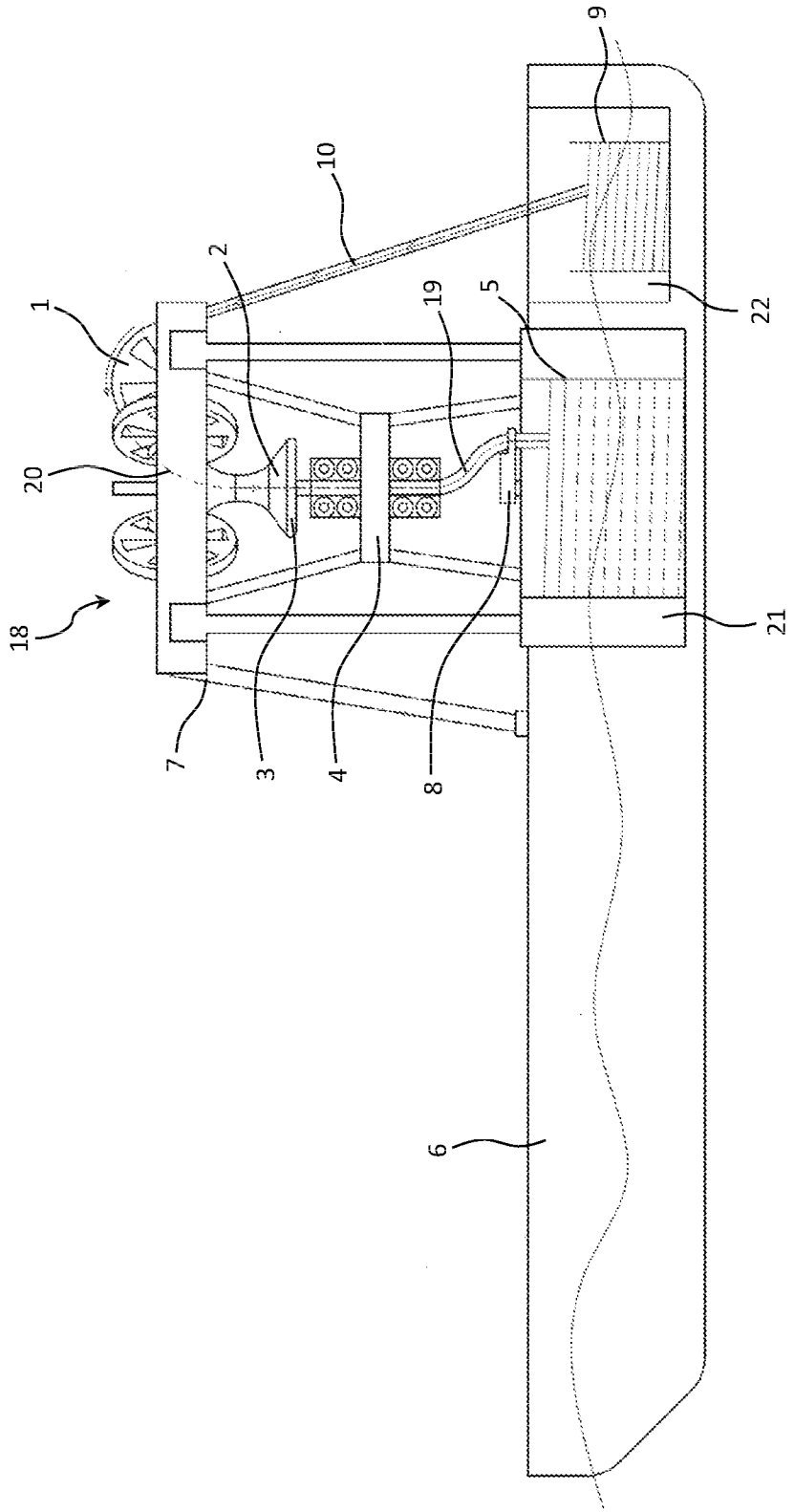


Fig. 1

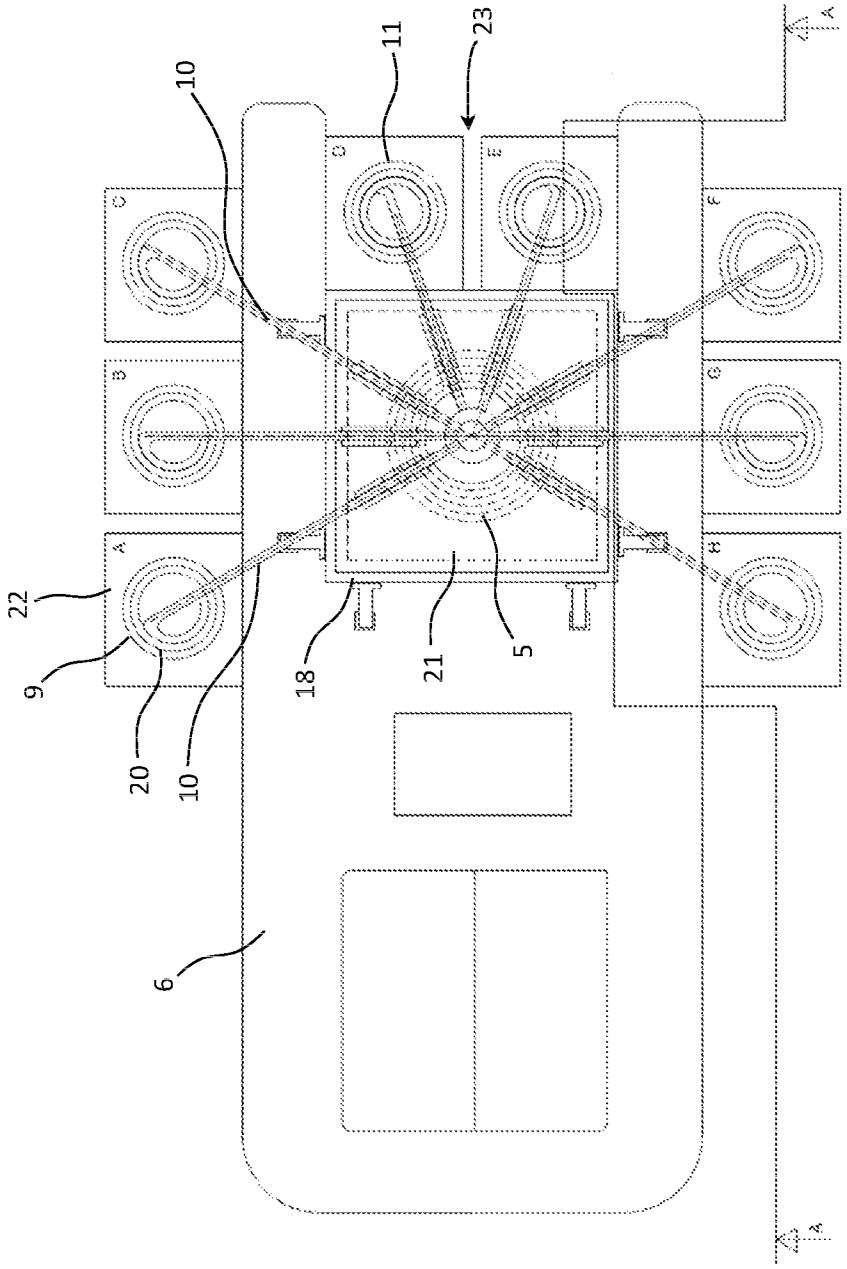


Fig. 2

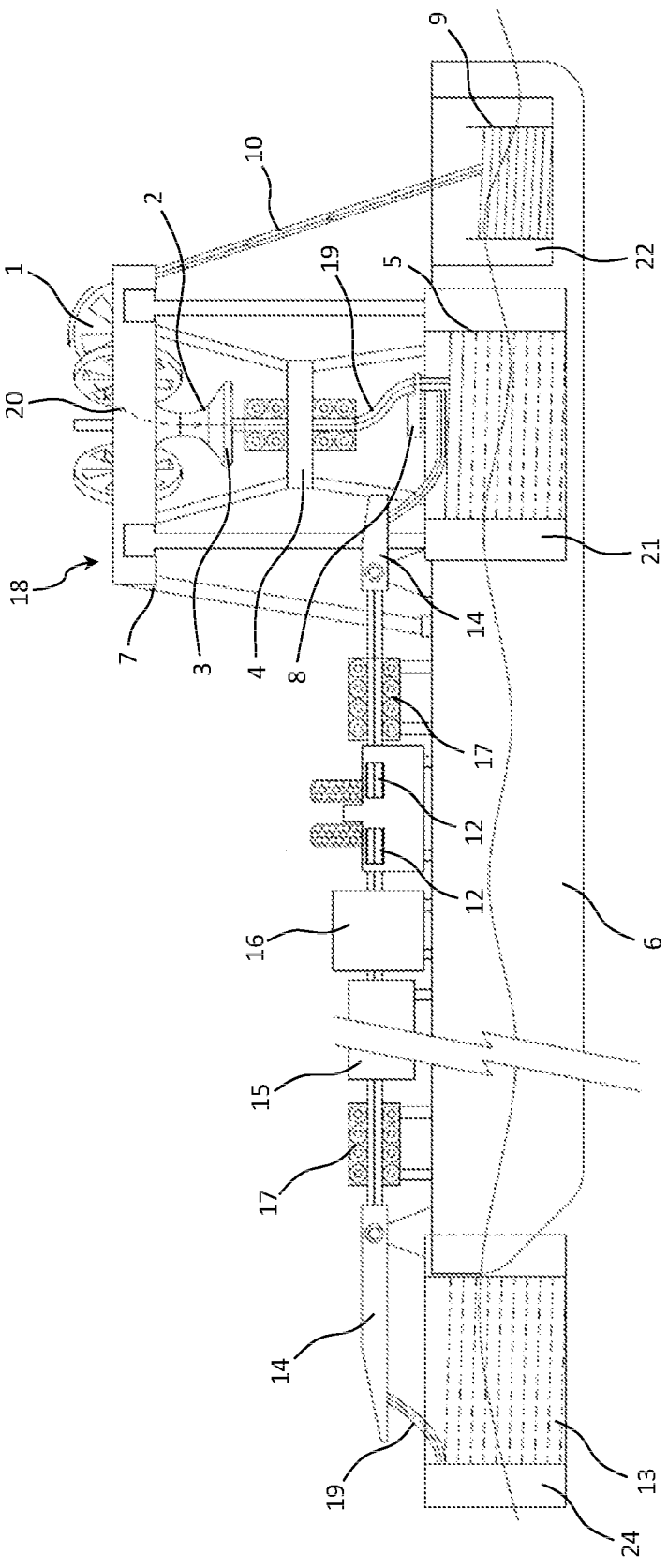


Fig. 3

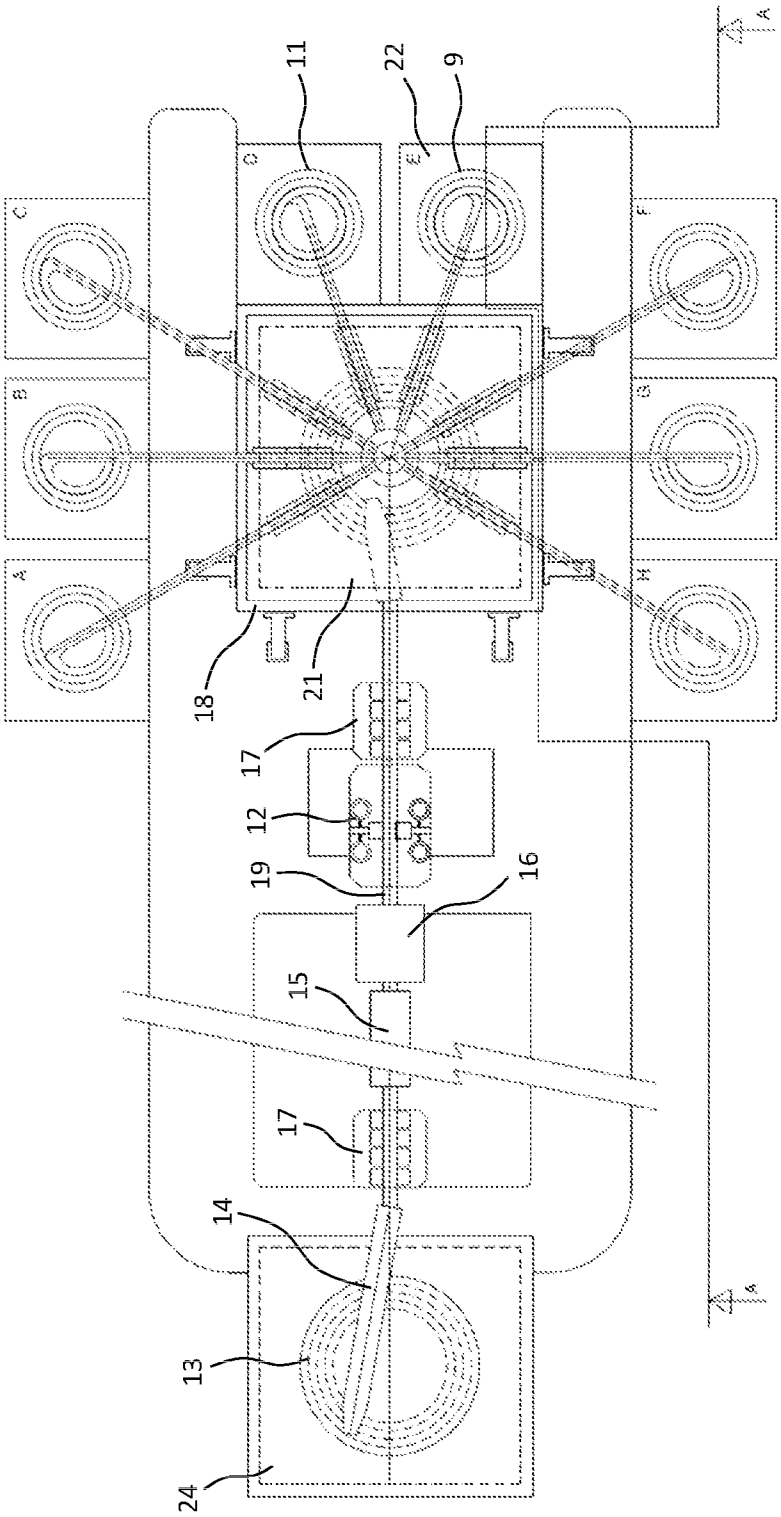


Fig. 4